# Suggested Specifications

## Antec Controls Laboratory Airflow Control System

### Division 23 – Heating, Ventilating, and Air Conditioning

### Section 23 09 00 – Instrumentation and Control for HVAC

The following specification is for a defined application. Antec Controls would be pleased to assist in developing a specification for your specific need.

## PART 1 - GENERAL

**1.01 Section Includes**

A. Laboratory Airflow Control System

**1.02 Related Requirements**

A. Section 01 30 00 – Administrative Requirements
B. Section 01 40 00 – Quality Requirements
C. Section 01 60 00 – Product Requirements
D. Section 01 74 19 – Construction/Demolition Waste Management and Disposal
E. Section 01 78 00 – Closeout Submittals
F. Section 01 79 00 – Demonstration and Training

**1.03 Reference Standards**

A. All referenced standards in this section pertain to the most recent publication thereof, including all addenda and errata.
B. AHRI 410 – Standard for Forced-Circulation Air-Cooling and Air-Heating Coils.
C. ASHRAE Standard 130 – Methods of Testing for Rating Ducted Air Terminal Units.
D. ISO 9001 – Quality Management Systems – Requirements.
E. ISO/IEC 17025 – General Requirements for the Competence of Testing and Calibration Laboratories
F. NEC – National Electric Code.
G. NIST – National Institute of Standards and Technology.
H. UL 916 – Standard for Energy Management Equipment.

**1.04 Administrative Requirements**

A. Pre-installation Meeting: The contractor shall conduct a pre-installation meeting prior to the start of the work of this section and requires attendance by all affected installers.

**1.05 Submittals**

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. Product Data shall be provided with data indicating configuration, general assembly, and materials used in fabrication, including catalog performance ratings that indicate air flow, static pressure, NC designation, electrical characteristics, and connection requirements.
C. Shop Drawings shall indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.
D. Certificates shall be issued to certify that the air coil capacities, pressure drops, and selection procedures meet or exceed specified requirements or coils are tested and rated in accordance with AHRI 410.
E. Manufacturer's Installation Instructions shall indicate support and hanging details, installation instructions, recommendations, and service clearances required.
F. Project Record Documents shall record actual locations of units and controls components and locations of access doors.
G. Operation and Maintenance Data shall include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.
H. Manufacturer’s warranty shall be submitted and ensure forms have been completed in Owner's name and registered with manufacturer.
I. Maintenance Materials shall be furnished for the Owner's use in maintenance of the project.
    1. See Section 01 60 00 - Product Requirements, for additional provisions.

**1.06 Warranty**

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
B. Provide 60 month manufacturer warranty from date of shipment for air terminal units, integral sound attenuators, integral heating coils, and integral controls.

## PART 2 – PRODUCTS

**2.01 Manufacturer**

A. Basis of Design: Antec Controls by Price
   1. Laboratory Air Control System

B. Acceptable Manufacturers:
   1. The plans and specifications for the Laboratory Airflow Control System (LACS) are based on systems and equipment manufactured by Antec Controls by Price.
   2. The laboratory airflow control system provider shall be an entity that designs, develops, manufactures and sells products and services to control the environment and airflow of critical spaces using a Quality Management System registered to ISO 9001.
   3. In strict accordance with this specification, alternative laboratory airflow control systems and equipment shall only be considered for approval provided that the equipment is equal in every respect to the operational characteristics, capacities and intent of control sequences specified herein. Approval to bid does not relieve the laboratory airflow control system supplier from complying with the minimum requirements or intent of this specification.
   4. The manufacturer shall possess a certification of accreditation by the National Voluntary Laboratory Accreditation Program (NVLAP) for calibration laboratories, in accordance with ISO/IEC 17025.
   5. Manufacturers submitting as alternate suppliers shall be in compliance with the Proposed Alternate Equipment described in Section 2.01C.
   6. Other acceptable manufacturers can be submitted provided they meet the specifications.
   7. The engineer and owner shall be the sole judges of quality and equivalence of equipment, materials, methods and life cycle cost.
   8. Only those systems specifically named in this specification or by addendum shall be considered for approval. Other systems submitted after the bid opening shall be returned without review.

C. Proposed Alternate Equipment
   1. Equipment:
      a. The laboratory airflow control system supplier shall provide a detailed proposal describing all elements of the laboratory control system. A schematic laboratory layout shall be provided, showing relations of these elements and a description of how they interact.
      b. Technical specification data sheets shall be provided for all proposed system components and devices.
      c. All proposed airflow control devices shall include discharge, exhaust and radiated sound power level performance obtained from testing in accordance with ASHRAE 130.
   2. Performance Verification:
      a. The laboratory airflow control system supplier shall demonstrate a typical laboratory space that includes multiple fume hoods, a general exhaust and a supply airflow control device for the purpose of verifying the laboratory airflow control system's ability to meet the performance requirements indicated in this specification.
      b. All travel and lodging costs to witness the performance verification shall be the responsibility of the laboratory airflow control system supplier.

