University of Virginia
LABORATORY VENTILATION DESIGN STANDARDS

1. REQUIREMENTS FOR ALL PROJECTS

The following requirements apply to all projects with laboratory space or an exposure control device, unless prevented by a more stringent Code or Standard (e.g., Association for Assessment and Accreditation of Laboratory Animal Care, International (AAALAC)). Additional exclusions shall be coordinated with EHS and may include laboratories designated BSL3/ABSL3 or containing pyrophoric and/or highly toxic gases.

1. Projects altering or introducing new exhaust systems shall comply with ANSI/ASSP Z9.5-2022 and follow International Institute for Sustainable Laboratories guidelines and best practices.
2. Unless otherwise specified, laboratory spaces shall be designed to Lab Ventilation Design Level 2 (LVDL-2) minimum ventilation rates. See Table 1 for Lab Ventilation Design Levels.
3. Significant changes to room-level exhaust and supply systems (e.g., fume hood replacement) will result in room-level testing, adjusting, and balancing (TAB) of all supply and exhaust devices.
4. New fume hoods shall be capable of operating as variable air volume (VAV). Existing fume hoods shall be converted to VAV operation where systems can accommodate this operation. Additional fume hood requirements can be found in the UVA Chemical Fume Hood Specification (link).
5. Supply diffusers shall be selected based on appropriate throw and placed to optimize safety and prevent turbulence that could interfere with ECD capture. Refer to Figure 1 for an example of diffuser placement best practices near fume hoods. Consider critical environment (e.g., perforated) diffusers near fume hoods and other ECDs.

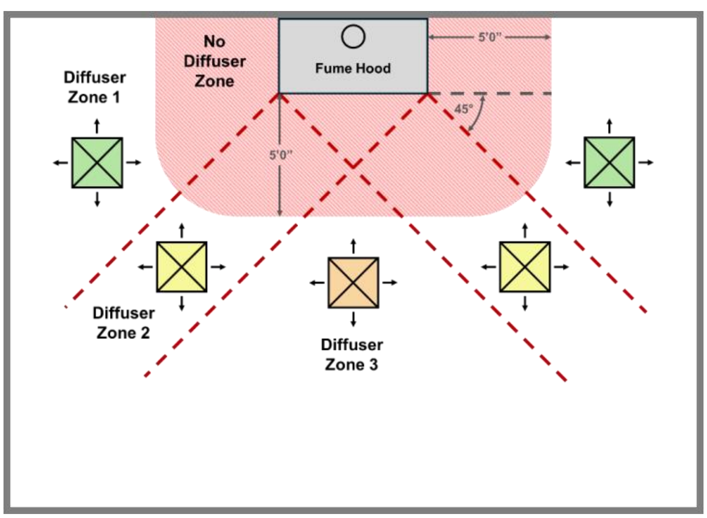

Figure 1. Example of best practice diffuser placement locations near fume hoods, including the area of no diffuser placement (red hatch) as well as good (orange, Zone 3), better (yellow, Zone 2), and best (green, Zone 1) diffuser placement locations to optimize safety and reduce turbulence.

6. Renovated laboratories shall be designed for variable volume operation of supply air, general exhaust, and fume hood exhaust where systems can accommodate this operation.
7. Laboratories capable of variable volume operation shall be equipped with occupancy sensors with integration into the BAS per section 2.2.4. Laboratories shall be programmed with occupied and unoccupied minimum air change setpoints per section 2.2.3.
8. The BAS shall be designed to dynamically calculate laboratory airflow requirements based on space pressurization, fume hood sash position, temperature, and humidity setpoints, and occupied and unoccupied minimum air change setpoints. For lab environment airflow controls specifications and performance criteria, see Table 1 below. Guidelines for BAS can be found in UVA's Building Automation Systems Standards (Resources – UVA Facilities Management).

Table 1. Laboratory Ventilation Design Level (LVDL)

The following table outlines minimum airflow set point based on relative laboratory space risk level.

	UVA Lab Ventilation Design Level				
	LVDL-0	**LVDL-1**	**LVDL-2**	**LVDL-3**	**LVDL-4 Special**
Occupied minimum airflow setpoint (air changes per hour)	n/a	4	6	8	10+
Unoccupied minimum airflow setpoint (air changes per hour)		2	3	4	

2. ADDITIONAL REQUIREMENTS FOR CAPITAL CONSTRUCTION AND MAJOR RENOVATION PROJECTS

The following requirements apply to all capital projects with laboratory space unless prevented by a more stringent Code or Standard (e.g., Association for Assessment and Accreditation of Laboratory Animal Care, International (AAALAC)). Additional exclusions shall be coordinated with EHS and may include laboratories designated BSL3/ABSL3 or containing pyrophoric and/or highly toxic gases.

2.1. Capital projects with laboratory space shall set up a kick-off meeting with Environmental Health and Safety and the Office for Sustainability's Sustainable Labs team (sustainability@virginia.edu) as early as possible and prior to schematic design phase submission.

2.2. Systems serving laboratory spaces shall be designed with the following minimum capabilities.

2.2.1. Redundancy shall be considered for major HVAC equipment including, but not limited to, air handlers and exhaust fans.

2.2.2. Supply air systems shall be separated between laboratory associated spaces (e.g., open laboratories, fume hood alcoves) and non-laboratory spaces (e.g., offices, meeting rooms) to enable more targeted airflow control and more effective energy recovery systems.

