The following standard specification is intended to be edited according to the specifics of the project. Brackets [ ] and areas shaded in gray [e.g. format] indicate requirements that are optional depending upon the type of system being provided or per instructions associated with the [ ] and project requirements. Consult with University's Representative and campus stakeholders.

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SECTION 25 95 05 – LABORATORY AIRFLOW CONTROL SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide a laboratory airflow control system to control the airflow volume into and out of laboratory spaces. The laboratory control system shall vary the amount of air supplied into the room and the amount of air exhausted from the room to operate the laboratories at the lowest possible airflow rates necessary to maintain temperature control, achieve minimum ventilation rates, and maintain laboratory pressurization in relation to adjacent spaces (positive or negative). The laboratory airflow control system shall interface with the building's energy management system. The exhaust flow rate of each laboratory fume hood shall be precisely controlled to maintain a constant average face velocity into the fume hood. Provide all necessary wiring, and auxiliary and electrical equipment for a fully functioning laboratory airflow control system. Refer to Contract Drawings for details.

B. The fume hood exhaust airflow volume for face velocity control shall be based on a sash position signal.

C. Laboratory pressurization control shall use the volume-offset method

1.2 RELATED SECTIONS

A. Section 11 53 13 Fume Hoods

B. Division 23 HVAC

C. Division 25 Energy Management System

1.3 REFERENCES

A. American National Standard for Laboratory Ventilation (ANSI/AIHA Z9.5).

B. ANSI/ASHRAE 110, latest adopted edition.

C. ASHRAE Standard 111, latest adopted edition and AMCA Standard 210 “Instrument Calibration”.

D. AMCA 610-611

E. ARI Standard 880

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 23 Shop Drawings Product Data and Samples.

B. Technical Narrative: Submit a technical narrative describing all elements of the laboratory control system, including proposed equipment and a schematic laboratory layout showing relations of all elements and a description of how they interact. This submittal shall include the scope detailed in this Section and shall be separate from any other building Energy Management System (EMS) submittal.

C. Shop Drawings: [Note to Specifier: provide details] Include plans, elevations, sections, and details, drawn to scale and coordinated with other installations, using input from installers of the items involved. Provide any necessary duct transitions and connection pieces for installing the control valve in the duct system.

D. Product Data: Submit product data for each type of material and product specified and all proposed system components and devices. Submit testing data for all airflow control devices to include discharge, exhaust, and radiated sound power level performance obtained in accordance with ARI Standard 880.

E. Calculations: Provide accuracy calculations for the conditions specified in 2.4.A.1 and each type of valve for the worst-case turndown ratio. The calculation shall take into account airflow sensor error, transmitter error, hysteresis, repeatability, valve error, drift, temperature, controller errors, and shall be calculated over the full airflow range of the valve. The full range of the valve shall be included to accommodate future changes in flow.

1.5 WARRANTY

A. In addition to the warranty requirements specified elsewhere in the Contract Documents provide the following:

1. The Guarantee to Repair Period shall be five years.

2. The manufacturer shall include two visits to the site after the University's acceptance to confirm the system is operating as commissioned. The first visit shall be at the end of year one and the second visit shall be at the end of year two.

3. During each visit, calibration of fume hood controls, pressure transmitters, terminal boxes and air flow sensors shall be performed as necessary and in the presence of the University representative. The time and sequence of each visit shall be coordinated at least 10 days in advance with the University's Representative. A written report of each visit detailing all work performed shall be provided to the University's Representative. The equipment supplier shall allow 8-hours on site time for a senior commissioning engineer with extensive knowledge of their system.

4. Calibration shall be performed in accordance with ASHRAE Standard 111 or latest edition and AMCA 210.

5. During the Guarantee to Repair Period, the Contractor shall re-calibrate sensors for all fume hood control valves which are out of calibration. Control valves which are out of calibration shall be deemed to be Defective Work, subject to the requirements of Article 12 of the General Conditions.

1.1 QUALITY ASSURANCE

A. Contractor Experience:

1. Contractor shall be in the business of installing laboratory airflow control systems for a minimum of five years.

2. Contractor shall have a minimum five similar laboratory airflow control system installations that have been completed in the United States, and have been in successful operation for at least one year. These installations shall employ components and materials similar to the components and materials submitted under these Contract Documents, shall be manifold exhaust/supply systems with multiple connections to fume hoods and laboratory supply and return grills from a manifold.

1.2 COORDINATION

A. Coordinate related work of the laboratory airflow control system with all other work. Install the system in strict accordance with the manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer Qualifications:

1. The manufacturer shall have designed, engineered, and provided laboratory airflow control systems for the last five years.

2. Manufacturer shall have a minimum of twenty existing successful installation in full operation in the US; five of which shall be in California. Each installation shall have a minimum of twenty laboratory controllers.

