180 Technology Parkway NW, Peachtree Corners, GA 30092
404-636-8400

DRAFT

TC/TG/MTG/TRG MINUTES COVER SHEET

(Minutes of all Meetings are to be distributed to all persons listed below within 60 days following the meeting.)

TC/TG/MTG/TRG No. TC 9.10 DATE February 11, 2025

TC/TG/MTG/TRG TITLE Laboratory Systems

DATE OF MEETING February 11, 2025 LOCATION Orlando, Florida

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
Robert Weidner	2022	Danny Sanchez	2023	Christine Reinders (CM)
Kelley Cramm	2022	John Varley	2020	Jason Atkisson (CM)
Rachel Romero	2022			Christine Benga (CM)
Ken Crooks	2020			Jerry Bogert (PCM)
Wei Sun	2021			Michael Carl (CM)
Chris Kirchner	2022			J Patrick Carpenter (CM)
Mark Malkin	2023			John Castelvecchi (CM)
Kurt Monteiro	2024			Roland Chameux (CM)
Anne Juran	2023			Victor Cincola (CM)
Jim Coogan	2023			Brad Cochran (CM)
Ryan Parker	2023			Jacob Edmonson (CM)
Justin Gardner	2024			Duncan Green (CM)
				Gregory Cross (CM)
				Keithammelman (CM)
				Paul Lemestre (CM)
				Pavel Likhonin (CM)
				William Lin (CM)
				John Macmurray (CM)
				Danny McGrail (CM)
				Victor Neuman (CM)

				Guy Perreault (CM)
				David Rausch (CM)
				Kurt Rindoks (CM)
				Ali Salim Shirazi (CM)
				Gordon Sharp (CM)
				Tom Smith (CM)
				Andrew Stout (CM)
				William Stump (CM)
				Mark VanderKooy (CM)
				Glenn Friedman (G)
				Mike McDermott (G)
				Raajesh Kumar (PCM)

DISTRIBUTION: ***All Members of TC/TG/MTG/TRG plus the following:***	
TAC Section Head: Joy Altweis	SH9@ashrae.net Where 9 is the section number
All Committee Liaisons As Shown On TC/TG/MTG/TRG Rosters (Research, Standards, ALI, etc.)	See ASHRAE email alias list for needed addresses.
Steve Hammerling, Assistant Manager of Research & Technical Services	AMORTS@ashrae.net

Note: These draft minutes have not been approved and not the official, approved record until approved by the TC.

CALL TO ORDER

Kelley Cramm called the meeting to order at 3:28 PM EDT

CODE OF ETHICS

In ASHRAE meetings, we will act with honesty, fairness, courtesy, competence, inclusiveness and respect for others, which exemplify our core values of excellence, commitment, integrity, collaboration, volunteerism and diversity, and shall avoid all real or perceived conflicts of interest. Our culture is one of inclusiveness, acknowledging the inherent value and dignity of each individual. We celebrate diverse and inclusive communities, understanding that doing so fuels better, more creative and more thoughtful ideas, solutions and strategies for the Society and the communities our Society serves. We respect and welcome all.

https://www.ashrae.org/about/governance/code-of-ethics

TITLE, PURPOSE, SCOPE for TC9.10

Kelley highlighted our Title, Purpose, and Scope: TC 9.10 is concerned with HVAC components for laboratory systems and their use therein. These components include but are not limited to air intakes, supply air conditioning systems, air distribution methods, laboratory fume hoods, biological safety cabinets, exhaust systems and exhaust discharge. The technical committee will address the unique

requirements of all types of laboratories. These laboratories include but are not limited to nuclear, pharmaceutical/medical, general chemistry, and teaching. Additional TC 9.10 concerns are; (1) the reduction of energy usage in laboratory systems, (2) the monitoring of government regulations affecting laboratory operation.

INTRODUCTIONS
The group did not do self-introductions in the interest of time.
Guy called roll call for voting members.

WEBSITE
Jim Coogan reported that the parts of the website is out of date. If subcommittee chairs will provide reports and/or content Jim will post it.

MEMBERSHIP
Guy reported 11 voting members are present. Quorum achieved. Quorum Took roll call for voting members. 11 of 15 voting members are present. Quorum achieved

MEETING MINUTES
Rachel R **moved** and Christine R seconded to approve the minutes from the last meeting as distributed. The minutes were **approved unanimously**.

SECTION HEAD REPORT
Joy indicated that we need to use the current activity form. Winter meeting is roster update time. Must have at least 6 voting members. Address PCM. Delete any members if the e-mails have bounced. ASHRAE has a new strategic plan on the website that goes into effect July 1, 2025. We have a new YEA mentor program, make YEA members aware of this new program. TAC is looking for feedback on the activity form. February 26th is the program deadline for Phoenix. Conference papers will remain, Technical papers may go away.

You can contact Joy Altweis at: SH9@ashrae.net
For general questions email: Asktac@ashrae.net

TOM SMITH'S CORNER
Tom Smith gave a presentation on how to specify the minimum flow for VAV fume hoods. See attached presentation.

GUIDELINE 36 UPDATE
Jim Coogan gave a presentation on the Status updates to Guideline 36. Guideline 36 specifies high performance SOO for HVAC. They are working to add a sequence for a lab room. Current lab room draft seems ready to go out for new public review. Now starting on lab exhaust SOO. Looks like this working group will continue. See attached presentation.

PROGRAM SUBCOMMITTEE REPORT
Rachel Romero provided a report. Met in early June. We had one co-sposnsored program in this conference. There is a Decarb in late October that may conflict with another relevant conference. Several other programs were not accepted at this conference. We may delay the guideline 36 program to Las Vegas. Join the next program subcommittee meeting before the Phoenix Meeting to discuss Las Vegas submissions.

See attached report for more information.

RESEARCH SUBCOMMITTEE REPORT
Greg Gross gave a report. Greg is the new research chair.

New section 9 RAC Liaison – Connor Murray, Roland is now RPS Chair.
There were no RTAR submissions across all TC's for this review session.
RP1835 – "Characterizing the performance of induced flow stacks". Greg reported they are still continuing to collect data
RTAR on 1780 Phase 2, Roland reported that there are volunteers ready to collaborate with TC 9.10
See attached report for details.

Motion to approve RTAR 1963 with editorial amendments and the addition of CFD "Methodology to measure in situ chemical emissions of labs equipment and processes" – moved by Kurt Montero seconded by Rachel Romero. Rachel volunteered to edit the RTAR to utilize more compelling language. **Approved 10-1-0.**

LAB CLASSIFICATION SUBCOMMITEE
This committee met. Danny Sanchez was not present.

STANDARDS SUBCOMMITTEE
Justin Garner was absent from the meeting. Christine led the meeting and sent notes. See attached report.

STANDARD 110
Kurt Rindoks gave a report. Working to cleanup and post for one public review. It is proposed to reinstate the 2016 standard to allow for time for revisions.

SPC 129 VENTILATION EFFECTIVENESS
Tom Smith gave a report. They have formed three working groups and hope to work on a new standard. They are scheduling a meeting for each working group.

STANDARD 241
Kishor gave a report regarding control of infectious aerosols. They voted to submit the draft to ANSI standard.

Z9.5
Jim Coogan gave a report. This standard will have a new number under ASTM.

NSF 49
Justin gave a report. Industry feedback 2B type cabinets needed dedicated exhaust systems should be revised as this is not currently standard. Thank you for everyone's input leading to yesterday's meeting. Committee understands more review of the language is needed.

STANDARD 100
Glenn gave a report regarding classifying types of labs energy efficiency.

NFPA 45
New version is out that includes ductless fume hoods.
The NFPA 45 committee will be assembling over the summer and fall to review the few submitted comments on the previously released 2024 edition. The committee will post response to those comments on Oct 28, 2025.Public comment period for the second draft of the next edition will open late this year and close on January 6, 2026.If all proceeds according to plan, the new 2027 edition will be released at the end of 2026, subject to change.If you are interested in more info, see NFPA web page: https://www.nfpa.org/codes-and-standards/nfpa-45-standard-development/45

DESIGN GUIDE

Ann Juran is the chair of this subcommittee. The committee met in January and reviewed the new table of contents. Volunteers are needed on HVAC system economics.

HANDBOOK SUBCOMMITTEE
Mark Malkin reported on chapter 17 for applications 2027. A few paragraphs are being edited. See attached report. Kishor and Jason volunteered to help with Z9.5 and CFD sections respectively.

ASHRAE JOURNAL
Roland Charneux reported that the January edition included an article written by Tom Smith discussing air change rate effectiveness.

BASECAMP CLEANUP
David reported on progress reorganizing. See attached report. Cleanup action will happen starting end of February until end of summer before Phoenix Meeting.

ALI COURSES
Laboratory Design Course – The Basics and Beyond – Danny McGrail – Had 29 attendees in the course. This is the second time teaching the course. Holding it online again in May and September.
Laboratory Exhaust Course – Safe and Energy Efficient Design – Brad gave a report from Honduras. Brad is working on updating the course for possibly summer or maybe fall.
Laboratory Controls Course – Jim reported that John developed a proposal, Christine will follow up with ASHRAE staff regarding what's next.

LIAISON REPORTS
TC 1.4 Control Theory and Application – Jim Coogan reported on updated Guideline 36 updates.

TC2.2 Plant and Animal Environment- Jim Coogan reported nothing to report.

TC 4.3 Ryan Parker nothing new to report

TC5.1 Fans – Mark reported that research project is extended through the end of this year.

TC5.3 Room Air Distribution–Kishor reported 5.3 discussed future research project

TC7.6 Building Energy Performance no report

TC7.9 Building Commissioning –Justin Garner no report

TC9.2 Industrial Air Conditioning and Ventilation. No report

TC9.6 Healthcare Facilities – nothing to report

TC9.7 Educational Facilities – Keith Hammelman nothing to report

TC9.11 Clean Spaces – Wei Sun reported that a new two volume version each 300 pages will be published.

MTG ACR –Jim Coogan reported that a program will be submitted on ACH in standards.

62.1 Ventilation for Acceptable IAQ – Seminar on new IAQ procedure presented in Indianapolis

90.1 – Need new Liaison – no report

SMACNA – No report

NFPA 45 – see above

NSF 49 – see above

ISPE – no report

AIHA Lab Health & Safety – Jim Coogan reported that California's new code need coordination on unoccupied ventilation rates. Can MOU assist? Tom Smith and Rachel Romero are presenting a professional development course for AIHA.

ASTM Z9.5 – see above

I2SL – Gordon reported on Labs2Zero updates. See attached slides.

Title 24 – California Energy Code – Glen reported there are new changes as Jim mentioned regarding night ventilation setback. See attached report.

NEW BUSINESS

Brad reported on guidance documents and whether they need to be archived or active control documents. This will be discussed at the next TC leadership meeting.

CLOSING THOUGHTS

Next Meeting – Phoenix – June. 24, 2025 3pm

ADJOURN It was moved and seconded to adjourn at 5:49 PM EDT

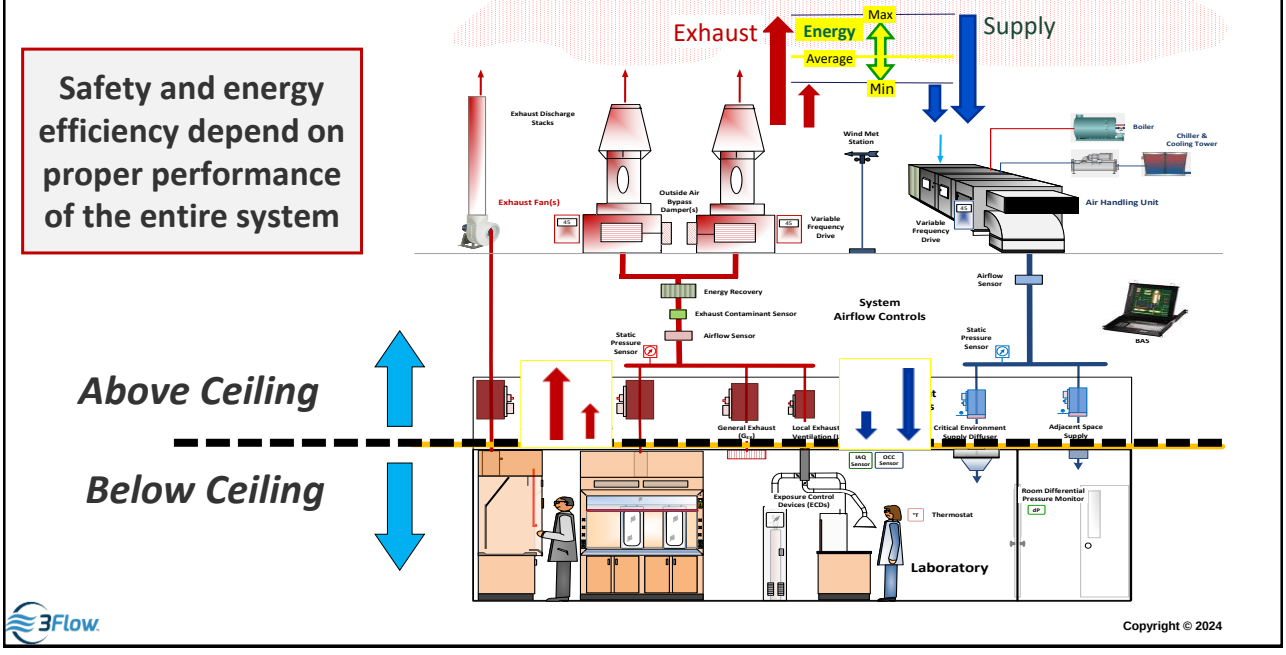
How to Specify Minimum Flow for VAV Fume Hoods