D. Compliance Schedule:
   1. Any alternate laboratory airflow control system supplier shall provide a separate compliance schedule, which shall include the section, paragraph and subparagraph of these specifications, and a direct statement to indicate compliance or noncompliance with the requirements. For all areas of noncompliance, the supplier shall describe what specific and alternative approach has been taken and document the impact this will have on the sizing of the air delivery systems, the required cooling and heating capacities, energy costs and maintenance of the building.
   2. The alternate laboratory airflow control system supplier shall furnish a letter of compliance to the engineer, signed by a corporate officer of the laboratory system manufacturer, certifying the compliance and noncompliance items as stated above 10 days prior to the bid.

**2.02 Laboratory Air Control System**

A. General:
   1. The Laboratory Airflow Control System (LACS) shall be pressure independent and be furnished and installed to control the laboratory environment.

B. Performance Requirements:
   1. The exhaust flow rate of a laboratory fume hood shall be controlled precisely to maintain a constant average face velocity into the fume hood.
   2. The laboratory control system shall vary the amount of make-up/supply air into 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.
   3. The LACS system shall be direct digital control (DDC) type.
   4. Each laboratory shall have a dedicated LACS system. The LACS system shall be independent and standalone from the building automation system.

5. The LACS shall be capable of operating as a standalone system, and as a system integrated with the Building Management System (BMS) directly through BACnet without the use of field servers or gateway devices.
6. The system shall not use or rely on information from controllers in other laboratory areas or from outside laboratory space to control functions within its laboratory.
7. The calibration laboratory shall measure volumetric flow rate with the following calibration accuracy, in accordance with the scope of accreditation to ISO/IEC 17025:
   a. 30 standard cubic feet per minute to 100 standard cubic feet per minute shall have 4.0 percent expanded uncertainty.
   b. 100 standard cubic feet per minute to 250 standard cubic feet per minute shall have 2.5 percent expanded uncertainty.
   c. 250 standard cubic feet per minute to 4200 standard cubic feet per minute shall have 1.4 percent expanded uncertainty.

C. Airflow Control Device – General:
1. See specification section 23 XX XX Airflow Control Devices – Venturi Valve
2. See specification section 23 XX XX Airflow Control Devices – Venturi FX Valve

D. Actuation:
1. See specification section 23 XX XX Airflow Control Devices – Venturi Valve
2. See specification section 23 XX XX Airflow Control Devices – Venturi FX Valve

E. Fume Hood Control Device – General
1. The fume hood control device shall be a 4.3 inch thin-film-transistor (TFT), dimmable, full color touchscreen display.
2. The fume hood control device shall be capable of displaying face velocity, face velocity setpoint, alarm status, alarm reason, valve airflow, valve differential pressure, mode of operation, sash position(when the sash position control method is used, See Section F) and face velocity control method.
3. The device shall utilize a password protected menu format to permit access to user settings.
4. The device shall have two binary outputs
5. The device shall have four universal inputs that can be configured as:
   a. Binary input (contact closure or active)
   b. Analog input (0 – 10 VDC)
   c. Resistance input – sash position (0 – 50 kOhm)
6. The device shall communicate with all other room level controls via a high-speed network. The device shall also have native BACnet capability to allow communication with building level networks.
7. The fume hood control device shall be capable of operating in up to 4 user defined modes. Each mode shall be fully customizable. Adjustable settings include, but are not limited to:
   a. Mode name
   b. Face velocity target
   c. Airflow setpoint
   d. Alarm types and setpoints
   e. Background color
8. The device shall have a physical push button to mute audible alarms in any mode.
9. The device shall have a physical button that is configured to engage an “Emergency Mode”.
10. The fume hood control device shall interface to the air valve that is serving the fume hood.

F. VAV fume hood face velocity control:
1. Each fume hood to be equipped with a fume hood controller to control fume hood average face velocity at the desired (adjustable) setpoint.
2. Control type:
   a. Sash position control: The fume hood controller shall employ a sash sensor that will measure the height of each vertical moving fume hood sash. The controller shall continually measure the fume hood’s total open area to determine the fume hood exhaust air flow required to maintain the average face velocity set point. Fume hoods utilizing vertical fume hood sashes shall employ the sash position control method.
   b. Sidewall control: The fume hood controller shall employ a sidewall velocity sensor to measure the fume hoods face velocity. The exhaust air flow shall be modulated to maintain the average face velocity setpoint. The response of the sidewall control method on each fume hood shall be tuned for speed and stability to meet the laboratory’s performance requirement.
   c. Hybrid control: The fume hood controller shall employ both a sash sensor to measure the height of each vertical moving fume hood sash, and a sidewall velocity sensor to measure the fume hoods face velocity. Upon movement of the fume hood sash the controller shall measure the fume hood’s total open area to determine the fume hood exhaust air flow required to maintain the average face velocity setpoint. Once the calculated air flow target has been achieved, the fume hood controller shall adjust the exhaust volume until the hood’s measured face velocity matches the average face velocity setpoint. The response of the hybrid control method on each fume hood shall be tuned for speed and stability to meet the laboratory’s performance requirement.
   d. Hoods utilizing combination vertical fume hood sashes with overlapping horizontal sash panes shall employ the sidewall or hybrid control method.
3. The fume hood speed of response shall be measured in accordance with ANSI Z9.5.
   a. A response time of less than 3 seconds after the completion of sash movement is considered acceptable for most operations.