B. Siemens, Tek-Air Phoenix, or equal.

2.2 AIRFLOW CONTROL – GENERAL REQUIREMENTS

A. Each individual laboratory space shall have a dedicated laboratory airflow control system with networked direct digital controllers for temperature and airflow controls. Each laboratory space shall be able to operate standalone for controls. The system software shall allow centralized overall system supervision, operator interface, management report generation, alarm annunciation, and communication with control units.

B. Laboratory Space Pressure Control

1. The system shall use volumetric offset control to maintain room pressurization. The system shall maintain proper room pressurization (negative or positive) regardless of any change in room/system conditions such as the raising and lowering of any or all fume hood sashes or rapid changes in duct static pressure. Systems relying on differential pressure measurement to control room pressurization are not acceptable.

C. Laboratory Temperature and Airflow Control

1. Each valve shall have a microprocessor-based digital controller. They shall control and communicate digitally via an industry-standard protocol (BACnet) with all equipment within a pressurized zone, including but not limited to digital fume hood, snorkel, flammable storage, equipment, general exhaust, makeup, and laboratory office airflow control devices.

2. The control system shall maintain constant design offset between the sum of room's total exhaust and make-up/supply airflows. This offset shall be field adjustable and represents volume of air, which will enter (or exit) room from adjacent spaces.

3. The temperature setpoints for heating and cooling for each zone, shall be independent with an adjustable deadband of 1 to 15 degrees.

4. Each main laboratory shall have the capability for full stand-alone operation and digital communication, using an industry-standard protocol (Lon or BACnet), building-wide digital laboratory control system network furnished by the laboratory control system supplier.

5. [Note to Specifier: Verify if required.] Each router shall provide a port for connecting a notebook computer. This port shall provide access to all points of the control system.

6. Each valve controller shall have input and output capability to address temperature control and non-network sensors. Refer to plans for locations of temperature sensors.

7. [Note to Specifier: Verify if required.] Each router shall be panel mounted in NEMA enclosure and shall operate on 24 volt AC power. Mount 24-volt AC transformers for routers in an enclosure that is accessible or adjacent to routers.

8. [Note to Specifier: Verify if required.] Routers shall meet FCC Part Subpart L Class A, and be UL 916 listed.

9. The supply valve controller shall provide a control signal to the reheat coil control valve to maintain space temperature. Provide electronic control valves for the reheat coil control valves. Refer to Section 25 95 30 DDC EMS Hardware.

10. Electronic sensors exposed to exhaust airflow shall meet the UL913 Standard for Intrinsically Safe Apparatus and Associated Apparatus for use in Class I, II, II, and Division I Hazardous Locations.

D. Noise Criteria

1. Room noise criteria shall not exceed NC 45. [for NIH, max levels NC 40 to 45, including fume hoods; NC 55 for instrument rooms; NC 65 or higher all others.

2. Contractor shall submit noise data accredited by an independent agency and test method, per ARI 880.

E. Exhaust and Supply Airflow Control Device

1. The variable volume airflow control device shall use closed loop control to linearly regulate airflow based on a digital control signal. The device shall generate a 0-10V or 4-20mA feedback signal that represents its airflow.

2. The airflow control device shall store its control algorithms in non-volatile, re-writable memory. The device shall be able to stand-alone or be able to network with other room level digital airflow control devices over a network.

3. The airflow control device shall use industry standard 24-vac power.

4. The airflow control device shall have a local port for connection to a notebook PC commissioning tool.

5. The airflow control device shall have sufficient I/O inputs and outputs to address fume hood control, temperature control, and non-network sensors.

6. The airflow control device shall meet FCC Part 15, Subpart J, Class A and be UL916 listed.

F. Fume Hood Monitor: [Note to Specifier: Coordinate alarms with the building Energy Management System (EMS) and fume hoods. Only one system shall provide alarms. If EMS system does not provide alarms, include the following:]

1. Provide a fume hood monitor for every fume hood. Monitor shall have an emergency purge button that drives the fume hood exhaust valve to full volume and real-time LCD readout of face velocity.

2. The Safety Monitor/Alarm System shall monitor face velocity and provide audible and visual alarm if face velocity drops below 90 fpm or rises above 125 fpm. Audible alarm shall pulse at 80 dbA.

3. The monitor shall be UL listed, with all alarm circuit electric components, external tubing, restrictors and manifolds furnished complete. Monitor shall display airflow conditions clearly. Safety monitor shall be tamperproof.