Thomas C. Smith
President/CEO
tcsmith@3flow.com
www.3flow.com

1

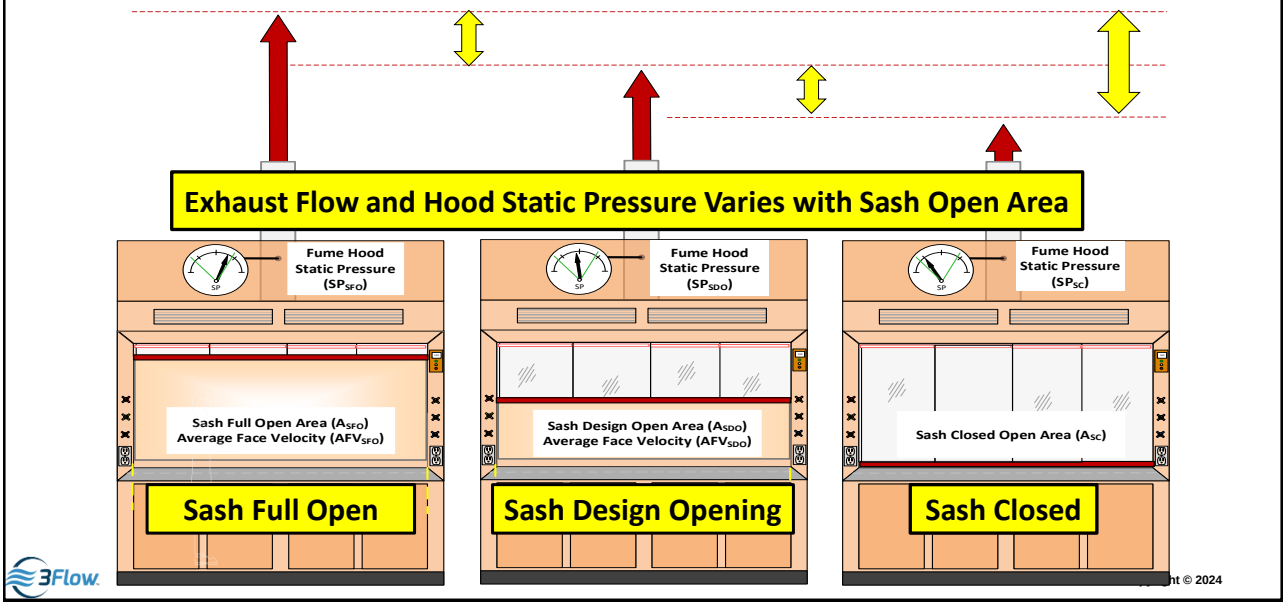
Proper performance requires a systems approach

Safety and energy efficiency depend on proper performance of the entire system



2

Shutting the Sash on Variable Air Volume (VAV) Fume Hoods Can Enhance Safety and Reduce Flow to Save Energy



4

Proper Response and Stability are Important

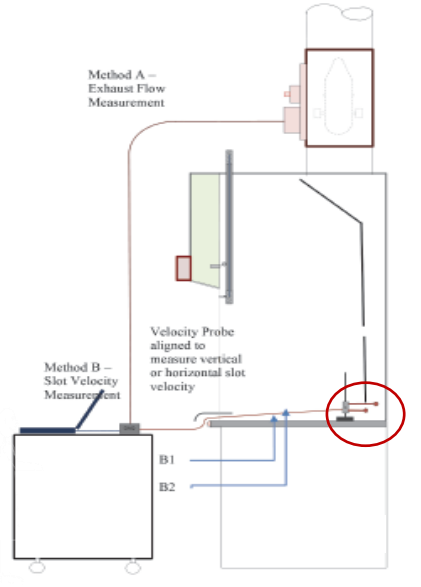
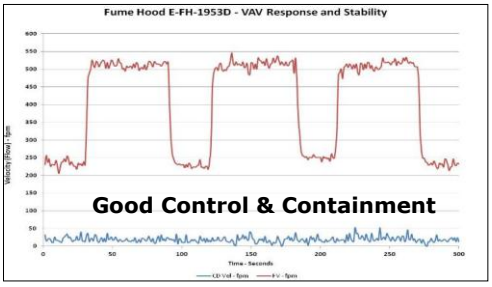
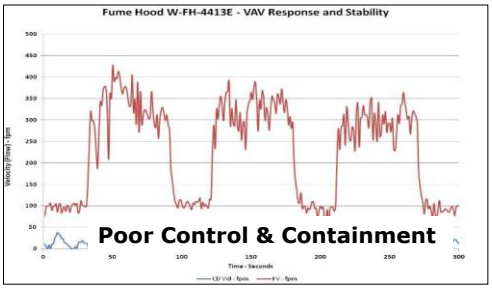


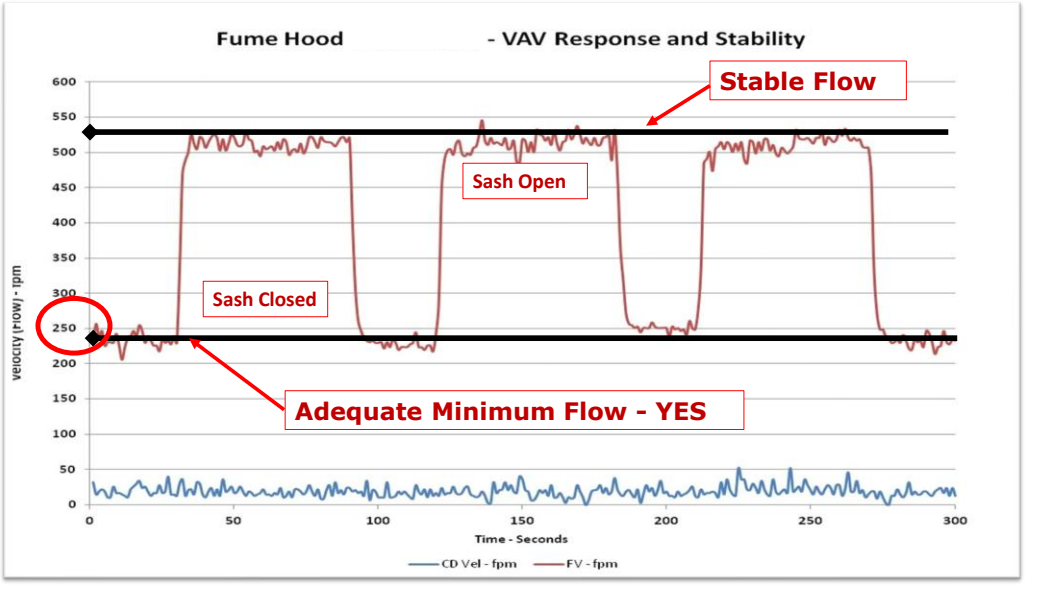
FIGURE 6.2 Sash movement effect flow test.





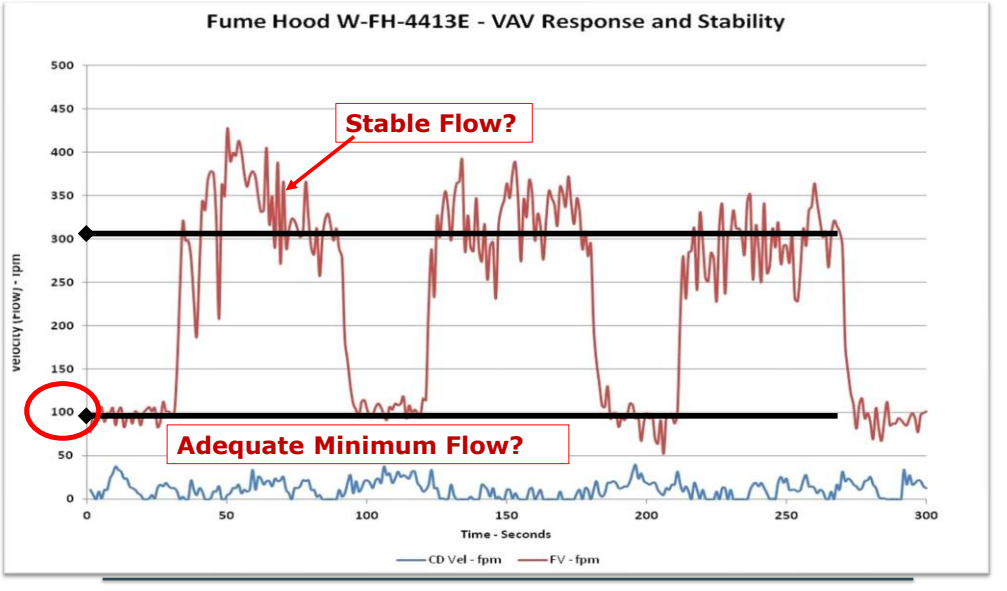
5

The airflow controls must be properly tuned



6

Inadequate flow and improper response can affect safety



7

Proper control of minimum flow is critical to safety and energy efficiency

- **Containment**
- **Dilution**
- **Removal**

1990s - EPA – 50 cfm / Ft, of hood width

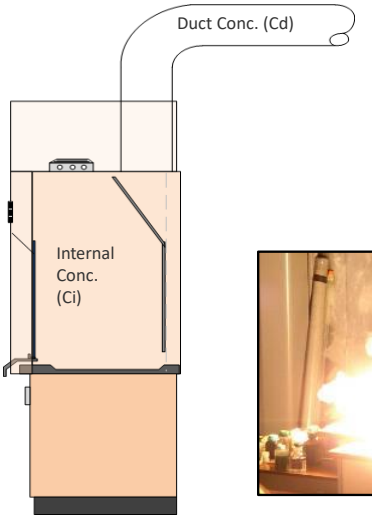
2004 - NFPA 45 – cfm / ft² Work Surface Area

- **25 cfm / sq. ft. ws**

2012 - ANSI Z9.5 (must be appropriate)

- **Internal Air Change Rate**
- **150 ACH ~ 10 cfm / sq. ft. ws** **Caution**
- **375 ACH ~ 25 cfm / sq. ft. ws**

Caution: Exhaust Flow depends on Hood Design, the System and the Application (i.e. Risk)

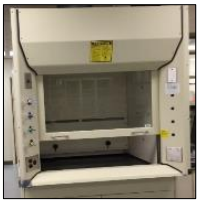


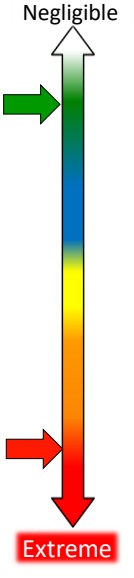
8

The LVRA evaluates the application to determine the level of risk

Risk factors are scored and rated to to determine the Risk Control Band (RCB)

Total Score	Control Band	Description
< 9	0	Negligible
10-23	1	Low
24-36	2	Moderate
37-69	3	High
70-92	4	Special Extreme





9

The LVRA assigns Risk based on Occupant Use and Application

Risk Control Band	Description	Fire Hazard Classification
0	Negligible	Class D
1	Low	Class C
2	Moderate	Class B
3	High	Class A
4	Special Extreme	Class A

Hazard Emission Scenario

- Type of Hazard
- Exposure Limit
- Quantity
- Potential Generation Rate
- Concentration Profile

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Fume Hood Specifications by Risk Control Band

Laboratory Fume Hood Specifications	Risk Control Band				
	0	1	2	3	4
Monitor	N/A	Yes	Yes	Yes	Yes
Fume Hood Face Velocity with Sash Open	N/A	60 fpm(1) 100 fpm (CA)	60 fpm(1) 100 fpm (CA)	80 fpm(1) 100 fpm (CA)	>80 fpm
Cross Draft Velocity	N/A	< 30 fpm	< 30 fpm	< 30 fpm	< 30 fpm
VAV Response Time and Stability	N/A	< 5 Secs < 20%	< 5 Secs < 20%	< 5 Secs < 20%	< 5 Secs < 20%
Minimum Fume Hood Flow (Effective ACH) With the Sash Closed	Turn off or Hibernate	> 150 ACH_{FH}	> 250 ACH_{FH}	> 375 ACH_{FH}	CAV
Internal Flammable Concentration	N/A	< 20% LEL	< 20% LEL	< 20% LEL	< 20% LEL
Fume Hood Duct Velocity	N/A	>300 fpm	>500 fpm	>1,000 fpm	>2,000 fpm
ASHRAE 110 Tracer Gas Control Level	N/A	4 lpm AU < 0.1 ppm	4 lpm AU < 0.1 ppm	6 lpm AU < 0.05 ppm	8 lpm AU < 0.01 ppm

1. California Law Requires 100-fpm average face velocity

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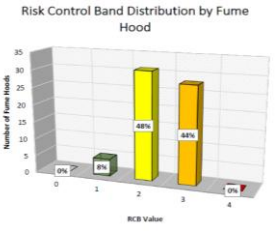
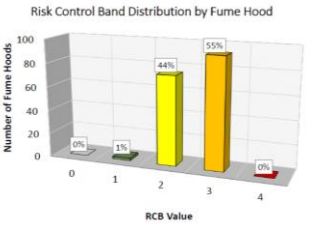
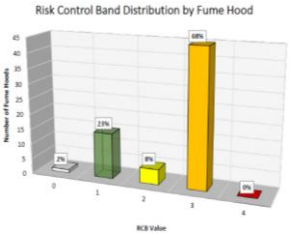
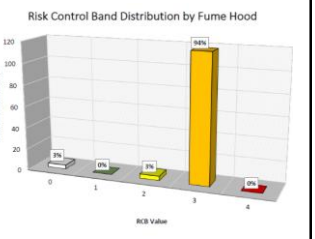
The range of RCBs for different buildings and fume hood systems demonstrate that prescriptive specifications are not appropriate

Fume Hood Use

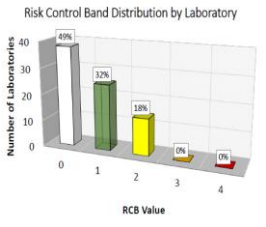




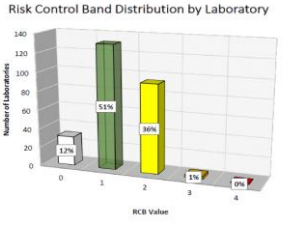




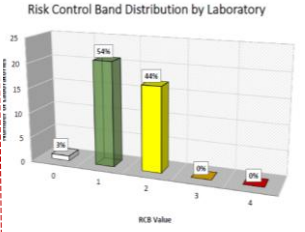
Lab Environment



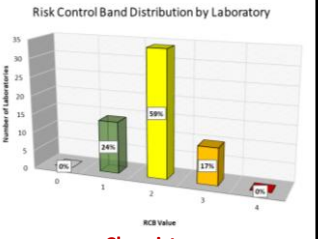
Physics/Engineering Lab



Biology - Natural Sciences



Bio-Chemistry



Chemistry

3Flow

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VAV Controls Modulate Flow from Low to High

6-ft. Bench-Top Vertical Sash Fume Hood

- Design Opening Width = 60 inches
- Design Opening Height = 18 inches
- Design Opening Area (Af) = 7.50 ft^2
- Internal Volume (Vi) = 40 ft^3 (60"W x 24"D x 48"H)
- Average Face Velocity Sash Open (AFV) = 100 fpm
- Min Flow at Sash Closed (Qex_{MIN}) ~ 375 ACH

VAV Range of Flow Modulation:

Design Opening – Exhaust Flow

Qex_{DOA} = AFV (100 fpm) * AF (7.50 ft^2)

