**SECTION 23 30 01 HVAC AIR DISTRIBUTION - LABORATORY VENTILATION DESIGN STANDARD**

1. **GENERAL**
	1. The intent of this section is to provide standard requirements for the design of laboratories and laboratory support spaces on campus including conceptual design requirements pertaining to system type, overall laboratory ventilation performance requirements, and performance requirements for laboratory ventilation system devices.
2. **LABORATORY HVAC SYSTEM DESIGN REQUIREMENTS**
	1. A general room ventilation system shall be designed to maximize the clearance of contaminants from the room while minimizing overall energy use. In laboratories where the heat load exceeds the required ventilation rate, supplemental cooling units are to be used. These units shall not be located above areas where research activities are planned.
	2. For all new lab facilities, the ventilation control scheme shall be variable air volume (VAV). For new or renovated labs in existing facilities that meet the requirements of this design standard, match systems with other labs in the facility. For non-compliant buildings (e.g. constant volume AHUs and exhaust systems), install systems that can operate with existing systems but which can later be converted to VAV without hardware changes.
	3. Refer to the Brown University Laboratory Design Guidelines document for additional design requirements.
	4. Laboratory ventilation systems shall be designed to meet the following performance requirements.
		1. Occupied air changes shall be designed for a minimum ventilation rate of 4 air changes per hour (ACH) and a maximum ventilation rate of no greater than 12 ACH (excludes ACF).
		2. Unoccupied air changes shall be designed for a minimum ventilation rate of 4 ACH, but installed systems shall be capable of reducing to 2 ACH (for future use).
		3. The designer shall include provisions for room “purge mode” in rooms where the use and/or storage of high hazard chemicals, or storage of oxygen-depleting gases, is anticipated.
		4. Design drawings shall indicate supply and exhaust (maximum and minimum) air flows for each lab.
	5. No fume hood installations are allowed in rooms with return air to other spaces. All chemical use rooms (wet labs) shall have 100% exhaust.
3. **LABORATORY HVAC SYSTEM AND CONTROL REQUIREMENTS**
	1. Where permitted, all laboratory spaces shall be designed for occupied/unoccupied ventilation control modes. Single mode infrared sensors covering the full lab footprint shall be used to establish occupancy/unoccupancy intervals along with schedules and sash positions as required. Systems shall integrate controls for both lighting and lab ventilation control.
	2. For spaces having an unoccupied ventilation mode, some form of local indication of mode shall be provided (e.g. general lighting on or indicator stack lights). An unoccupied laboratory will be defined as having no people present in the room and there may be other considerations for occupancy including hood sash position and/or building automation system (BAS) occupancy schedules.
	3. Pressure-independent air valves shall be provided for laboratory supply, general exhaust and hood exhaust air. For VAV systems, all air valves shall be manufactured by Phoenix or Price and valve controllers shall be fitted with differential pressure (DP) switch and reside on the MS-TP trunk of the BAS.
	4. Supply and general exhaust air valves shall have an integral air flow ring or measuring device in compliance with manufacturer's requirements.
	5. HVAC system duct materials shall be compatible with compounds to be exhausted. Stainless steel (Type 316, 26 gauge) should be used with most solvents and potentially flammable vapors. PVC ducting (Type 1, Grade 1, Schedule 10) should be used for corrosive vapors.
	6. Materials for hoods and all associated ductwork and exhaust systems for high hazard or unique use such as perchloric acid must be specifically designed for its use and approved by Brown University EH&S.
	7. The control system for all laboratories and research space shall include a space differential pressure sensor that is addressed to the BAS for each adjacent space fitted with a door or other access to the laboratory space.
	8. All snorkel exhausts must be tied into the main exhaust using a control valve and be fitted with on/off actuation. Exhaust flow and snorkel design must ensure that appropriate capture velocity is achieved.
