APPENDIX W

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LABORATORY VENTILATION SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. This standard is for Laboratory Ventilation Systems, and includes:

1. Laboratory supply air.

2. Laboratory general exhaust, and Laboratory hood, cabinet, and snorkel exhaust.

3. Laboratory animal rooms.

1.02 CODES, STANDARDS and REFERENCES

A. CODES

1. Code of Federal Regulations (CFR)

2. National Electric Code (NEC)

3. Ohio Building Code (OBC)

4. Ohio Revised Code (ORC)

B. STANDARDS and REFERENCES

Refer to the most current version of the following standards and references:

1. Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC)

2. American Conference of Governmental Industrial Hygienists (ACGIH), Industrial Ventilation - A Manual for Recommended Practices.

3. American National Standards Institute, American Industrial Hygiene Association, (ANSI/AIHA), National Standard for Laboratory Ventilation.

4. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), Laboratory Design Guide.

5. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), Heating, Ventilating, and Air Conditioning Applications.

6. National Fire Protection Association (NFPA), 45 Fire Protection for Laboratories Using Chemicals.

7. NFPA 801, Chapter 5 - Recommended Fire Protection Practice for Facilities Handling Radioactive Materials.

8. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

9. NFPA 91 - Standard for the Installation of Blower and Exhaust Systems.

10. National Research Council (NRC), Guide for the Care and Use of Laboratory Animals, National Academy of Sciences, Washington, D.C.

11. National Sanitation Foundation (NSF) NSF-49 - Standard for Class II (Laminar Flow) Biohazard Cabinetry.

12. Scientific Equipment and Furniture Association (SEFA), Laboratory Fume Hoods Recommended Practices, SEFA 1.2 - 1996.

13. The Ohio State University (OSU) Building Design Standards (BDS)

1.03 SYSTEM DESCRIPTION

A. The purpose of Laboratory Ventilation Systems is to provide a safe environment to occupants, researchers, teachers, staff, students, visitors, and subjects, and to protect the laboratory and the business investment therein, by controlling and exhausting contaminants and providing acceptable ventilation, while simultaneously minimizing energy and maintenance costs.

1. The primary means of providing safety and controlling and exhausting contaminants shall be fume hoods (chemical hoods, radiological hoods, perchloric acid hoods, laminar flow hoods, biological safety cabinets (Class II, B2, or B3), glove box (Class III), snorkels, and Laboratory hood exhaust system. See Appendix N for all primary means of providing safety with hoods, cabinets, and snorkels.

2. The secondary means of providing safety and controlling and exhausting contaminants shall be the Laboratory Ventilation Systems. In addition to safety, the Laboratory Ventilation Systems shall also provide comfort control within the room (temperature and humidity). The Laboratory Ventilation Systems shall include Laboratory supply air, and Laboratory general exhaust.

1.04 ENERGY COST CONSIDERATIONS

A. The system's design, the equipment selections, and the equipment operation must incorporate all considerations to allow operation at the lowest energy costs.

1.05 MAINTENANCE COST CONSIDERATIONS

A. The system's design, the equipment selections, and the equipment and accessory locations, must incorporate all considerations to facilitate maintenance, and allow maintenance at the lowest costs.

1.06 LAY-IN CEILINGS

A. Lay-in ceilings shall be provided in all Laboratory and Laboratory Support spaces which are required to have minimum air changes per hour (ACH's).

B. Ceiling heights (between finished floor and lay-in ceiling) within these spaces shall be designed and installed realistically as low as possible in order to minimize total

ventilation volumes, while maintaining minimum ACH's, and thereby minimize total energy costs.

PART 2 PRODUCTS

2.01 SYSTEM PERFORMANCE

A. LABORATORY SUPPLY AIR SYSTEMS

1. Laboratory supply air systems shall be capable of containing contaminants below accepted governmental and consensus industrial exposure standards, flammable limits, and noxious chemical odor thresholds.

2. Recommended minimum air changes per hour (minimum ACH's) to provide best energy savings while maintaining safety to occupants are listed below in Table 1.

TABLE 1

	Minimum Air Changes per Hour (ACH's)	
	Occupied ACH's	Vacant ACH's
Research/Teaching Laboratories		
Low Toxicity (> 500 ppm threshold)	8	6
Moderate Toxicity (100-500 ppm threshold)	10	6
High Toxicity (<100 ppm threshold)	10	6
Animal Rooms		
Unventilated Racks	10	10
Direct Ventilated Racks	8	6
Mixed Laboratories (Animals/Chemicals)	10	10
Teaching Laboratories (No Fume Hoods)	8	6
Chemical Storage	8	8
Dark Room	10	6

a. The above are OSU recommended minimum ACH's. The associate remains responsible to consider and apply the heating and cooling ventilation requirements, the toxicity of the contaminants, hood manufacturer recommendations, all applicable codes, all applicable standards, and all recommended good practices for each application. The associate shall obtain approval from OSU before proceeding with the design.

b. The Vacant ACH's are applicable only when the ventilation rates can be restored to the Occupied ACH's by the laboratory personnel when working during vacant periods such as evenings, weekends, and holidays. The system must incorporate these Occupied and Vacant features and selections.

3. Air supply systems serving laboratory areas shall be separate from air supply systems serving non-laboratory areas.

4. Fresh (outside) air intakes shall be located to prevent recapture and/or re-entrainment of exhaust air contaminants.

5. Laboratory supply air shall be 100% fresh (outside) air, and reuse of recirculated air is prohibited.

6. Heating for 100% fresh (outside) air shall be of sufficient capacity to retain supply fan system operational at record cold temperatures, which for Columbus is minus (-) 22ºF.