Qex_{DOA} = 750 cfm

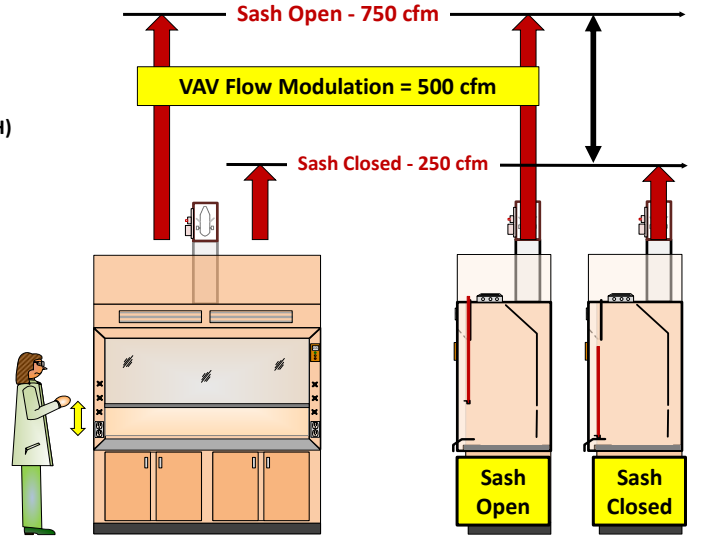
Sash Closed – Minimum Flow

Qex_{MIN} = (ACH x Vi)/ 60,

Qex_{MIN} = (375 x 40) / 60

Qex_{MIN} = 250 cfm

VAV Flow Modulation Range (Qex_R) = 500 cfm



3Flow

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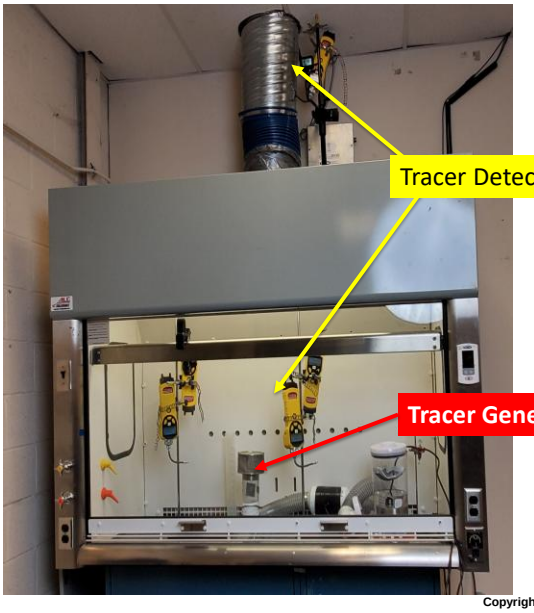
Minimum Flow can be determined using an Air Tracer Test

- Determine minimum safe exhaust flow for VAV Fume Hoods when the Sash is Closed
- Measure internal concentration profile
- Calculate Dilution Factor = Ratio between concentration inside the hood versus steady state duct concentration
- Dilution Factor greater than 1 indicate excess accumulation inside hood and potential to upgrade hood performance



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Fume Hood Minimum Flow Reduction Test

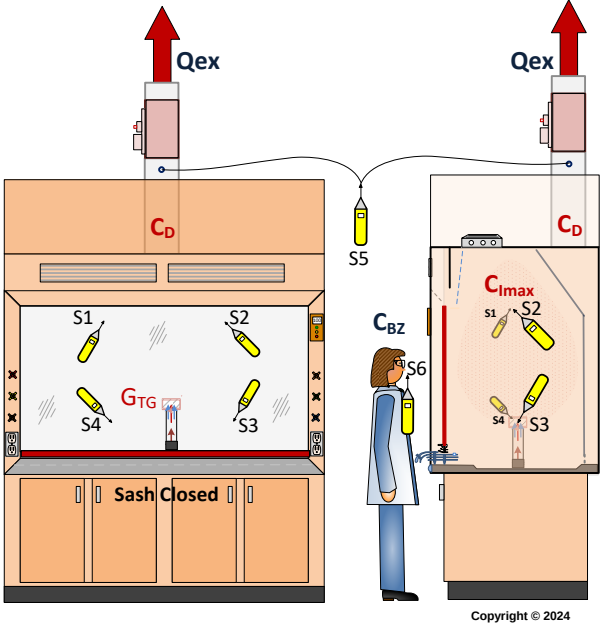
- Sash Closed – Minimum Flow (Qex)
- Tracer Generation (G)
- Concentration Samples (S)
  - Internal Concentrations (S1 – S4)
  - Duct Concentration (S5)
  - Breathing Zone Concentration (S6)

Dilution Factor (DF) = Max (S1, S2, S3, S4) / S5

Hood Protection Factor = Max (S1, S2, S3, S4) / S6

Minimum Exhaust Flow (Q'min) = G / C_{LEL}* 1E6

Final Minimum Qmin = Q'min * DF



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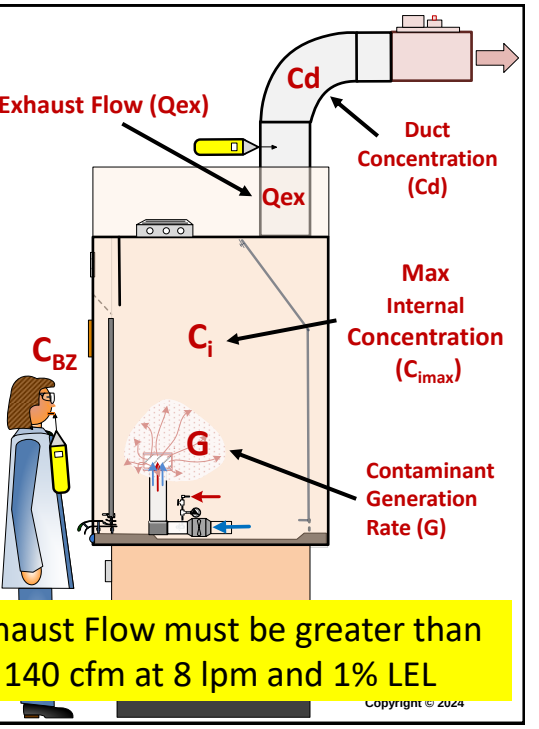
Safe Minimum Fume Hood Flow – How low can you go

- **Contaminant Generation Rate based on LVRA Rating:**
  - RCB-3: Generation Rate 4 – 8 lpm (0.14 - 0.28) and 1% LEL
- **Concentration of concern must be less than 20% of the LEL**
  - 1% LEL = 10,000 ppm, 20% of LEL = 2,000 ppm
  - Ci and Cd must be less than 2,000 ppm at the Generation Rate
- **The Theoretical Minimum Exhaust Flow (Qex_{min})**
  - Qex = (G / C) * 1E6
  - Qex = (0.28 cfm / 2000 ppm) * 1E6 ppm (at RCB-3 ~ 8 lpm)
  - **Qex ≥ 140 cfm**
- **Required Fume Hood Flow (Qex_F) = Qex_{min} x DF**
- **Hood Dilution Factor (DF) = Cimax / Cd**
  - **If DF = 2 then Qex_F = 2 x 140 cfm = 280 cfm**



Exhaust Flow must be greater than 140 cfm at 8 lpm and 1% LEL

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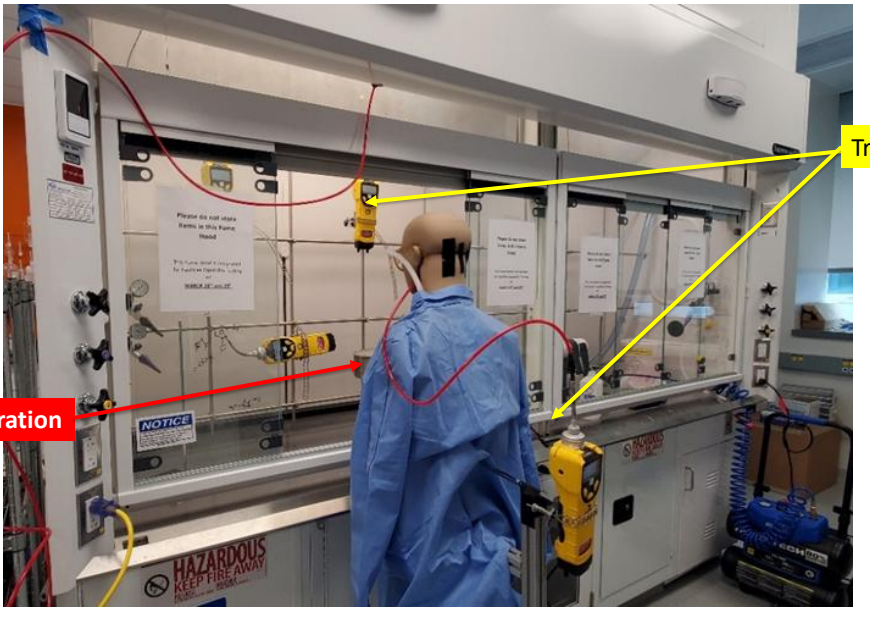
Configuration of Fume Hood Minimum Flow Test Equipment



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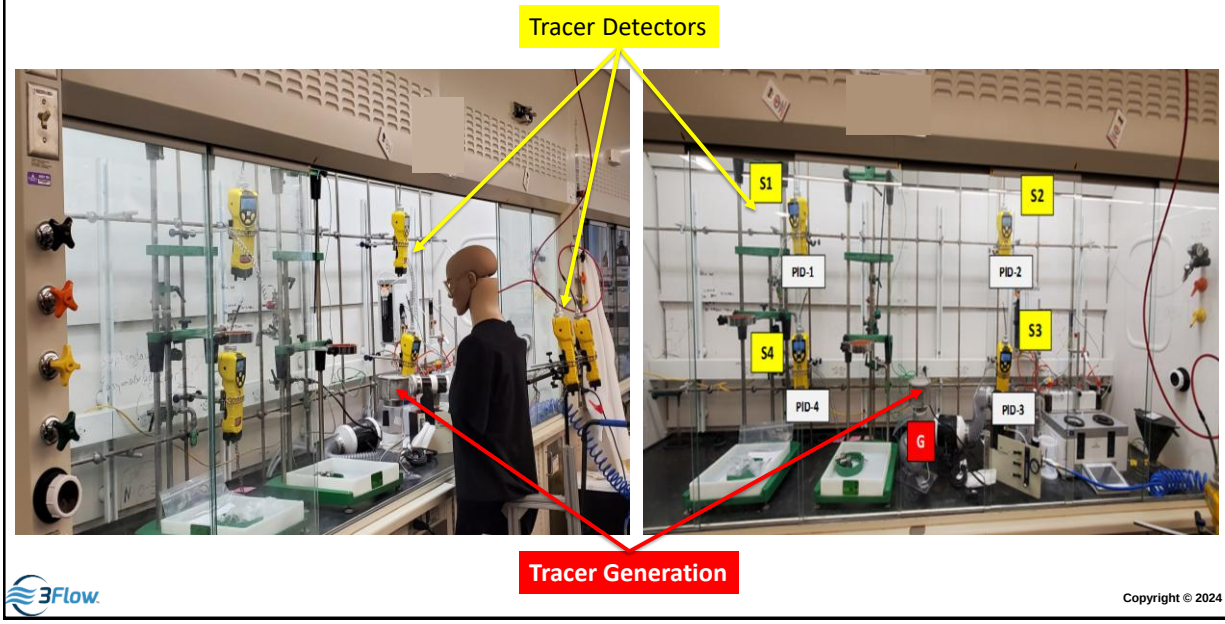
Configuration of Fume Hood Minimum Flow Test Equipment



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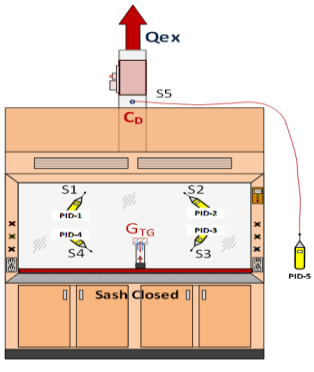
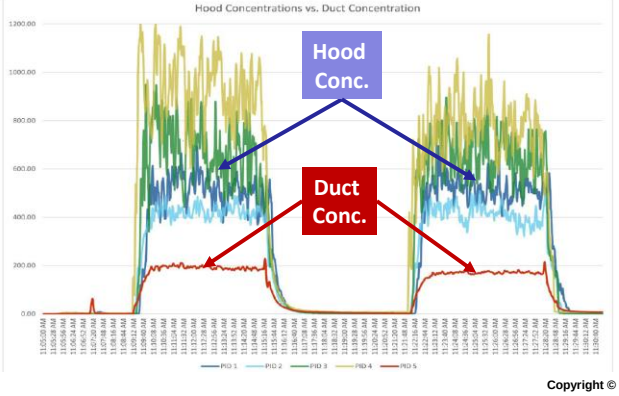
Fume Hood Minimum Flow Reduction Test Results – Sample 1



Test	Condition	Minimum Flow at Sash Closed (cfm)	Internal Air Change Rate (ACH)	Max. Dilution Factor
Test 1	As Found Minimum Flow Baffle Slot opened to 2.5"	270	368	5.1
Test 2	As Found Minimum Flow Baffle Slot opened to 4"	270	368	4.8
		Dilution Factor		**4.95**



- Fume Hood = RCB-3
- Theoretical Min. Flow (Qex_{min}) = 140 cfm
- Dilution Factor (DF) = 4.9
- Min. Flow (Qex_F) = Qex_{min} x DF
  - Qex_F = 4.9 x 140 cfm = 683 cfn

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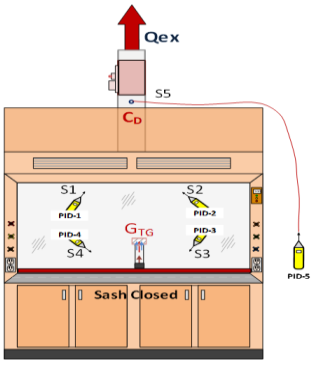
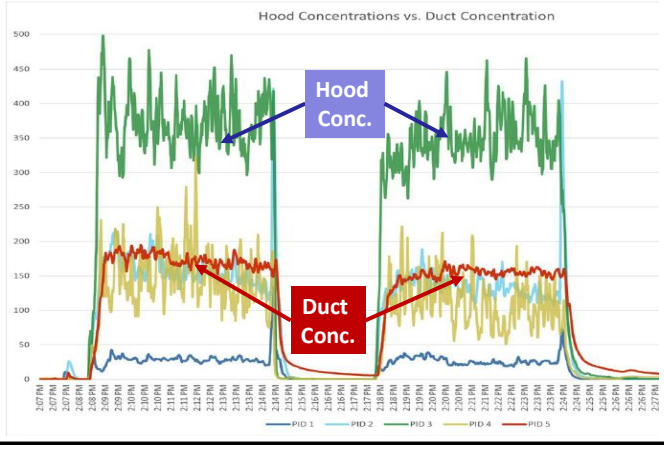
Fume Hood Minimum Flow Reduction Test Results – Sample 2