4. Alarm Signal: Audible pulsating signal and a visual, large flashing red light emitting diode.

   a. Silence push button, which temporarily overrides the audible alarm for a period no longer than 5 minutes, shall be accessible on the front of the Safety Monitor. Note: Teaching laboratory hood alarm override shall not exceed a one-minute period. Once the “unsafe” operating condition has been corrected, the audio alarm shall automatically reset.

   b. During temporary silence of audible alarm the visual alarm remains activated until the alarm condition is corrected.

   c. It shall not be possible to routinely disable the alarm signal. Locate electrical outlet on top of hood.

   d. When alarm condition is corrected and face velocity and volume is return to specified levels, the safety monitor shall automatically reset and begin routine monitoring.

5. Test circuit shall be provided to verify proper safety monitor operation.

6. Connect between fume hood and the filter or air valve.

7. Flow tube device (floating indicators), magnehelic, or ribbons hanging in the air stream are not acceptable airflow indicators.

G. Interface With Building Energy Management System (EMS)

1. The laboratory airflow control system network shall connect directly with the building EMS. The required software interface drivers shall be developed and housed in a dedicated interface device furnished by the laboratory airflow control system supplier. [Note to Specifier: Verify if required.]

2. All room-level points shall be available to the EMS for monitoring and trending. The gateway shall maintain a cache of all points to be monitored by the EMS. The room-level airflow control devices shall update this cache continuously.

3. The building-level network shall be a BACnet communications or LonTalk high-speed (1.25 Mbps) communications protocol. The building-level network shall support up to 100 subnets or pressurization zones, or 6000 data points.

4. Fully map the following points, using English language descriptors, so that they are available through the campus EMS.

    a. The following set points shall be adjustable through the campus EMS

        1) Zone occupancy schedule for each laboratory zone

        2) Zone occupied heating setpoint

        3) Zone occupied cooling setpoint

        4) Zone unoccupied cooling setpoint

        5) Zone unoccupied heating setpoint

        6) Output command for zone re-heat coil valves.

        7) [Note to Specifier: Leave in if using chilled beams] Room dew point temperature

    b. The following points shall be transferred for monitoring only

        1) Total supply air volume for each space

        2) General exhaust air volume for each space

        3) Fume hood exhaust volume for every hood

        4) Current laboratory air volume offset setpoint

        5) Current laboratory air volume offset

        6) Zone Temperature

        7) Zone occupancy status

        8) Supply Air Temperature

        9) [Note to Specifier: Leave in if change-over system] Change over valve position

        10) Supply air terminal valve position

        11) General exhaust air terminal valve position

        12) Fume hood air terminal valve position.

        13) Total Room Exhaust, including hoods and general exhaust.

        14) Sash position

5. Comply with requirements of Section 25 95 50 DDC EMS Software for information on the alarm point and graphic screens that shall be provided using these transferred points.

6. Where a PC is required to provide the link between the networked laboratory control unit (LCU) and the EMS it shall be rack mounted in a clean and ventilated control panel in an accessible location agreed to by the University's Representative. The PC shall be an industrial grade such as the CAPAX, CNS-5012-BE or equal, with additional rack mounted industrial grade 5 GB HDD, LCD screen display, mouse and all necessary software to provide the point transfer capability.

2.3 AIRFLOW CONTROL VALVES (SUPPLY, GENERAL EXHAUST, FUME HOOD EXHAUST) – MINIMUM PERFORMANCE STANDARDS

A. Airflow Accuracy

1. All airflow control valves shall have a minimum accuracy of +/-5 percent of actual airflow with, 7:1 turndown ratio. This accuracy shall be achieved in the actual installed conditions at each valve. The range of airflows over which this accuracy shall be achieved is indicated on the Contract Drawings.

2. Each airflow control valve shall be factory calibrated to the job specific airflows as detailed on the Drawings and Specifications using NIST traceable air stations and instrumentation having a combined accuracy of at least +/- 5 percent of signal over the entire range of measurement. Also refer to other requirements in this Section.

3. All airflow control devices shall be individually marked with device specific, factory calibration data. As a minimum, it should include: tag number, serial number, model number, eight point characterization information (for electronic devices), and quality control inspection numbers. All information shall be provided to University's Representative for review prior to installation. All information shall be stored by the manufacturer for use with as-built documentation.

4. All airflow control valves and controls must be sized to operate under normal flow rates for each lab and also be able to maintain a steady controlled air flow when commanded to an unoccupied value of 4 air changes per hour rate for the space that it controls.

5. Submit equipment manufacturers' performance and accuracy statements and independent certifications, i.e. AMCA 610-611, for each product verifying conformance with the requirements of this Specification.

B. Airflow Pressure Independence

1. The system shall maintain the specific airflow at ±5 percent of actual airflow within one second of a step change in the duct static pressure that is within the system's stated duct static pressure requirements. The pressure relationships shall be maintained regardless of any changes in the system.