   b. The speed of response shall be defined as the time between the completion of sash movement and the achievement of 90% of the target airflow or face velocity.
   c. The rate of sash movement shall be from 1.0 to 1.5 feet per second.
4. Where mechanically pressure independent venturi air valves (See section 23 XX XX) are used with sash position control, a response time of less than 1 second after completion of sash movement is considered acceptable.
5. The fume hood controller shall maintain a minimum hood exhaust air flow (adjustable) based on fume hood manufacturer requirements. The minimum airflow shall be maintained whenever the fume hood exhaust air flow required for maintaining average face velocity is lower than the minimum hood requirements.
6. Presence Sensor [**Optional**]: The fume hood controller shall include an operator presence sensor. When no operator is present at the hood for an adjustable time interval, the fume hood shall automatically adjust to a lower average face velocity setpoint.

G. Room ventilation, pressurization, supply and general exhaust control:
1. The LACS shall use volumetric offset control to maintain room pressurization. The system shall maintain proper room pressurization polarity (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 achieving room pressurization control using differential pressure measurement are unacceptable.
2. The LACS shall continuously gather the airflow values from up to 12 total devices including fume hood controllers in the laboratory, as well as any miscellaneous process exhaust airflows.
3. The laboratory control system shall vary the amount of make-up/supply air into 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.
4. The LACS shall continuously calculate the difference between the total exhaust airflow and the total supply airflow in the laboratory. The general exhaust valve shall modulate to maintain the room volumetric offset setpoint.
5. As fume hoods or miscellaneous exhaust airflows are increased beyond the ability of the general exhaust valve to maintain the room offset, the LACS shall increase the make-up/supply air volume into the space above the minimum required for ventilation rate and temperature control.
6. As fume hood or miscellaneous exhaust airflows are decreased beyond the ability of the general exhaust valve to maintain room offset, the LACS shall decrease the make-up/supply air volume into the space below the current room temperature control requirement. Room pressurization control takes precedence over room temperature control.

H. Room temperature control:
1. The LACS shall maintain the room temperature at set point by varying the supply airflow (if applicable) and supply air temperature. Supply air temperature shall be varied by modulating a reheat coil.
2. Upon a call for heating, the make-up/supply air volume shall target the minimum airflow allowed by the room air change rate and current fume hood/miscellaneous exhaust rate. The reheat valve shall modulate to maintain the room setpoint while ensuring that the supply air temperature stays within specified limits.
3. Upon a call for cooling, the make-up/supply air volume shall increase toward the maximum cooling airflow target to bring the room air temperature down to the room temperature setpoint. The reheat valve shall close.
4. While the room setpoint temperature is satisfied the make-up/supply air volume shall target the minimum airflow allowed by the room air change rate and current fume hood/miscellaneous exhaust rate. The reheat valve shall modulate to maintain the room setpoint.
5. The temperature control algorithm shall be tunable to ensure thermal comfort is maintained.

I. Occupancy Control:
1. The LACS shall have the ability to change the minimum ventilation and temperature control set points, based on the occupied state, in order to reduce energy consumption when the space is not occupied.
2. The occupancy state may be set by either the BMS as a scheduled event or through the use of a local occupancy sensor.
   a. Any BMS command shall be given priority over a local occupancy sensor
3. While in unoccupied mode and the room temperature is between the unoccupied heating and cooling room temperature setpoints, the make-up/supply air volume shall be reduced to the minimum unoccupied target. The reheat valve shall be closed.
4. If the room temperature increases above the unoccupied cooling setpoint or decreases below the unoccupied heating setpoint, the make-up/supply air volume shall increase to the occupied heating/cooling targets and the reheat valve modulated as required. Once the room temperature is brought back to within the unoccupied heating/cooling setpoints, the supply air volume is once again reduced to the minimum unoccupied target and the reheat valve closed.