Test	Condition	Minimum Flow Sash Closed (cfm)	Calculated Internal Air Change Rate (ACH)	AVG. Dilution Factor	Max. Dilution Factor
Test 1	As Found	275	375	1.0	2.2
Test 2	Minor Adjustment of Probes	275	375	1.0	2.2
		Dilution Factor		**1.0**	**2.2**



- Fume Hood = RCB-3
- Theoretical Min. Flow (Qex_{min}) = 140 cfm
- Dilution Factor (DF) = 2.2
- Min. Flow (Qex_F) = Qex_{min} x DF
  - Qex_F = 2.2 x 140 cfm = 308 cfn

3Flow

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Minimum Flow Test Results for Upgraded Fume Hood

Traditional Fume Hood

High Performance Upgrade

3Flow

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Minimum Flow Test Results for Upgraded Fume Hood

Average Concentration Calculations				Duct	Top Left	Top Right	Bottom Right	Bottom Left			
Lab	Hood ID	Test No.	Hood Type	PID 5	PID 1	PID 2	PID 3	PID 4	P1 - P4 Avg	AVG Dilution Factor	Max Dilution Factor
309	No. 1	Test 1	High Performance Upgrade	152.2	258.6	80.9	97.9	213.2	162.6	1.1	1.7
		Test 2		116.0	199.7	115.5	84.6	124.2	131.0	1.1	1.7
309	No. 2	Test 1		175.1	57.0	331.7	237.6	74.6	175.2	1.0	1.9
		Test 2		154.0	105.7	224.1	174.2	64.4	142.1	0.9	1.5
311	No. 2	Test 1	Traditional Fume Hood	112	49	129	214	302	173	1.6	2.7
		Test 2		119	73	162	218	284	185	1.6	2.4
		Test 3		127	34	113	188	451	197	1.5	3.5
		Test 4		99	27	125	70	320	136	1.4	3.3

- **Traditional Fume Hood DF = 2.9**
- **Upgraded Fume Hood DF = 1.7**

Upgrade Reduced Fume Hood Flow by 40%

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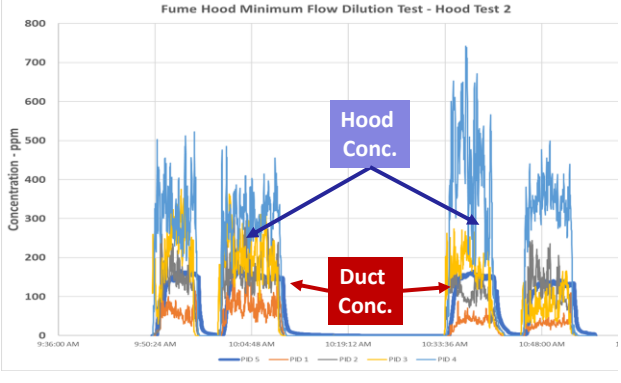
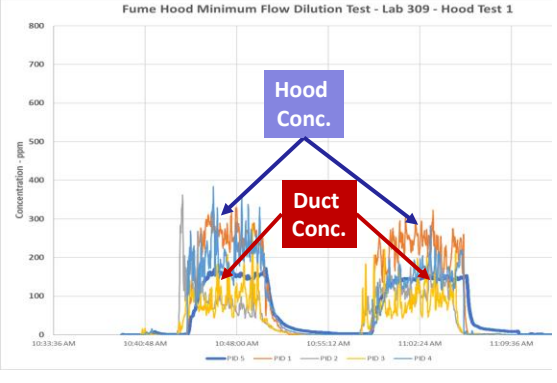
Minimum Flow Test Results for Upgraded Fume Hood





Traditional Fume Hood

- **DF = 2.9**
- **Minimum Safe Flow = 400 cfm**

High Performance Upgrade

- **DF = 1.7**
- **Minimum Safe Flow = 240 cfm**

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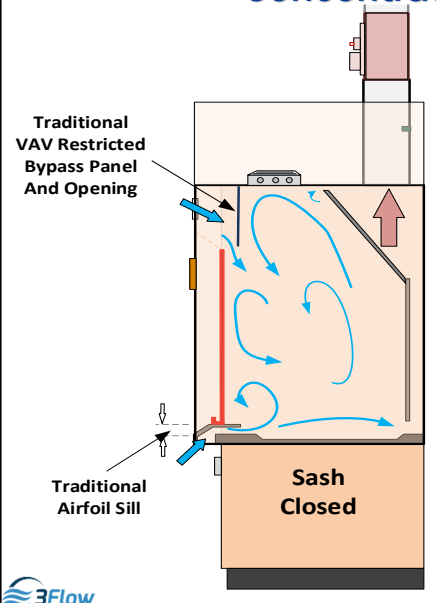
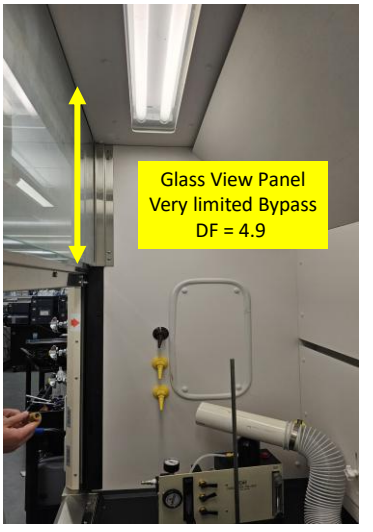
Traditional Restricted Bypass Panels Increase Internal Concentrations with Higher Dilution Factor





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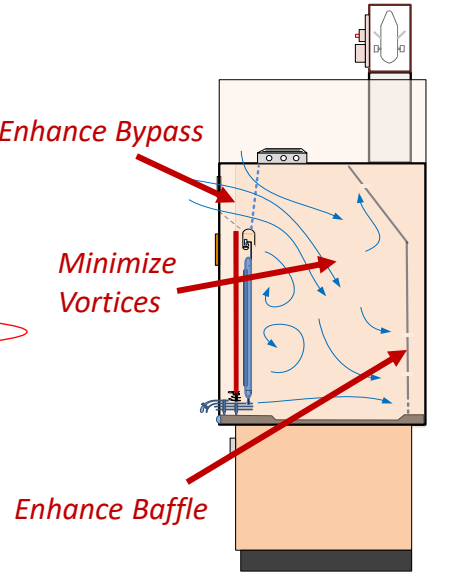
Optimize Internal Airflow Patterns to Improve Safety Performance

- Test and Determine Fume Hood Dilution Factor
- ~~Option 1 - Risk Reduce by reducing contaminant generation rate~~
  - Places restrictions on Hood Users
  - Restrict the types of materials used in the hood
  - Minimize generation rate of contaminants
  - Requires training personnel and management oversight
- ~~Option 2 - Increase fume hood exhaust flow and energy consumption~~
- Option 3 – Upgrade fume hood to improve Ventilation Effectiveness
  - Improve Safety Performance
  - Optimize Internal Airflow Patterns
  - Enhance bypass opening and baffle configuration
  - Reduce minimum flow and internal ACH
  - Minimize restrictions on hood users
  - Reduce Flow to maximize energy savings



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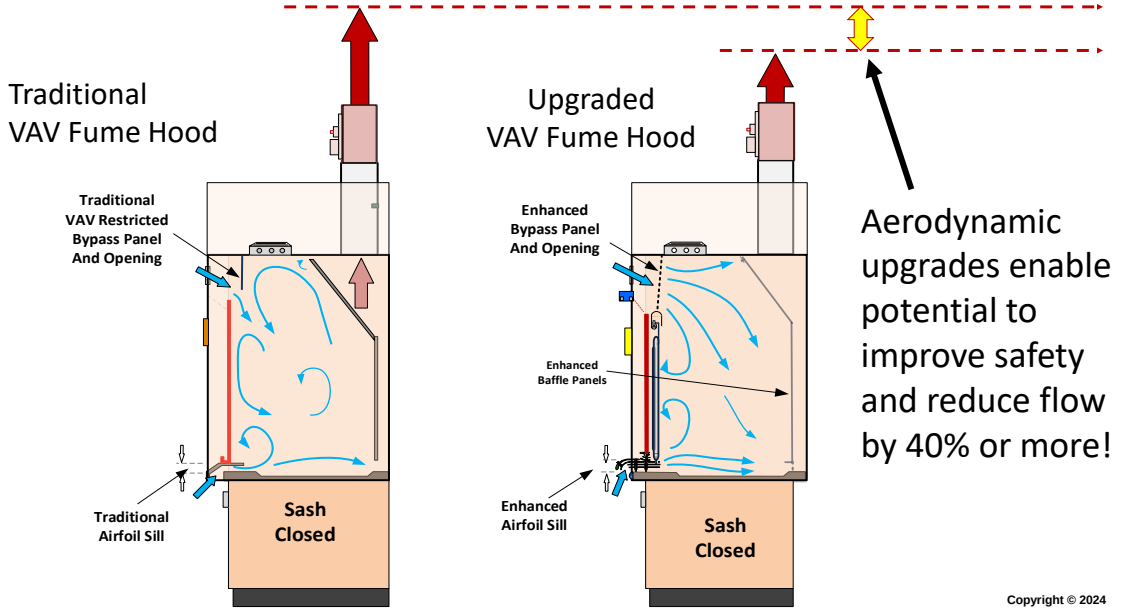
Fume Hood Upgrades improve safety while reducing energy use



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Thank You!

Questions

Thomas C. Smith
919-319-4290
tcsmith@3flow.com

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Analysis of IPA as an Alternative Air Tracer

- **Fume hoods are designed for generation of airborne hazards (acids, solvents, alcohols, etc.)**
- **IPA is a flammable liquid with a lower explosion limit in air of 2% or 20,000 ppm**

$C_{tg} = G_{tg} / Q_{air}$

G_{tg} = 1.7 lpm (0.06 cfm)
Q_{air} = 566 lpm (20 cfm)

C_{tg} = 3,003 ppm

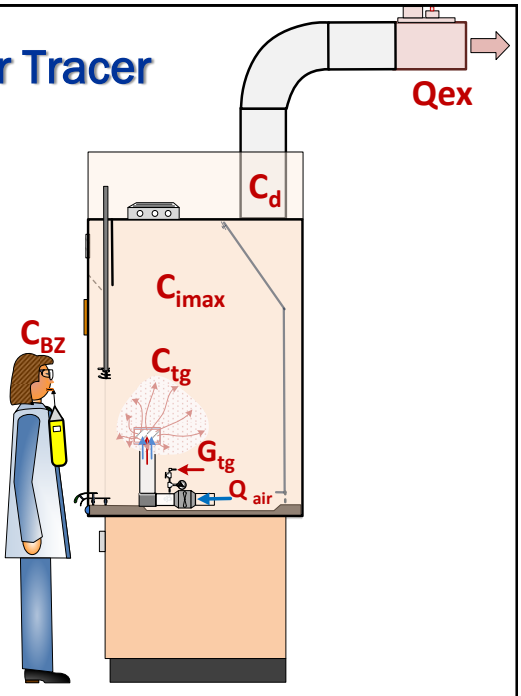
C_{tg} = 15% of LEL at outlet of diffuser

- **CAL-OSHA requires exhaust concentration in the duct to be less than 20% of LEL**

$C_{duct} = G_{tg} / Q_{ex}$

G_{tg} = 1.7 lpm (0.06 cfm)
Q_{ex} = 3540 lpm (125 cfm) at sash closed and minimum flow

C_{duct} = 480 ppm (2.4% of LEL) at minimum flow with the sash closed



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TC 9.10 Standards Orlando 2025:

Attendees; (10) Christine Reinders, Kelley Cramm, Jim Coogan, Robert Weidner, Jason Atkisson, Kurt Monteiro, Raaj Murugesan, Ken Crooks, Greg Gross, Chris Kirchner

ASHRAE 110 (Laboratory Fume Hoods Performance Testing) Tom Smith (absent)

- Targeted for publication in 2026
- Complete Draft posted for committee review

ASHRAE 129 (Measuring Air Change Effectiveness) Kishor Khankari / Tom Smith (absent)

- Committee's objective is to evaluate ventilation effectiveness
- MOT is currently for lab testing
- Modifying standard to add field testing with hybrid air tracer
- Formed four task groups – lab, CFD, field testing, metrics

ASHRAE 241 (Control of Infectious Aerosols) Tom Smith (absent)

- Update Field Testing and Appendix

Z9.5 (Laboratory Ventilation) Jim Coogan

- Will have a new number soon
- Revision task group will meet 1/16/2025
- Need to advance the content for failure scenarios
- Moving document into ASTM format
- All Z9's moved to ASTM

NSF 49 (Bio-Safety Cabinets) Justin Garner

- Working group evaluating language in the standard that mandates dedicated exhaust systems for 2B2 cabinets; committee recognizes the reality of current design applications and has asked for input from the lab controls marketplace
- Kelley spoke with Luke Savage about cabinet operation
- Exploring Valve shut off question and resolutions

ASHRAE Guideline 36 (Best in Class HVAC Control Sequences) Jim Coogan, Kelley Cramm, Ryan Soo, Jason Atkisson

- Traci Hanegan will reach out to TC 9.6 to discuss how these sequences affect healthcare applications
- Working Group has been formed, 9.10 members are on the working group. This group has been affective at advancing the guide.
- Priority on pressurization over other airflow functions.
- Heating/Cooling sequence issues resolved
- Still work to do on excessive pressurization

Standard 170 (Ventilation of Health Care Facilities) – Brendon Burley Or Traci Hanegan (both absent)

Standard 100 – Glenn Friedman

- To be added as pertinent to TC 9.10 (90.1 of existing buildings)
- Is there a way to classify labs to allow them to be included as an existing building types?

NFPA 45 – Ken Crooks

- 2024 edition is out with section on ductless fume hoods
- Healthcare labs added

Respectfully submitted by Christine Reinders, January 2025

ASHRAE TC 9.10 Research Subcommittee - 2025 Winter Meeting Minutes (1/17/25)

1. **Attendees**
    a. Kelley Cramm, Robert Weidner, Roland Charneux, Beth Mankameyer, Bill Stump, Chris Kirchner, Jason Atkisson, Jim Coogan, Ken Crooks, Mark Malkin, Ryan Parker, Brad Cochran, Greg Gross
2. **Introductions and News**
    a. New Research Chair – Greg Gross
    b. New Section 9 RAC Liaison - Conor Murray
    c. Roland Charneux is now RPS Chair, tasked with RTAR reviews
        i. Interesting note for 2025 Winter Conference, no RTAR submissions across all TCs…opportunity for research…funding is there!
    d. Bill Stump with DEDC, was heavily involved with TC 9.10 previously, now more focused on TC 7.9 but looking for opportunities to collaborate on research between groups.
        i. Introduction to Anne Juran regarding Design Guide commissioning section.
3. **Current Research Projects**
    a. 1835-RP (Characterizing the Performance of Entrained Flow Stacks)
        i. Latest update from 2024 Summer meeting indicated test site up and running, working through data collection challenges.
        ii. Meeting to discuss current progress scheduled for afternoon of 1/17/25.
            1. Update to be provided during the main TC 9.10 2025 Winter meeting.
        iii. Billing to date at approximately 2/3 of budgeted amount.