C. Valve Response Time

1. Supply and exhaust valves within a single laboratory space shall react to changes in duct pressure, movement of a fume hood sash, changes in required airflow for temperature control, or any other change in the system within 3 seconds to assure that the laboratory negative pressure is maintained.

2.4 Fume Hood Airflow Control Valve

A. General

1. The laboratory airflow control system shall employ individual average face velocity controllers that directly measure the area of the fume hood sash opening and proportionally control the hood's exhaust airflow to maintain a constant average face velocity across the entire air flow range from the sash closed position to the sash open position. The average fume hood face velocity shall be maintained between 100 and 120 fpm. No point in the face of the hood shall be less than 70 fpm.

2. Provide the sash position-sensing device within the fume hood. Coordinate as necessary with the fume hood supplier.

B. Valve Response Time

1. When the fume hood sash is moved from fully closed to the design operating height at a speed of between 1.0 to 1.5 FPS the following shall occur:

a. The hood exhaust airflow volume (as measured at the valve) shall reach the required airflow within one second of the sash reaching its final position.

b. The measured hood face velocity shall be stable and within the specified limits within 3 seconds of the sash reaching its final position.

2. The speed of response shall be verified under the requirements of section 6.4 of the AHSRAE 110 test.

2.5 AIRFLOW CONTROL VALVES - MINIMUM MATERIAL QUALITY STANDARDS

A. Valves in non-corrosive airstreams (supply and general exhaust valves):

1. Valve: The materials, material thicknesses and coatings for casings, shafts, shaft support brackets, pivot arms, internal mounting links, pressure independent springs and shaft bearing surfaces shall be constructed of laboratory grade materials, material thicknesses and coatings.

2. For all supply valves, provide a factory exterior insulation jacket, or provide neatly applied on site insulation over the valve in such a way to have zero impact on the operation of the valve.

B. Valves in corrosive airstreams (typical for all valves connected to fume hoods, biological safety cabinets and any other valve located in stainless steel exhaust ductwork):

1. Valves: The materials, material thicknesses and coatings for casings, shafts, shaft support brackets, pivot arms, internal mounting links, pressure independent springs and shaft bearing surfaces shall be constructed of laboratory grade materials, material thicknesses and coatings. Materials, material thicknesses and coating shall be suitable for use in a university research laboratory installation in which a wide range of corrosive chemicals are exhausted. Valve bodies and all components within the air stream shall be manufactured from phenolic coated metal or stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the LCU in an accessible location in the designated laboratory room.

B. Provide an appropriately sized and fused 24 Vac transformer suitable for NEC Class II wiring and provide wiring to every device in the laboratory airflow control system that requires it. Refer to the Drawings for information on available power sources.

C. Provide, terminate and connect all required cables, including low voltage, line voltage, power wiring and communications cabling. Comply with requirements of Section 25 95 10 DDC EMS Basic Materials & I/F Devices for wiring standards.

D. Install all airflow control devices in the ductwork and connect all airflow control valve linkages.

E. Provide all reheat coils and transitions.

F. Provide insulation as required.

G. Provide each pressurization zone with either a dedicated, single-phase primary circuit or a secondary disconnect.

H. Provide all necessary electrical systems including conduit, wiring and associated accessories for the laboratory airflow control system. Use spare slots in the emergency power panel boards as the source of power for electrical equipment associated with the laboratory airflow control system. All electrical work performed under this Section shall comply with the requirements of Division 26 and the requirements of Section 25 95 00 DDC EMS General Requirements.

3.2 WALL TEMPERATURE SENSORS

A. Provide wall temperature sensors as necessary for temperature control in each laboratory zone. Provide expanding foam, or other sealant at the temperature sensor connection to the wall box. This sealant shall block airflow through the sensor due to the difference in pressure between the laboratory and the neighboring spaces.

3.3 COMMISSIONING

A. Commissioning: Comply with the requirements of Section 01 91 00 Commissioning, 23 08 00 Commissioning of HVAC and Section 25 08 00 Commissioning of DDC/EMS System.

B. Demonstration and Training: Comply with the requirements of Section 01 79 00 Demonstration and Training and Section 25 08 00 Commissioning of DDC/EMS System.

C. Operations and Maintenance: Comply with requirements in Division 01 Close out Submittal Requirements.

D. Testing:

1. The accuracy of the installed system will be verified with an independent on site test.

2. The installed airflow control system shall be 100 percent field tested in conformance with ASHRAE 110.

3. A qualified independent testing agency shall perform field testing on each hood. Coordinate testing with [Section 11 53 13, Laboratory Fume Hoods].

4. Test data shall be submitted for the University's Representative for review and approval before the installation is accepted.

END OF SECTION 25 95 05