	9. Provide standby power for laboratory systems equipment including dedicated lab equipment and user loads, fume hood controls and lab ventilation control panels, and lab safety monitoring equipment (oxygen deprivation / chemical leak detection systems, lab equipment alarm monitoring systems, etc.). Refer to Electrical Standard for Additional Requirements.
4. **CHEMICAL FUME HOOD REQUIREMENTS**
	1. Equipment
		1. Only “high-performance” style fume hoods shall be installed. The following vendors and models have been approved for use at Brown:
			1. Lab Crafters – Air Sentry
			2. Labconco – Protector Xstream
			3. Kewaunee – Supreme Air LV
			4. ThermoScientific Hamilton – Concept
			5. Mott - RFV2
		2. All fume hoods shall be of the variable air volume (VAV) type and shall have controls and hardware to maintain an acceptable face velocity over the entire range of sash movement.
		3. Hood sashes shall be of the single pane, vertical movement design only.
		4. Hoods which are high hazard or unique use, such as perchloric or other acid digestive systems, as well as radio iodination hoods can only be included in a project if specifically approved by EH&S.
		5. Hoods shall be labeled to identify the supply and exhaust units with which they are associated.
		6. Biological safety cabinets shall be of the Class II B2 type.
		7. The design professional shall specify, on design drawings, the following parameters for each fume hood: Flowrate at 18-inch sash height; flowrate at minimum sash position; design face velocities and sash length.
		8. Chemical fume hoods shall not have drains on the inside of the hood.
		9. Fume hoods shall not have an integrated remote chemical waste collection system.
		10. Hood sashes shall be fitted with a sash stop at working height (typically 18”). Sash stops may allow manual release to raise sash above working height for installation of large equipment, but hood should alarm when sash is raised above working height.
	2. Fume Hood Performance
		1. All new hoods shall be designed to provide safe operation at an average face velocity of 60 to 100 FPM @ 18 inch sash opening height. The current target minimum airflow rate is 80 FPM. This target rate may be lowered in the future as allowed by EH&S.
		2. Fume hood air exchange rate shall not drop below 250 ACH.
	3. Fume Hood Controls and Alarms
		1. All new hoods must be equipped with the following minimum control and alarm points:
			1. Visible and audible alarms for high and low face velocity
			2. Local alarm reset
			3. Display of face velocity
			4. Sash sensors (position), flow monitor with audible alarm which is tied into the BAS. Output to BAS shall be via native Bacnet or hard-wired. Output signals shall include: face velocity, airflow, sash position and general alarm.
			5. No “gateway” server between the lab control system components and BAS is allowed
			6. All hood exhaust valves shall have differential pressure (DP) switch.
		2. Acceptable manufacturers (VAV)
			1. TSI
			2. Phoenix
			3. Price
		3. All labs shall have graphics and trend information incorporated into the BAS system per standard 23 09 01.
5. **FUME HOOD AND LABORATORY ACCEPTANCE TESTING**
	1. Signage shall be installed in/on all fume hoods prohibiting their use until such time as ASHRAE 110 testing is completed and the fume hood is deemed acceptable for active use.
	2. All labs shall be evaluated for unoccupied lab ventilation eligibility by a Certified Industrial Hygienist (CIH) selected by Brown EH&S.
	3. Laboratory HVAC fume hood controls shall be set up for implementation of the building specific Laboratory Ventilation Management Plan (LVMP plan).
	4. For buildings that have a building specific Lab Ventilation Management Plan (LVMP plan), the building LVMP (plan) must be modified as needed for new lab equipment etc.
	5. All labs shall be commissioned per ASHRAE Standard 202 or agreed upon commissioning standard or guideline.
	6. All lab supply, exhaust, and hoods will be labelled with parent unit information (e.g. "tied to EF-1/2").
	7. All fume hoods are to be ASHRAE 110 tested. HAM (human as manikin) testing is required for all hoods. No use of SF6 gas is permitted for ASHRAE 110 testing. Nitrous oxide (NO) or other more ozone protective alternatives are required.