4. ***Research Projects in RTAR or Work Statement***
    a. RTAR 1963: "Develop a methodology to characterize and quantify emission rates from processes in labs."
        i. Following push back from RAC on the enormity of the project scope, title was updated and refocused on quantization of emission rates.
        ii. "Heavy re-write" needed…current progress?
            1. No new progress per Roland 1/16/25…help needed.
        iii. Method of test: Bottles, chemicals, equipment, specific processes.
            1. Box to contain chemicals to measurement
            2. Establishing airflow
            3. Risk assessment
        iv. AIHA may be interested in collaboration based on recent MOU
            1. Jim Coogan will take the lead on coordination between groups
    b. WS 1936 - Ventilation Effectiveness for Labs:
        i. WS 1936 complete and should go out to bid Spring 2025 as TRP-1936
        ii. Variety of Groups working on this - I2SL, ASHRAE MTG ACR, SP 129
        iii. Funded by Price, Phoenix

5. Research Topics Under Consideration (but no specific movement)

Topic	*Interest/Responsibility*	*Status/Action*
1780 Part 2 – Cross-contamination in Sensible Wheels	*Roland Charneux, Otto Van Geet, Bob Weidner*	• *RTAR to be developed…3/15/25 deadline* • *Bob will be primary author* • *Consideration for using higher velocities* • *Check with 1780 team for co-sponsorship* • *Forum proposed but not accepted for Orlando* • *Plan to Resubmit for Phoenix* • *Discussion of consideration of evaluation of purge section following the wheel, include in RTAR*
Demand Control Ventilation in Labs via Contaminant Monitoring	*Kishor, possible speakers…Gordon Sharp, Tom Smith*	• *Goal of reducing airflow rates in labs* • *What is it? How does it work?* • *Ready to present…just need to get a couple more speakers.*
Hourly Data on Lab Plug Loads for Design Guidance	*Rachel Romero*	• *Coordinate with I2SL Labs2Zero and Laboratory Benchmarking Tool* • *TC 9.6 is collecting data…possible to collaborate?* • *RP-1816…imaging equipment (MRI, etc.)* • *Equipment specific ranges for calculation guidance*
Using AI to Better Operate Buildings	*Jim Coogan*	• *Not currently much interest in moving forward, but keeping for consideration* • *Low Priority*
Duct Velocities for Lab Exhaust	*Tom Smith*	• *Transport velocities required for chemical removal, prevention of condensate* • *Concerned with heated acid vapors* • *Coordinate with 110 Committee for guidance* • *Low Priority*
Hazardous Emissions in Vivarium Exhaust	*Henry Hayes*	• *Concerned with nuisance odors, air changes, historic design practices, advancements in technology* • *Discussion with TC 2.2* • *Will reach out to Henry Hayes to determine if this is still a research interest and possible involvement* • *Low Priority*

6. **Review of Pertinent Ongoing Research Outside of TC 9.10**
    a. ASHRAE 110 Method of Fume Hood Performance
        i. Final draft currently in progress with committee vote today (1/17/25)
    b. ASHRAE 129 Estimation of Ventilation Effectiveness for Ventilated Indoor Spaces
        i. 4 subgroups currently working on:
            1. Original Research Method
            2. New Field Test Methods
                a. Intensive Investigation Method
                b. Simplified Commissioning Test
            3. CFD Method
            4. Metrics and Definitions
    c. ASTM WK882 78 Lab Vent (Previously ANSI/ASSP Z9.5 American National Standard for Lab Ventilation)
        i. Recently migrated standard from ASSP to ASTM
        ii. Jim Coogan leading effort and committee formation, first meeting was yesterday 1/16/15
        iii. Many parts of standard do match ASTM framework, rewriting will be needed per Jim and Brad to address these differences
            1. May evaluate keeping portions of Z9.5 that do not fit framework and add to laboratory handbook section or design guide
    d. 3D Printing Hazardous Issues (nano particles, chemicals, fumes, etc.)
        i. TC 9.7 discussing; Roland to follow up and also Jason Atkisson – Protocol for investigation for contaminant emission could be used for 3D. (Keith Hammelman was mentioned as potential lead) – Kelley interested; UL 2904 Test Method for assessing particle and VOC's from 3D printers
        ii. Need to review documentation and research to determine currently available guidance
        iii. Possible in-situ measurements and tie in with RTAR 1963 scope

7. **Open Floor for Research Topic Discussion**
    a. No additional items mentioned during Winter 2025 meeting

8. **Adjourn**

ASHRAE TC 9.10 Laboratory Systems
Program Sub Committee
Tuesday, January 14, 12:00 - 1:00 PM EST
Minutes

Program Sub Committee Meeting, Orlando Winter Meeting 2025

Attendees: Rachel Romero, Kelley Cramm, Jim Coogan, Bob Weidner, Beth Mankaymeyer, Christine Reinders, Jerry Bogert, Ken Crooks, Kishor Khankari, David Rausch, Raajesh Kumar Murugesan, Jason Atkinsson, Kurt Monteiro

In ASHRAE meetings, we will act with honesty, fairness, courtesy, competence, inclusiveness and respect for others, which exemplify our core values of excellence, commitment, integrity, collaboration, volunteerism and diversity, and shall avoid all real or perceived conflicts of interest. Our culture is one of inclusiveness, acknowledging the inherent value and dignity of each individual. We celebrate diverse and inclusive communities, understanding that doing so fuels better, more creative and more thoughtful ideas, solutions and strategies for the Society and the communities our Society serves. We respect and welcome all.

1. **Review of Roles:**

   Programs Chair:
   - Maintain a list of program ideas
   - Solicit program chairs and speakers
   - Solicit reviewers for Conference Papers
   - Assist in submitting programs online
     - Go to Track Chair or ASHRAE staff for assistance
   - Serve as the liaison between your TC and CEC
   - Not responsible for presenting <u>all</u> of your TC's programs
   - Notify chairs of areas of potential conflict times for TC 9.10:
     - TC 9.10 meetings on Tuesday from 2-6 pm
     - SGPC Guideline 36- Monday 8 am -12 pm (avoid if possible)
     - Other?

   Session Chair:
   - Develop a detailed **program abstract** and identify speakers (contact Track Chair with questions)
   - Upload the required information on the session and speakers to the Conference website
   - Preview speaker presentations to check that they meet the ASHRAE Conference Presentation Policy (found at https://www.ashrae.org/file%20library/conferences/speaker%20resources/)
   - Make sure speaker presentations are uploaded prior to the Conference
   - Coordinate presentations to minimize overlap and make sure the timing is correct
   - Introduce and monitor session at the Conference
   - Assist authors in identifying learning objectives & completing Q&A

2. **Sponsored Program in Orlando:**
   Seminar 49: Diluting the Dangers Within: Applying and Validating Demand Control Ventilation
   Wednesday, February 12
   8:00 AM – 9:30 AM EST
   Location: Hilton Orlando, LL, Orange B
   Chair: Ryan Soo; Presenters: Tyler Kee, Kishor Khankari, Tom Smith

3. **Future ASHRAE Conferences**
   June 21-25, 2025 – Phoenix, AZ- https://www.ashrae.org/conferences/2025-annual-conference-phoenix
   Jan. 31-Feb. 4, 2026 – Las Vegas, NV
   June 27-July 1, 2026 – Austin, TX

   Speaker Resources
   https://www.ashrae.org/conferences/speaker-resources
   https://www.ashrae.org//File%20Library/Conferences/Speaker%20Resources/SpeakersManual_0718.pdf

   a. **Phoenix Annual 2025 Conference Deadlines**

      - **Wednesday, February 26, 2025** | Debate, Panel, Seminar, Forum, Workshop, and Debate Proposals Due
      - Friday, April 11, 2025 | Debate, Panel, Seminar, Forum, Workshop Scheduling Notifications

   b. **Phoenix Annual 2025 Tracks:** https://www.ashrae.org/conferences/2025-annual-conference-phoenix/2025-annual-conference-technical-program

      1. Fundamentals and Applications
      2. HVAC&R Systems and Equipment
      3. Research Summit
      4. Workforce Development
      5. Industrial Ventilation, Refrigeration, Air Conditioning, and Energy Utilization
      6. Heat Pump, Refrigerants, and Decarbonization
      7. Onsite Energy Storage

   c. **Suggested formats:**
      - **Seminar:** feature presentations on subjects of current interest
      - **Panel Discussion**: can feature a broad range of subjects and explore different perspectives on industry related topics. This session format includes a panel of 3-4 speakers each addressing a facet of the session topic, followed by an interactive discussion lead by the session chair.
      - **Debates:** highlight hot-button issues commonly faced by our membership. Industry experts, either on teams or as individuals, argue opposing sides of an issue, concluding with position summaries and audience feedback.
      - **Forums**: The sessions are "off-the-record" discussed held to promote a free exchange of ideas. Reporting of forums in limited to allow individuals to speak confidentially without concern of criticism. There are no papers attached to forum
      - W**orkshop**: enable technical committees and other ASHRAE committees to provide a series of short presentations on a topic requiring specific expertise. These short presentations are provided with an increased emphasis on audience participation and training in a specific set of skills (60 or 90 minutes)

4. **Proposed Programs for Phoenix:**
    - RESUBMIT for PHX: Forum: Is it Risky to use Total Energy Wheels heat recovery devices?
        - **Chair: Roland Charneux-** AI to Bob to send email to confirm resubmission
        - Note: resubmission- and note that there is a research project about this.
    - RESUBMIT for PHX: Seminar: Laboratory Plug Loads: What's Real and What's Not?
        - **Chair: Rachel Romero**
        - Project is in Phoenix
        - Track: 1. Fundamentals and Applications
        - Note that we didn't get into Orlando
    - PHX: Total flow through the building- System operating mode test- turn down air flow rates fan flow doesn't go down
        - Panel Discussion - Presenters: Tom Smith
        - Track: Fundamentals and Applications
        - Special requests: re-submission from Jim Coogan
        - Jason Atkisson interested
        - Beth Mankameyer
        - Include facility operator? To talk about controls
        - **Chair: Christine Reinders**
        - Alternative: move to TC committee meeting if rejected.
    - PHX: Guideline 36 in Labs-
        - **Chair: David Rausch**

Las Vegas 2026:

- On hold for PHX: Lab case studies to decarb
    - Jason Atkisson (USGS)?? Or Jessica Mangler
    - Can we do location specific?
    - GSA/FDA- Smith Group- Rachel is POC here
    - Track: Pathways to Building Decarbonization
    - Wade Conlan- Case studies
    - Chris Kirchner- refrigerant switch out at pharma sites?
    - **Chair: Kelley Cramm**
- On Hold for PHX: : General air cleaning seminar
    - 145 came out of this
    - How this may relate to labs?
    - Bob to work with 185.5 (testing protocols) to get speakers together

    - **Chair: Bob**
- LV conference: Keith Hammelman- Education committee- 3-D printing exhaust?- could be case study as part of a different grouping – Makerspace- Kelly Cramm-
    - Elizabeth C at Cornell?
    - UL2904 standard
    - Chair: Christine Reinders
- Decarb or LV conference: Electrification- All Electric Labs
    - Chris Kirchner- might have a project?
    - Kurt Monteiro- NHP vivarium project
    - EMAPS at NREL
    - Chair: Rachel Romero
- LV conference: Standard 100 Energy Efficiency and emissions efficiency for existing buildings- lab specific tables- Glenn Friedman
    - Forum- How to categorize lab? Can we define this enough to start research on this.
    - Could work with Healthcare TC, manufacturing, data centers 9.9

Unassigned:

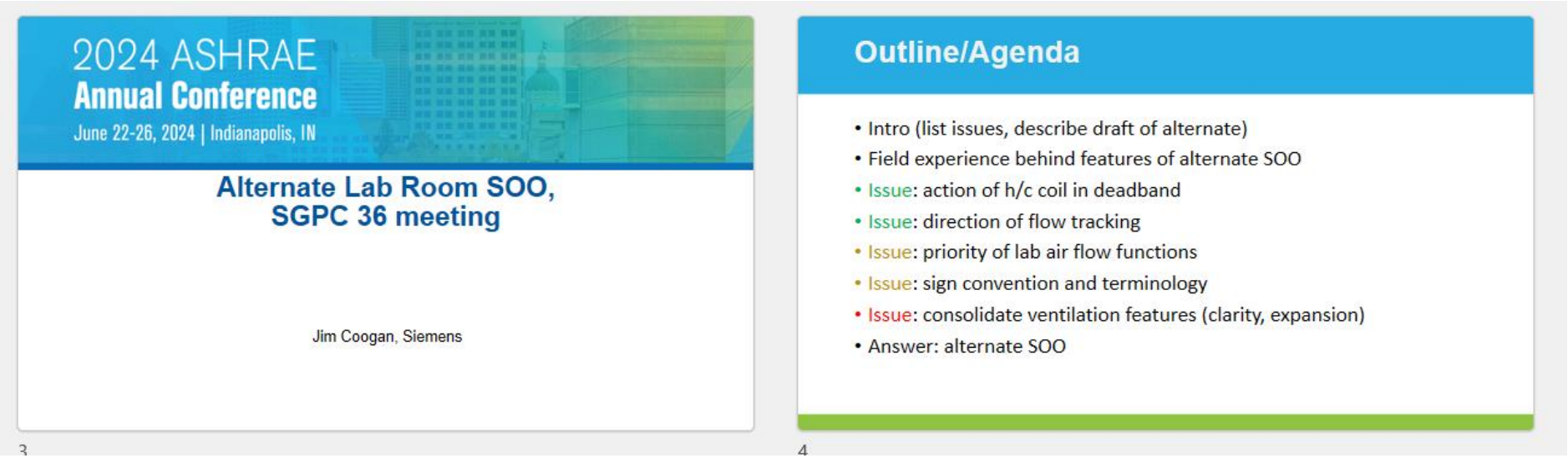
- Control tuning and lab performance- Ryan Soo
    - Tom Smith? Ryan?
- Energy modeling of labs?
    - ORNL?
- Commissioning in labs with TC 7.9- Justin Gardener
- Characterize Savings of controls (Phoenix)
    - PG&E through Tom Smith
    - Correlation between flow and energy to $
    - Add to program above?