J. Start-up, Integration into building management system:
1. The entire LACS shall be configured from a single access point. Each fume hood controller shall be available as an access point. Where fume hood controllers are not present a remotely mounted access point shall be installed. Systems that rely on users to start up each room control device and fume hood control device from separate access points are not permitted.
2. The LACS shall be native BACnet for integration into the building management system.
3. No protocol conversion gateway devices are acceptable for interfacing with a BACnet building-level network.
4. The LACS shall employ a room-level network to ensure that loss of BMS communication does not affect the room airflow control or result in a loss of room pressure.
5. A native BACnet MS/TP connection is to be provided for each space.

# Suggested Specifications

K. Certification:
   1. Each airflow control device shall be factory calibrated to the job specific airflows as detailed on the plans and specifications using NIST traceable air stations and instrumentation having a combined accuracy of no more than plus or minus one percent of signal over the entire range of measurement.
   2. Each airflow control device shall be marked with device-specific factory calibration data. At a minimum, it should include the tag number, serial number, model number, characterization information (for electronic devices), and quality control inspection numbers. All information shall be stored by the manufacturer for use with as-built documentation.

L. Humidity monitoring (**optional**):
   1. The LACS thermostat shall be provided with an embedded humidity sensor. The humidity reading shall be made available to the BMS system for monitoring and/or air handler humidity control.

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M. Room Pressure Monitoring (**optional**):
   1. The LACS shall be provided with a room pressure sensor.
   2. The room pressure shall be monitored at all times with reference to the adjacent space.
   3. The room pressure reading shall be available to the BMS system.

## PART 3 – EXECUTION

**3.01 Examination**

A. Verify that conditions are suitable for installation.
B. Verify that field measurements are as shown on the drawings.

**3.02 Installation**

A. All temperature control wiring required for a complete and operating system, as herein specified, shall be furnished and installed by the temperature control contractor unless specifically shown on the electrical drawings.
B. The term “wiring” shall be construed to include the use of conduit, wire, miscellaneous materials and labor, as required for installation and connection of the electrical control devices furnished as part of the control system or furnished by equipment suppliers.
C. This wiring shall include all electrical connections required as specified in the sequence of operation. All devices and wiring required for interlocking HVAC equipment as specified in the sequence of operation shall be furnished by the temperature control contractor.
D. All line and low voltage wiring materials and installation covered by this Section shall be in accordance with the latest revision of the National Electric Code and applicable local codes and shall carry the UL label where applicable.
E. The Automatic Temperature Controls (ATC) contractor shall install the sash sensors, sidewall sensors, presence and motion sensor, and fume hood monitor on the fume hood under initial supervision of the laboratory airflow control system supplier. Reel-type sash sensors and their stainless steel cables shall be hidden from view.
F. The ATC contractor shall install all routers and repeaters in an accessible location in or around the designated laboratory room.
G. The ATC contractor shall install appropriately sized and fused 24 VAC transformers suitable for NEC Class II wiring.
H. All cables shall be furnished and installed by the ATC contractor. The ATC contractor shall terminate and connect all cables as required. The ATC contractor shall utilize cables specifically recommended by the laboratory airflow controls supplier.
I. The mechanical contractor shall install all airflow control devices in the ductwork.
J. The mechanical contractor shall provide and install all reheat coils and transitions that are not integral to the venturi air valves.
K. The mechanical contractor shall provide and install insulation as required.
L. Each pressurization zone shall have either a dedicated, single-phase primary circuit or a secondary circuit disconnect.

**3.03 System Start-up and Training**

A. System start-up shall be provided by a factory trained and authorized representative of the LACS manufacturer. Start-up shall include calibrating the fume hood control device and any combination sash position/sidewall sensing equipment, as required. Start-up shall also provide electronic verification of airflow (fume hood exhaust, supply, make-up, general exhaust or return), system programming and integration to BMS (when applicable).
B. The balancing contractor shall be responsible for final verification and reporting of all airflows. The factory trained and authorized representative of the LACS manufacturer shall be on hand to assist the balancing contractor in adjusting any airflow or velocity readings as required.
C. The LACS supplier shall furnish a minimum of four hours of owner training by factory trained and certified personnel. The training shall provide an overview of the job specific airflow control components, verification of initial fume hood monitor calibration, general procedures for verifying airflows of air valves and general troubleshooting procedures.
D. Operation and maintenance manuals, including as-built wiring diagrams and component lists, shall be provided for each trainee.

**3.04 Field Quality Control**

A. See Section 01 40 00 - Quality Requirements, for additional quality requirements.

**3.05 Cleaning**

A. See Section 01 74 19 - Construction Waste Management and Disposal for additional cleaning requirements.

**3.06 Closeout Activities**

A. See Section 01 78 00 - Closeout Submittals for closeout submittals.
B. See Section 01 79 00 - Demonstration and Training for additional closeout requirements.

END OF SECTION 23 09 00