2.2.3. Laboratories shall be programmed with occupied and unoccupied minimum air change setpoints in alignment with the lab ventilation design level (LVDL) per Table 1.

2.2.4. Laboratories shall be equipped with zone occupancy sensors which are integrated into the building automation system (BAS). Occupancy sensors shall be selected to provide full coverage of the occupied work area by utilizing multiple sensors where necessary. Multiple occupancy sensors shall be consolidated into one occupancy signal (i.e., one digital point) per HVAC zone. Provide visual indication of occupancy status in BAS system. Lab chemical fume hood occupancy sensors will not be considered for lab air change setbacks.

2.2.5. During unoccupied periods, detection of occupancy shall trigger occupied airflow minimums per Table 1. Unoccupied airflow minimums shall resume after a minimum of 30 minutes of vacancy.

2.2.6. Supply and exhaust valves shall be pressure-independent and fast-acting.

2.3. Exhaust air systems serving laboratory spaces shall be designed with the following minimum capabilities.

2.3.1. All new exhaust systems shall be variable flow systems.

2.3.2. Manifolded systems shall be considered for any exhaust systems serving multiple labs or exposure control devices (ECDs). Use a life cycle cost analysis to inform the decision.

2.3.3. Exhaust systems shall be designed for high plume discharge. See UVA University Design Guidelines section 7.4.5.3 for additional requirements.

2.3.4. Exhaust systems shall be equipped with wind responsive stack velocity controls and be designed to minimize exhaust fan bypass airflow and energy.

2.3.5. Exhaust air energy recovery shall be considered. Use a life cycle cost analysis to inform the decision.

2.3.6. Fume hoods shall be of variable flow and high efficiency type. Fume hoods shall comply with the UVA Chemical Fume Hood Specification (link).

2.4. Supply air systems shall be designed to modulate air flow based on air demand and support exhaust requirements outlined in section 2.3.

2.5. The following documentation shall be provided at appropriate design phase submissions.

2.5.1. HVAC zoning diagrams for supply and exhaust on floor plans shall be provided during schematic design (SD), preliminary design (PD), construction documents (CD), and as-built submissions.

2.5.2. Airflow line diagrams and pressurization floor plan drawings (with directional airflow arrows and associated flow offsets in CFM illustrating room pressurization) shall be provided during CD and as-built submissions.

2.5.3. Room-level airflow tables shall include at minimum the following parameters for each separate laboratory or laboratory support space. An example table is provided in Table 2.

i. Room type (e.g., laboratory, fume hood alcove, etc.)
ii. Number of chemical fume hoods
iii. Lab ventilation design level (LVDL)
iv. Minimum occupied airflow setpoint (in ACH and CFM)
v. Minimum unoccupied airflow setpoint (in ACH and CFM)
vi. Minimum unoccupied room airflow with all chemical fume hood sashes closed (CFM)
vii. Minimum unoccupied room airflow with all fume hood sashes opened to maximum safe, operating height (e.g., 18”) (CFM)
viii. Peak room airflow (in ACH and CFM)
ix. Room pressurization airflow offset (in CFM, where a negative number denotes negative room pressurization)
x. Occupancy sensor integration into BAS (yes or no) per section 2.2.4

Table 2. Example Room-Level Exhaust Airflow Table

Room #	**Room Type**	**Fume Hoods**	**LVDL**	**Min Occ airflow**		**Min UnOcc airflow**		**Sashes closed**	**Sashes opened**	**Max airflow**		**Room press**	**Occ sensor integ.**
				ACH	CFM	ACH	CFM	CFM	CFM	ACH	CFM	CFM	
101	Bio lab	0	1	4	670	2	340			12	2000	+100	Yes
103	Chem lab	2	2	6	1000	3	500	500	1200	14	2340	-100	Yes

2.5.4. Device-level airflow tables shall include at minimum the following parameters for each separate device serving laboratory or laboratory support space. This may be combined with parameters from section 2.5.3 as exemplified in Table 3.

xi. Device name
xii. Device type
xiii. Room serving
xiv. Parent air handling unit or exhaust air unit
xv. Minimum occupied airflow setpoint (in CFM)
xvi. Minimum unoccupied airflow setpoint (in CFM)
xvii. Peak airflow (in CFM)

Table 3. Example Device-Level Exhaust Airflow Table

Room #	**Room Type**	**Fume Hoods**	**LVDL**	**Device name**	**Device type**	**Parent unit**	**Min Occ airflow**		**Min UnOcc airflow**		**Sashes closed**	**Sashes opened**	**Max airflow**		**Room press**	**Occ sensor integ.**
							ACH	CFM	ACH	CFM	CFM	CFM	ACH	CFM	CFM	
101	Bio lab	0	1				4	670	2	340			12	2000	+100	Yes
101				SAV-101	Supply air valve	DOAS-1		670		340				2000		
101				EAV-101	Exhaust air valve	EAU-1		570		240				1900		
103	Chem lab	2	2				6	1000	3	500	500	1200	14	2340	-100	Yes
103				SAV-103A	Supply air valve	DOAS-1		450		200				1120		
103				SAV-103B	Supply air valve	DOAS-1		450		200				1120		
103				EAV-103	Exhaust air valve	EAU-1		600		100				2340		
103				FHV-103A	Fume hood air valve	EAU-1					200	600				
103				FHV-103B	Fume hood air valve	EAU-1					200	600				