5. **Potential Chairs in the future:**
    - Jake Edmondson
    - Raajesh

Status of Lab SOO development, February 2025

- G36 specifies ‘High Performance SOO for HVAC’
- Working to add sequence for a lab room
  - Ran 1 public review, then formed a working group with TC 9.10
  - Group met several times since summer 2024 conference
  - Handled several important issues
- Current lab room draft seems ready new public review
- Now starting on lab exhaust SOO
- Looks like working group will continue

Status of Issues Raised in Indy



- The most important problems are fixed
- Other aspects still might be improved
- Still want people to evaluate organization and clarity

Next Project: Lab Exhaust Fan Sequence

- First draft on lab sequences is now available in the SGPC
- Monday, SGPC talked about extending the mission of working group to develop this document too
- SGPC 36 views this collaboration as a big success

Thank you, everybody!

New Lab Requirements in Title 24-2025 (and a refresher on some existing ones)

January 2025

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International Institute for Sustainable Laboratories

Agenda

- New Lab Requirements for 2025
  - L Occupancy
  - Modified VAV / Unoccupied Ventilation Setback
  - Exhaust Air Heat Recovery
  - Reheat Limits (4-Pipe VAV)
  - Modified Exhaust Fan Power Consumption
- Some Existing Requirements
  - Available Transfer Air vs 100% OA
  - Fume Hood Automatic Sash Closure

L Occupancy

L (laboratory) occupancy group no longer exempt from Title 24

- In addition to B (business), E (educational) and H (hazardous) already covered

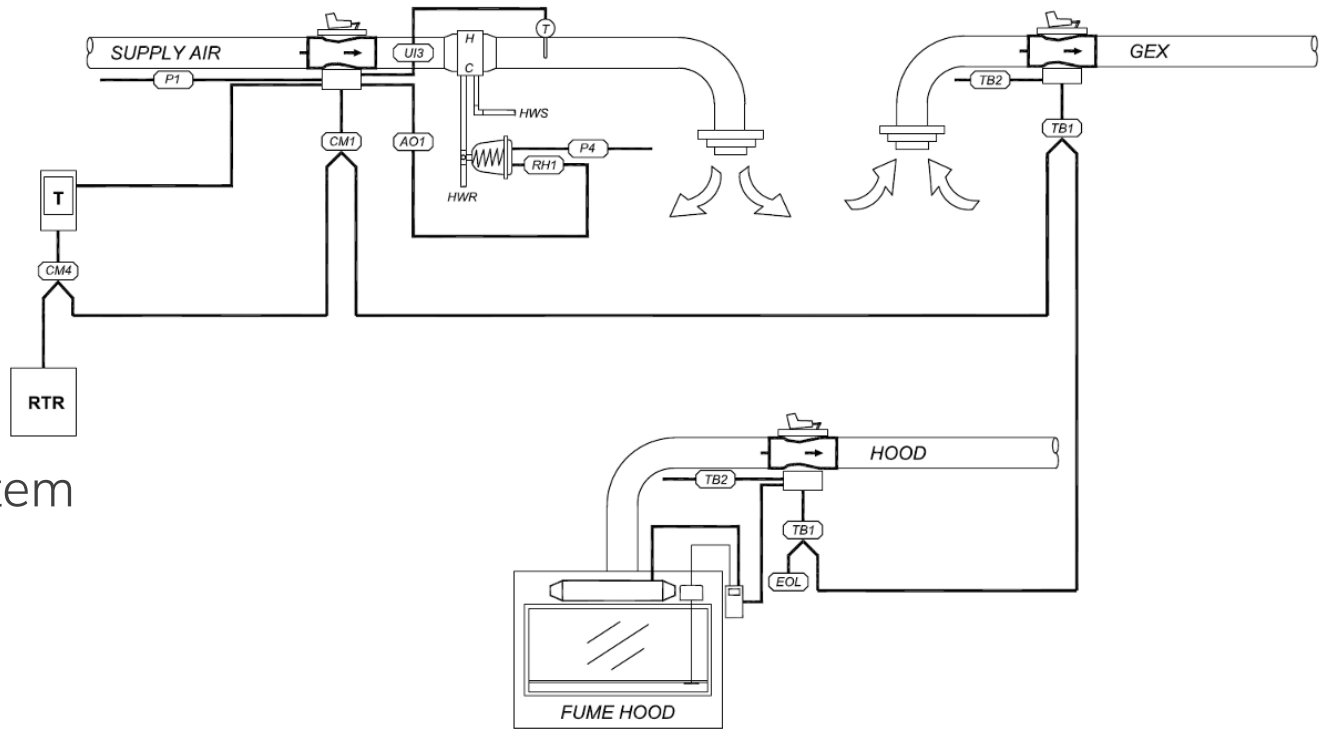
Modified VAV / Unoccupied Ventilation Setback

2022

- VAV supply/exhaust required for all labs designed for 10 ACH or less
- Exceptions
  - where constant volume is required by EH&S
  - New zones on existing constant volume system

2025

- VAV required for all labs. Supply/exhaust shall not exceed:
  1. Heating/cooling demand
  2. Fume hood demand
  3. EH&S required airflow
  4. Airflow for pressurization
  5. Ventilation based on occupancy sensors:
     - ≤ 1 cfm/ft2 occupied (~6 ACH)
     - ≤ 0.67 cfm/ft2 unoccupied (~4 ACH)
- Exceptions
  - New zones on existing constant volume system



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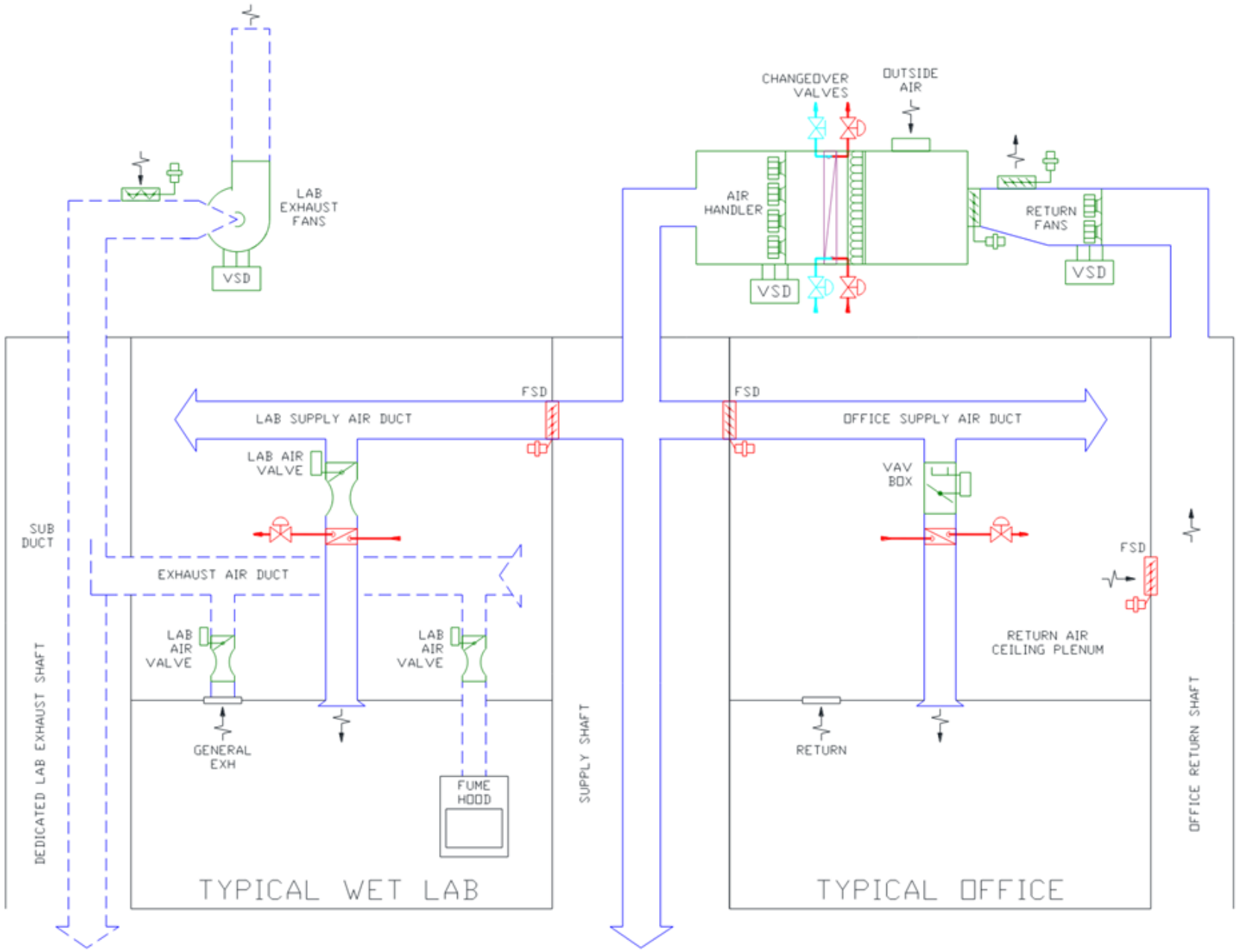
Exhaust Air Heat Recovery

- Non-Compliant



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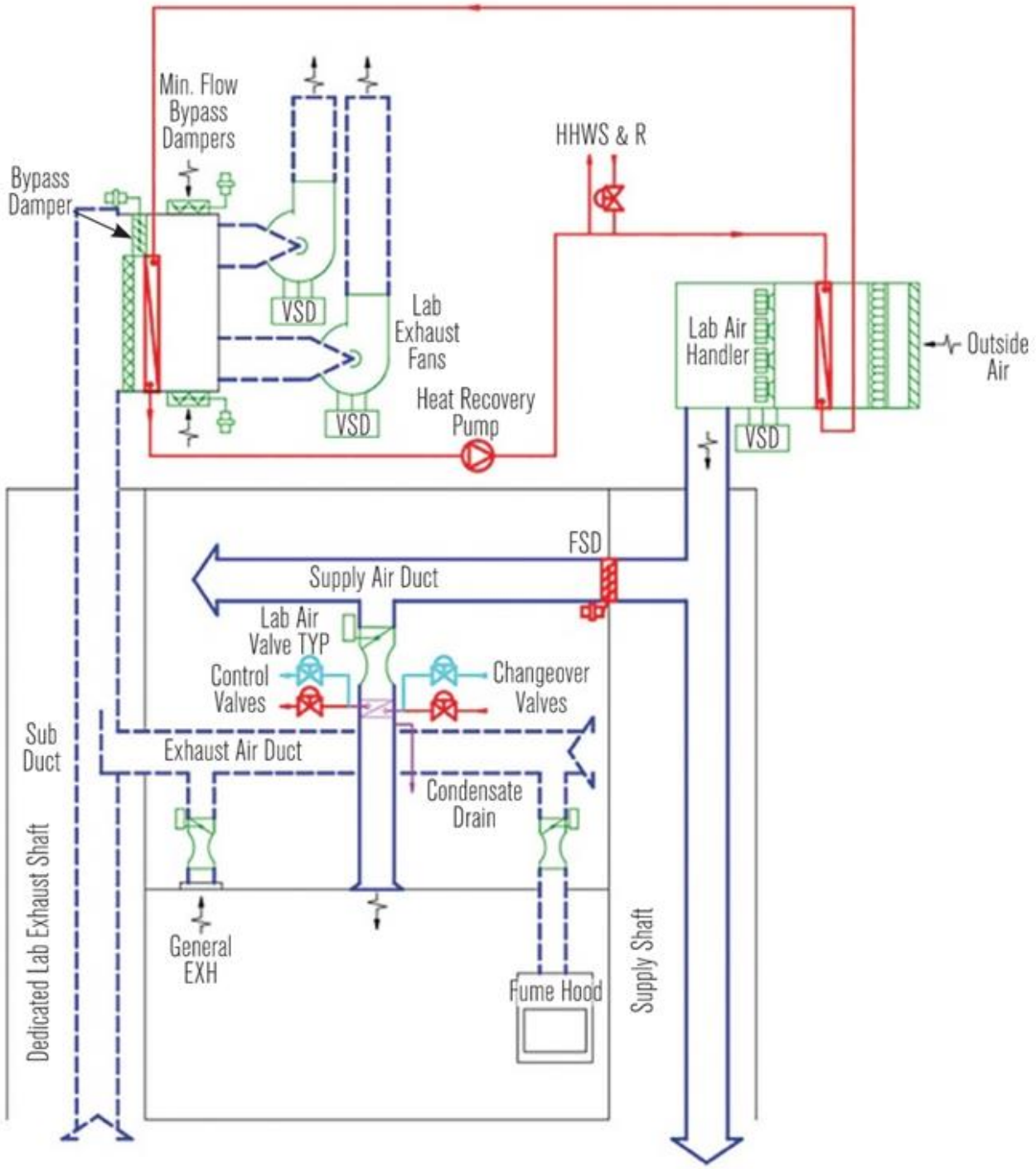
Exhaust Air Heat Recovery