7. Heating for 100% fresh air shall apply hot water heating, with coil recirculation pump for continuous flow to the coil, modulating face-and-bypass damper, and modulating heating water valve. The modulating heating water valve shall remain in continuous control under all load conditions. If the supply and/or exhaust fans are served by emergency power, then the coil recirculation pump shall also be served by emergency power.

8. Pressure gradients between rooms and areas shall be obtained by designing and balancing total air volumes at any and all operating conditions:

   a. Laboratory Rooms shall be maintained at negative pressures, in relation to Laboratory Support Rooms and non-laboratory areas, by total Laboratory exhaust volume being 5% greater than total supply air volume.

   b. Laboratory Support Rooms shall be maintained at negative pressures, in relation to non-laboratory areas, but at a slightly less negative pressure than Laboratory rooms. The total exhaust volume being 5% greater than total supply air volume.

9. Laboratory room temperatures should be maintained within Building Design Standard room temperatures specified in 15/16-6.3.2. during 'Occupied' periods. Temperatures shall be relaxed during 'Vacant' periods, i.e., approximately 5ºF lower heating temperatures and approximately 5ºF higher cooling temperatures, in order to reduce energy usage when 'Vacant'. The associate shall obtain approval of room design temperatures for each space prior to start of design.

10. Laboratory room humidities should be maintained within Building Design Standard room humidities specified in 15/16-6.3.2. during 'Occupied' periods and shall be relaxed during 'Vacant' periods. The associate shall obtain approval of room design relative humidities for each space prior to start of design.

11. Laboratory noise levels should be maintained not to exceed Building Design Standard Appendix J, Ranges of Design Limits for Sound Control.

B. LABORATORY EXHAUST SYSTEMS

1. Laboratory exhaust fans shall be above the roof and readily accessible for maintenance.

2. Exhaust Duct Velocity - minimum exhaust duct velocity to be 2000 fpm.

3. No entire floor of a building shall depend upon one exhaust fan to serve all hoods and cabinets, unless only one hood or cabinet is served on that floor.

4. Provide at least 50% or greater backup exhaust fan capacity, and isolate each exhaust fan, such that one exhaust fan may be stopped and serviced, while simultaneously retaining the full capacity and function of the total exhaust system.

5. All laboratory exhaust ducts shall be at negative pressure with respect the entire building envelope. It is prohibited to have any portion of any laboratory exhaust duct to be at any positive pressure with respect to any portion of the building envelope.

6. Vertical-up Laboratory exhaust discharge velocity shall be 3000 fpm minimum, or greater.

7. Exhaust stacks shall be sufficiently high such as to eject the exhausted contaminants away from the building, and away from all adjacent buildings. Exhausted contaminants shall be ejected in a manner such as to prevent re-entrainment of contaminants into fresh air intakes into the building, or into all adjacent buildings.

8. Exhausts from fans shall discharge upwards and shall have an all- weather cap. "China Caps" are prohibited on exhaust stacks. The exhaust stacks or ducts should be at least 8-feet higher than building elements within 33-feet, including any door, window, intake grille or occupied space. Exhaust should run straight at least seven (7) to ten (10) duct diameters before the fan in order to reduce the "systems effect" that will result in increased static pressure.

9. Energy recovery systems may be provided for all laboratory exhausts to pretreat (heat or cool) supply air stream. The associate shall evaluate energy recovery system(s) and obtain approval for type of system(s) prior to start of design.

C. CONSTRUCTION

1. Materials for the Laboratory exhaust system shall be non-combustible. Suggested materials are:

   a. Radioisotope or bacteriological: stainless steel.

   b. General chemical exhaust: carbon steel sandblasted and coated with epoxy or coated with a phenolic.

   c. Perchloric acid: Type 316 stainless steel or rigid PVC, and inorganic ceramic coating.

2. Fire dampers are prohibited in hood exhaust ducts, unless specified otherwise by local codes.

3. An interlocking arrangement to shut off laboratory exhaust fan, if laboratory supply fan fails, is prohibited.

4. Fire detectors and alarm devices shall not automatically shut off laboratory exhaust fans, except as required when actuating a fluorocarbon or carbon dioxide extinguishing system.

5. Horizontal duct runs serving any one hood, safety cabinet, or equal shall be limited to 33-feet or four 90-degree bends or equivalent.

6. All supply air fittings, all exhaust air fittings, and all transitions shall be low-loss to reduce static pressure losses, minimize noise, and to retain operation at lowest energy costs.

7. Exhaust ductwork for perchloric acid hoods must be entirely vertical, with the exception that one bend is permitted. Provide a wash-down system for the perchloric exhaust duct and fan, with washdown control and indication located at the hood.

8. For Animal rooms, all exhaust air grilles (and/or return air grilles) shall include 35% pre-filters, nominal 2"-thick, to prevent animal hair and/or dander from accumulating in the exhaust (and/or return) ductwork, and from accumulating in the fan(s). The pre-filters shall be maintained by the Using department. The prefered design location for exhaust and return grilles is 18" above the floor.

9. Supply diffusers and return grilles shall be located and designed to minimize odors and short circuiting, and to promote air circulation.

10. For Animal rooms, where wash-down of the room is required, sensors for temperature control, humidity control, and lighting shall be located such as to never have water or water mist impacting on the sensor or transducer or transmitter.

END OF APPENDIX W