- Compliant



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Exhaust Air Heat Recovery

Buildings > 10,000 CFM of laboratory exhaust

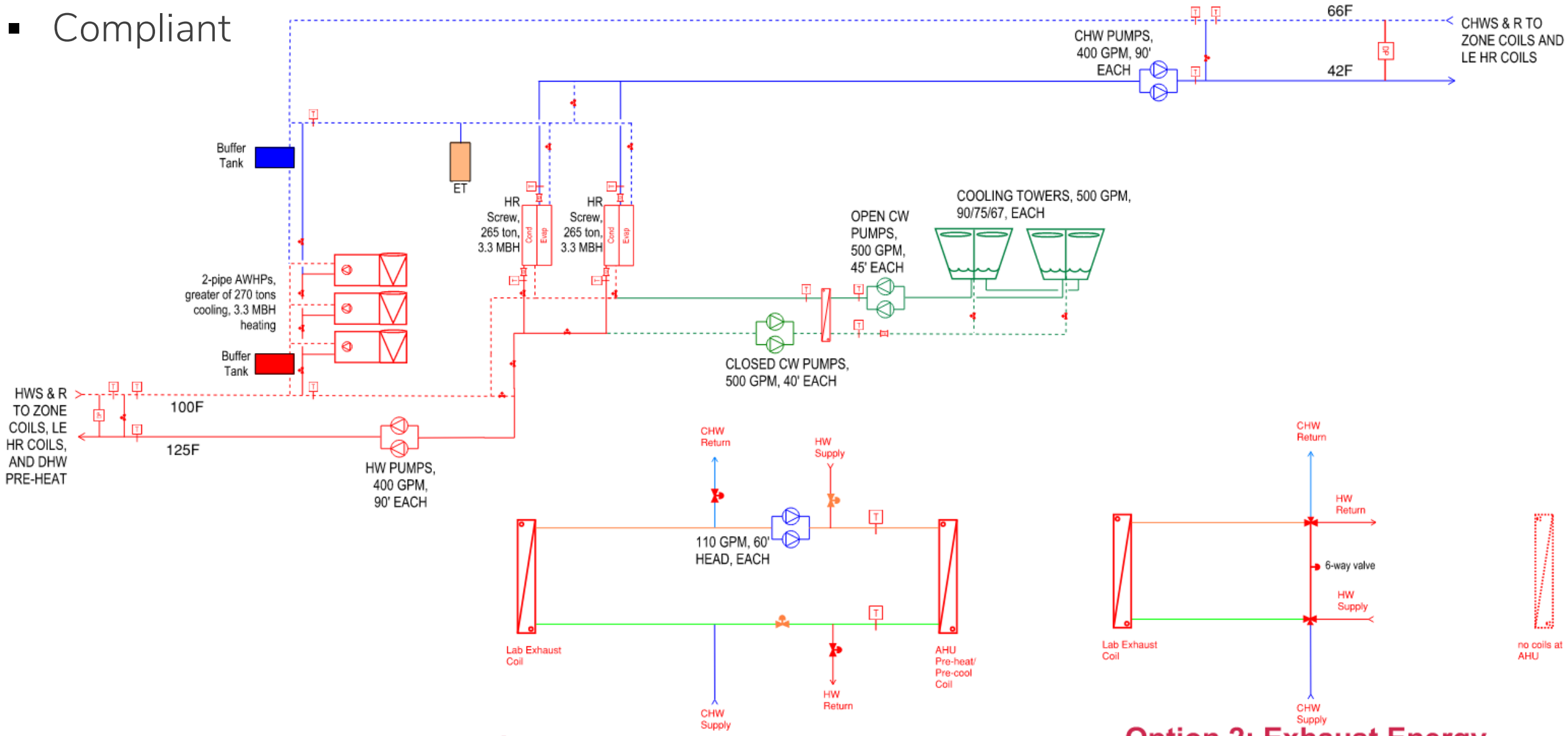
1. Sensible energy recovery ratio > 45% heating and > 25% cooling
2. Heat is recovered from at least 75% of all lab exhaust air
3. Includes a run-around coil pump or other means to disable heat recovery
4. Includes a bypass damper or other means so that the exhaust air pressure drop through the heat exchanger ≤ 0.4” when heat recovery is disabled

Exceptions

1. Additions/alterations to existing systems that do not include exhaust air heat recovery
2. Buildings where the total laboratory exhaust rate exceeds 20 cfm/ft2 of roof area
3. Buildings in Zones 6 (Long Beach) or 7 (San Diego) and where gas heating is allowed
4. Buildings with an exhaust air heat recovery system and heat recovery chillers designed to provide at least 40% of the peak heating load from exhaust heat recovery
5. Exhaust systems requiring wash down systems such as perchloric acid fume hoods

Exhaust Air Heat Recovery

- Compliant

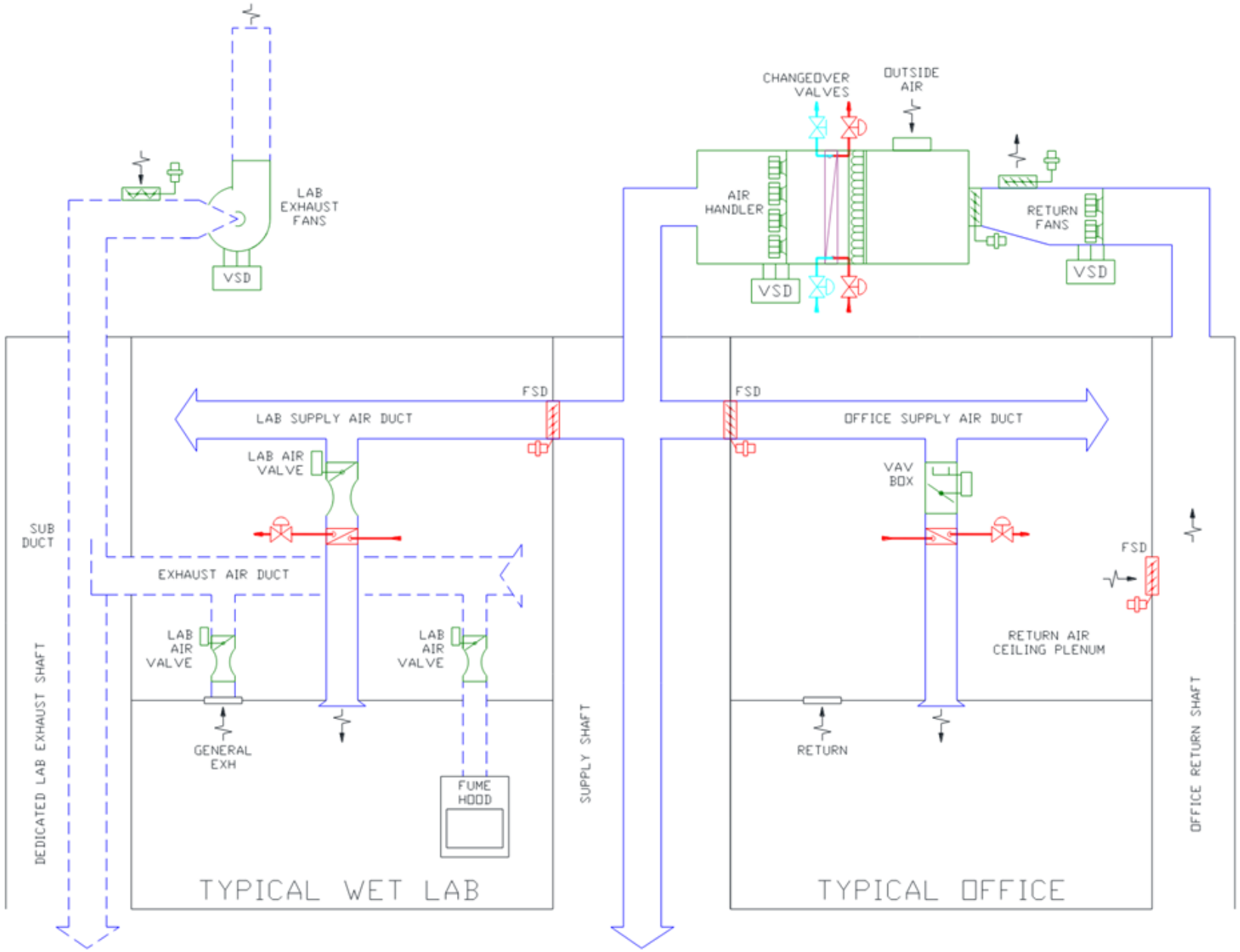


Option 1: Exhaust Energy Recovery to Chiller and AHU

Option 2: Exhaust Energy Recovery just to Chiller

Reheat Limits (4-Pipe VAV)

- Non-Compliant



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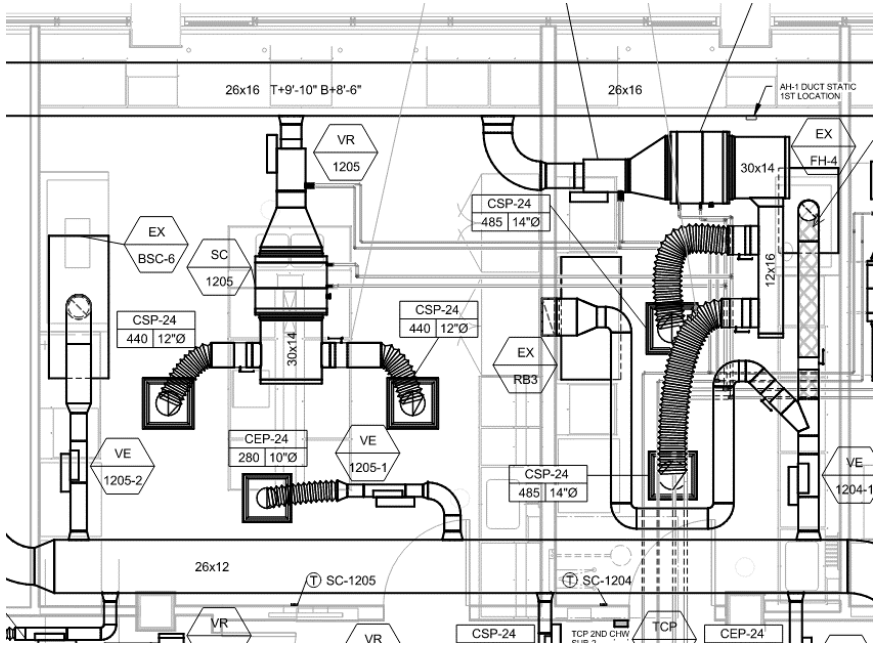
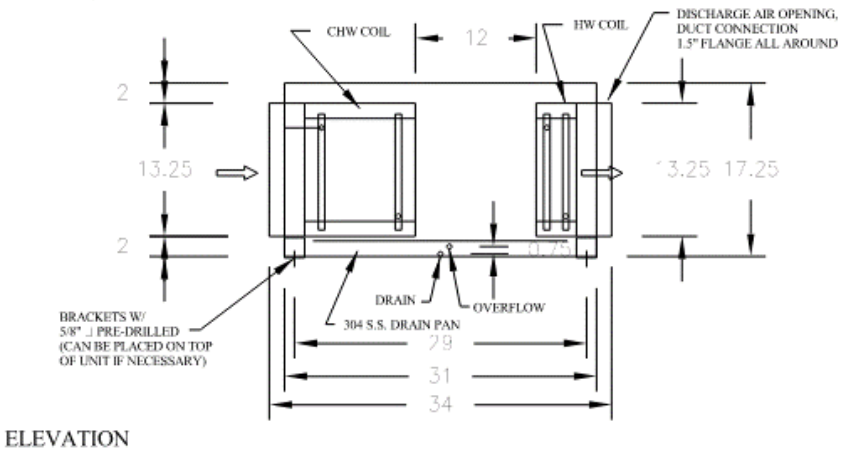
Reheat Limits (4-Pipe VAV)

- Compliant





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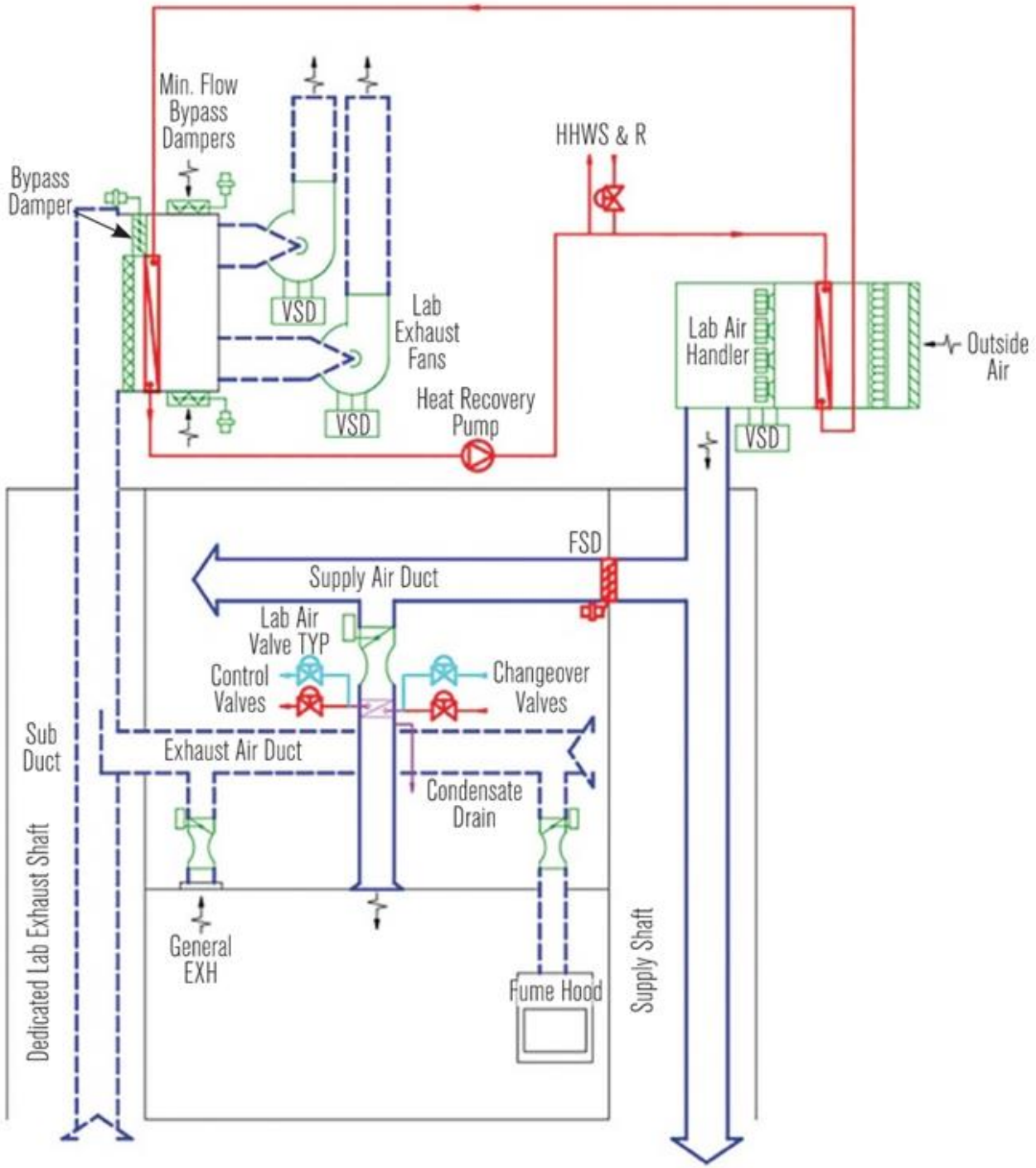
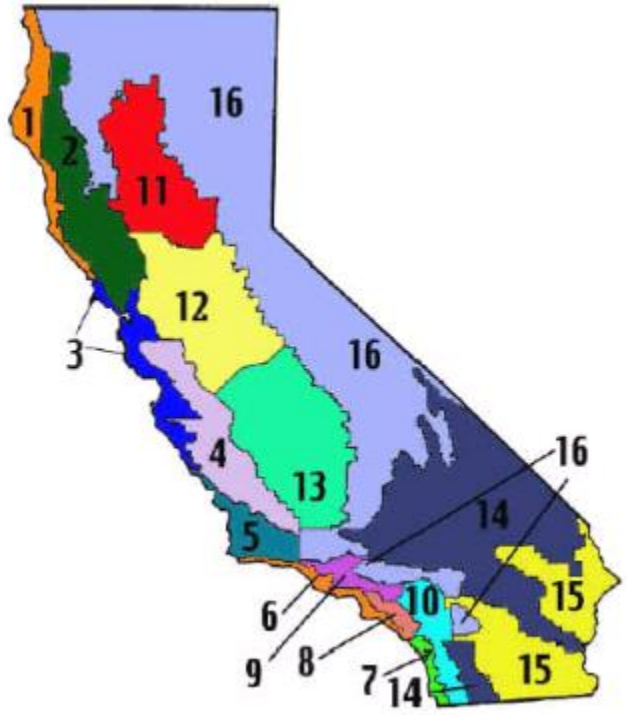
5 CHW / HW COIL - 2500 CFM
3/4" = 1'-0"



Reheat Limits (4-Pipe VAV)

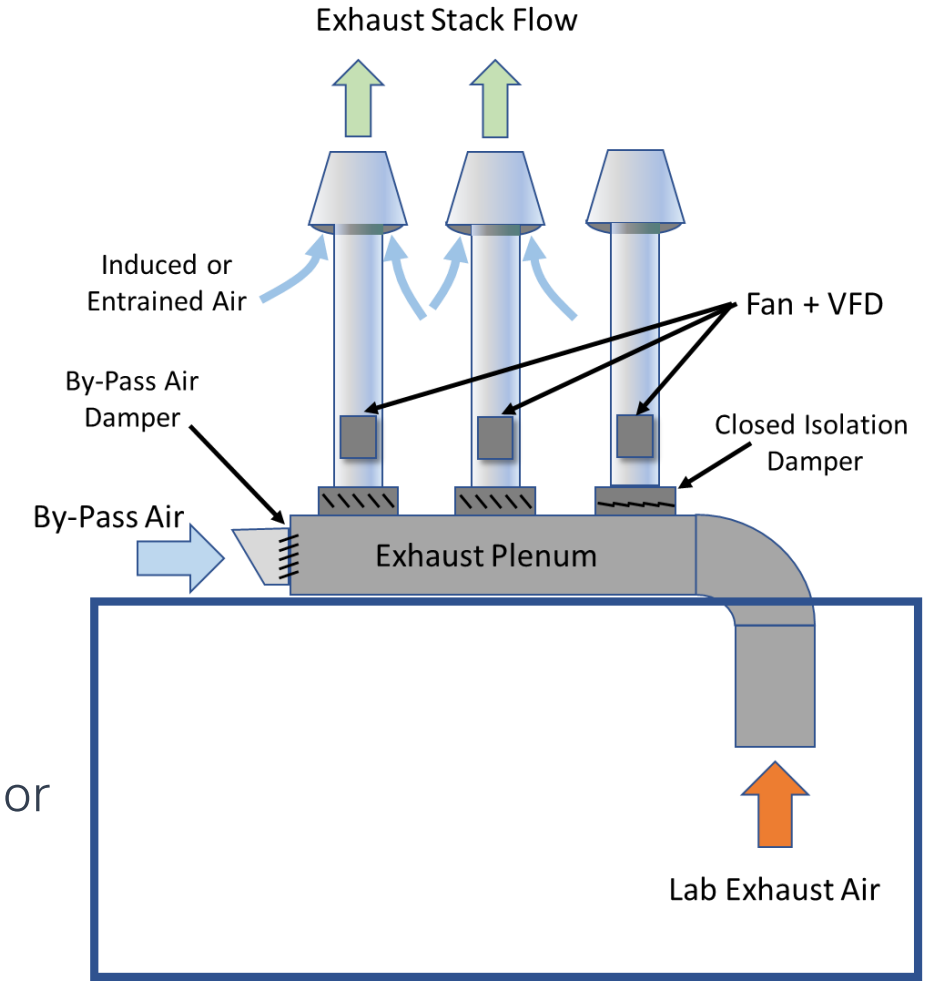
- Buildings > 20,000 cfm of laboratory exhaust
- MZ AHUs shall not cool SAT < 74F or heat SAT > 50F
- Each zone shall include heating and cooling capacity, such as 4-pipe VAV, VRF, chilled beams, or 4 pipe fan coils.
- Exceptions:
  - Additions/alterations to existing systems without zone heating and cooling capacity
  - Climate Zones 7 (San Diego) or 15 (Salton Sea)
  - Vivaria or BSL3
  - Systems:
    - located where the outdoor dew point temperature ≥64°F at the ASHRAE 2% annual dehumidification design condition, and
    - Include heating and cooling capacity at each zone, such as 4-pipe VAV, and
    - Do not mechanically cool air handler supply air below 74F when the outdoor dew point temperature is below 60F



Modified Exhaust Fan Power Consumption

Exhaust fans serving labs with > 10,000 cfm of exhaust shall meet one of these:

1. Fan power budget in section 140.4(c)
2. Design power ≤ 0.65 W/cfm or 0.85 W/cfm with filtration
3. All of these:
    1. ∑ zone min flow < 60% of design flow
    2. Design power ≤ 1.3 W/cfm
    3. VFD and fan power < 40% when airflow < 60%
    4. Exhaust flow ≤
        1. The sum of the space exhaust airflow rates, or
        2. Min acceptable exhaust airflow
    5. Min acceptable flow of
        1. 60% (simple turndown), or
        2. < 60% for > 70% of year, with wind-responsive controls, or
        3. < 60% when measured contaminants < threshold conc.



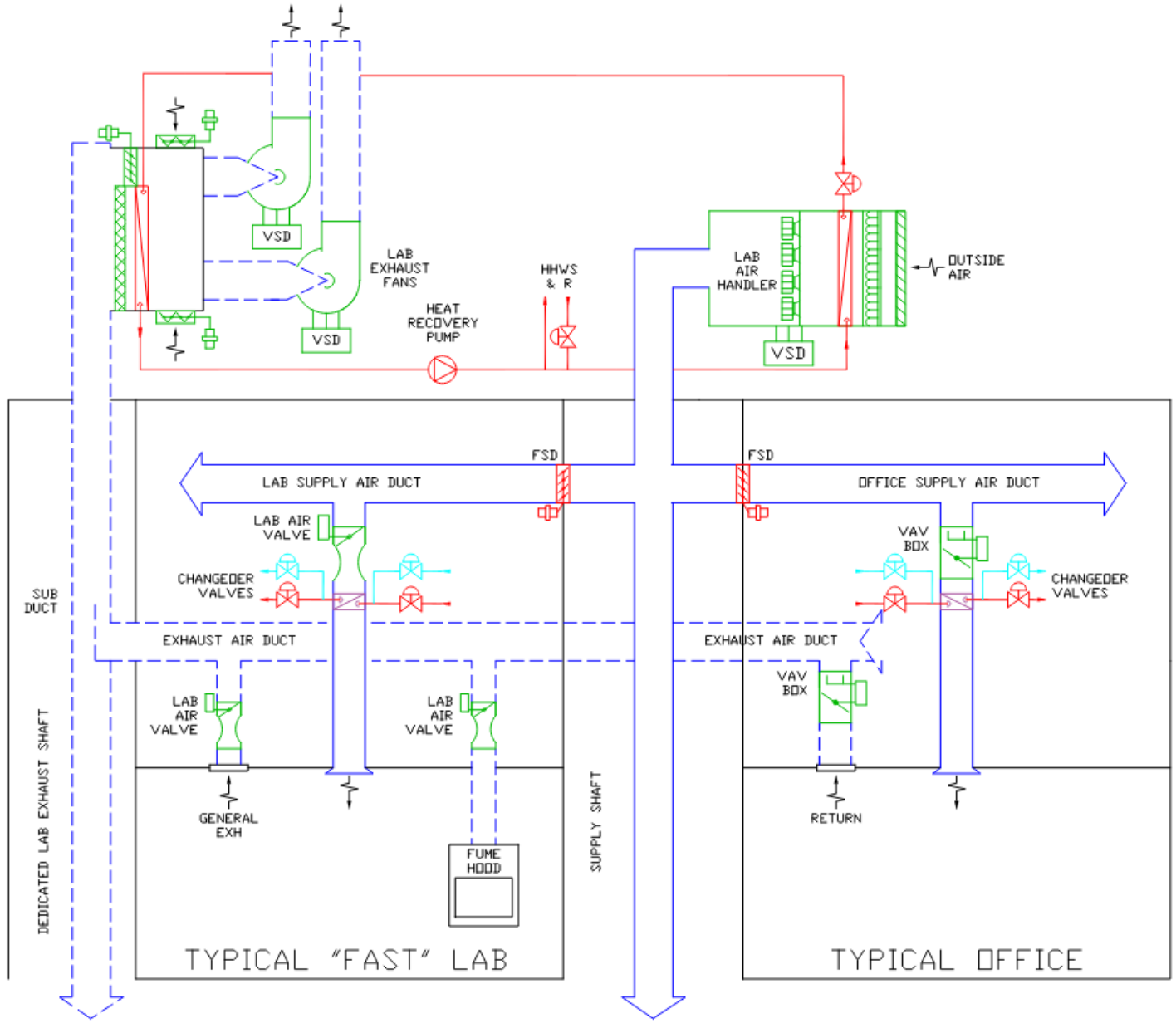
Available Transfer Air vs 100% OA

Conditioned supply air delivered to any space with mechanical exhaust shall not exceed the greater of:

- The supply flow required to meet the space heating or cooling load; or
- The ventilation rate required by AHJ or EH&S; or
- The mechanical exhaust flow minus the available transfer air. Available transfer air shall be from another conditioned space or return air plenums on the same floor and same smoke or fire compartment, and that at their closest point are within 15 feet of each other.
- Exceptions:
  - BSL-3 or higher
  - Vivaria
  - Spaces required to be maintained at a positive pressure differential to adjacent spaces
  - Spaces where the highest amount of transfer air that could be used for exhaust makeup may exceed the available transfer airflow rate and where the spaces have a required negative pressure relationship.
  - Healthcare facilities.

Available Transfer Air vs 100% OA

- Non-Compliant



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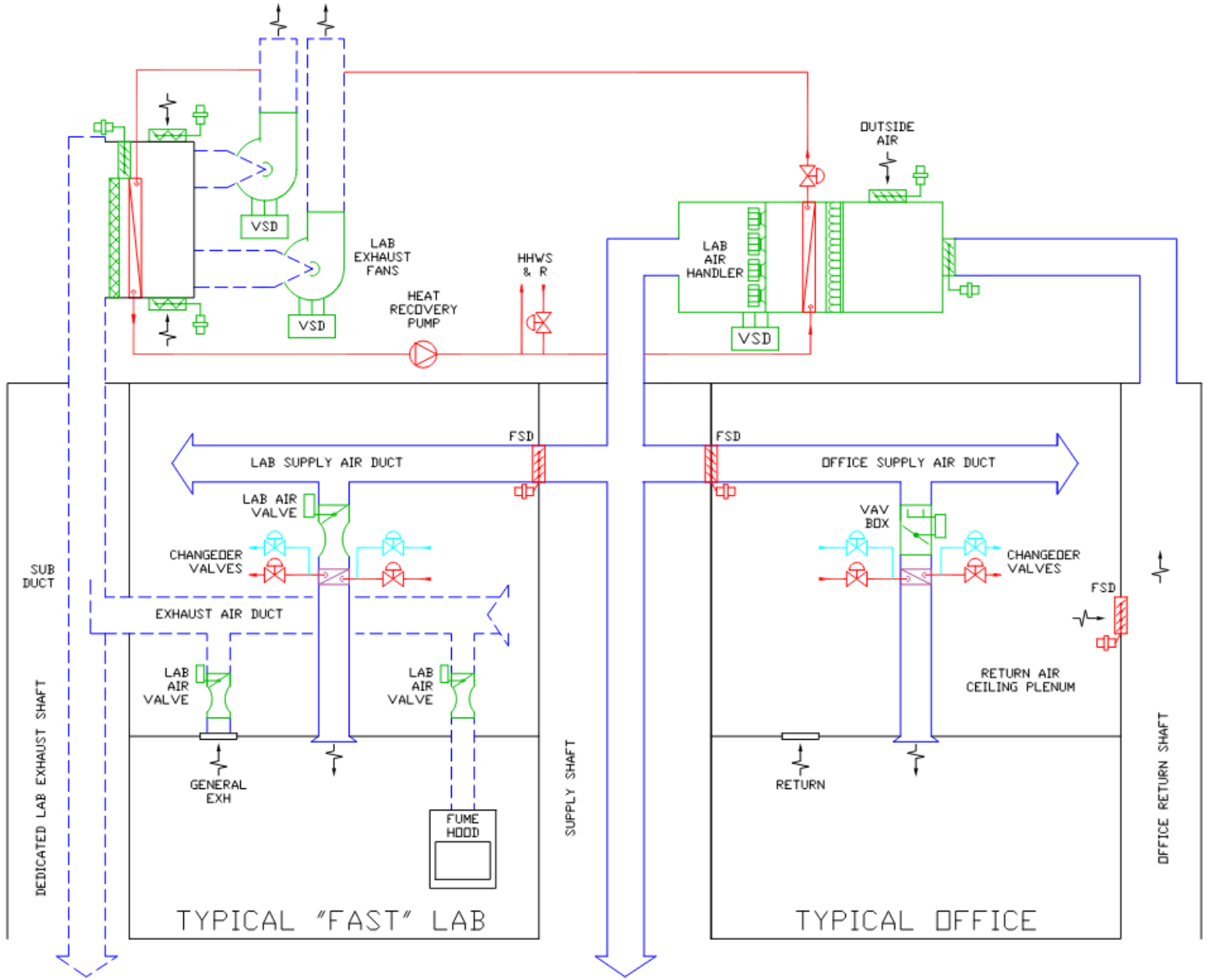
Available Transfer Air vs 100% OA

- Compliant



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Fume Hood Automatic Sash Closure

VAV fume hoods with vertical only sashes located in fume hood intensive labs shall have an automatic sash closure with:

- Dedicated zone presence sensor that automatically closes sash within 5 minutes of no detection
- Controls to prevent the sash from auto closing when a force ≥10 lbs is detected
- Obstruction sensor that prevents the sash from auto closing with obstructions including transparent materials such as laboratory glassware.
- Manual open mode where once the sash is closed, detection of people in the area near the fume hood by the zone presence sensor does not open the fume hood sash.

Table 140.9-D Fume Hood Intensive Labs

Occupied Minimum Ventilation ACH	≤ 4	> 4 and ≤ 6	> 6 and ≤ 8	> 8 and ≤ 10	> 10 and ≤ 12	> 12 and ≤ 14
Hood Density (linear feet per 10,000 ft3 of laboratory space	≥ 6	≥ 8	≥ 10	≥ 12	≥ 14	≥ 16