

University of Houston Master Specification

<Insert Project Name>
<Insert U of H Proj #>

<Insert Issue Name>
<Insert Issue Date>

SECTION 25 0910 - LABORATORY AIRFLOW CONTROLS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

This Section uses the term "Engineer." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

Delete hidden text after this Section has been edited for the Project.

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
 - 1. The current version of the *Uniform General Conditions for Construction Contracts*, State of Texas, available on the web site of the Texas Facilities Commission.
 - 2. The University of Houston's *Supplemental General Conditions and Special Conditions for Construction*.

1.2 DESCRIPTION OF WORK

- A. Provide engineering, documentation, materials, equipment, components, installation, supervision, calibration, software programming, and checkout for a complete and operational Laboratory Control System (LCS).

1.3 QUALITY ASSURANCE

- A. Laboratory airflow controls shall be manufactured by a certified Laboratory air flow vendor of lab system controls and installed by their local representative. All valves shall be Venturi-style without the use of flow measurement for accuracy, speed of response, and reliability of accurate air flow.
- B. Products and system specially designed and marketed for laboratory applications with not less than 10 years of past project installations of comparable size and complexity to this Project.

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 1

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

- C. Required Certifications for Quality Assurance Purposes:
1. Provide manufacturers and independent test lab certification of test results, signed by an authorized officer of the company. The laboratory airflow 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.
- D. Preparation: Laboratory airflow control products to be clean and free of all foreign matter prior to shipping. Units and associated equipment such as controls, shall be packaged in a manner to prevent dust and other foreign matter from entering the unit, controls, and similar items during shipment. All external controls, operators, and sensors shall be covered by rigid metal shields during shipment and storage.
- E. Performance Verification: The laboratory airflow control system supplier shall demonstrate a typical laboratory space within 150 miles that includes multiple fume hoods, a general exhaust, and a supply airflow control device to verify the laboratory airflow control system's ability to meet the project performance requirements. This demonstration shall be done after project is awarded and prior to submitting submittals for review.
1. If a visit is required, all travel and lodging costs to witness the performance verification shall be the responsibility of the laboratory airflow control system supplier for the Engineer and two Owner Representatives.

[Confirm requirements with UH project manager.](#)

- F. Preventive Maintenance: The laboratory airflow control system supplier shall provide at no additional cost to the Owner during and after the Warranty Period, five years of preventive maintenance on all airflow sensors (e.g., pitot tube, flow cross, orifice ring, air bar, hot wire, vortex shedder, side wall sensors, etc.), and flow transducers provided under this Section. Airflow sensors shall be removed, inspected, and cleaned [**quarterly**] during the five year period to prevent inaccuracies due to long term buildup from corrosion, lab tissues, wet or sticky particles, or other materials that foul the sensor. If impractical to remove the airflow sensors, the laboratory airflow control system supplier shall include in the proposal the cost of supplying and installing duct access doors, one for each sensor. The transducer shall be checked and recalibrated annually to insure long-term accuracy. Note that auto-zero recalibration of transducers is not acceptable as a substitute for annual recalibration.
- G. Warranty Period: Warranty shall commence upon the date of Substantial Completion and extend for a period of 24 months whereupon any defects in materials or laboratory airflow control system performance shall be repaired by the supplier at no cost to the Owner.

1.4 SUBMITTALS

- A. All submittals under this section must be approved in writing by the Owner as part of the formal submittal approval process. Submittals shall include, but not be limited to, the following:

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 2

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

1. The laboratory airflow control system supplier shall provide a detailed proposal describing all elements of the laboratory control system. A schematic layout shall be provided, showing relations of these elements and a description of how they interact.
2. The laboratory airflow control system manufacturer shall submit a compliance schedule, which shall include each section, paragraph and subparagraph of the specifications, and a direct statement to indicate compliance or noncompliance. For all areas of noncompliance, describe what specific alternative approaches have been taken and document the impact the alternative approaches will have on the sizing, sequence, maintenance, or energy costs of the building.
3. Technical specification data sheets shall be provided for all proposed system components and devices.
4. Cut sheets on all laboratory airflow controls, clearly marked to show sizes, configuration, construction, unique features, controls, clearances, accessories, performance data, sound data, operating sequence and other pertinent information.
5. Air valve curves or charts that clearly show air valve performance, including air flow sensor calibration curves.
6. Performance characteristics for each terminal unit.
 - a. All proposed airflow control devices shall include discharge, exhaust, and radiated sound power level performance obtained from testing in accordance with ARI Standard 880.
 - b. Wiring and control diagrams.
 - c. Copies of factory-certified sound, leakage and performance test results from actual tests of units of the same model and construction to those which will be provided for the project.
 - d. Written report of the test results including noise criteria (NC) in sound power as tested in reverberant room with terminal unit operating at the scheduled airflow. When reporting NC levels, no credits or reduction shall in any way be considered for room, plenum, ceiling, and similar item effects.
 - e. Certified dimensioned drawings showing the locations of all openings, support points, connections, sizes for same, overall dimensions of all boxes and any other pertinent information that may affect the installation of the boxes.
7. Submit the following certified performance data for each size and type of terminal unit to be used on the project:
 - a. Maximum and minimum cfm ratings at design inlet and discharge static pressure.
 - b. Pressure drop through each terminal unit at 25%, 50% and 100% of design cfm.
 - c. Pressure drop through terminal unit and heating coil at design heating and design cooling airflows.
8. Product warranties and guarantees.
9. Additional information as required in Section 25 0000 "Building Management Systems (BMS) General."

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 3

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

- A. Deliver laboratory airflow control systems in bulk containers or factory-fabricated water-resistant packaging.
- B. Handle laboratory airflow control systems carefully to avoid damage to components, enclosures, and finish.
- C. Store laboratory airflow control systems in a clean, dry space and protect from weather until delivery to the site or to the designated contractor.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Refer to Section 25 0000 "Building Management Systems (BMS) General" for a list of acceptable manufacturers.
- B. Only those systems specifically named in this specification shall be considered for approval.
- C. No substitutions are permitted.
- D. The final acceptance of a LCS shall rest solely with the Owner. The LCS Vendor is required to have the Owner's written acceptance of the submitted LCS, which will be based upon best overall value, taking into account total life cycle costs, energy usage, low maintenance, accuracy, and overall safety for the end users and their staff. An approval to bid does not relieve the LCS Vendor from complying with the specification requirements.

2.2 LABORATORY CONTROLS

- A. System Description: Provide a Laboratory Airflow Control System (LCS) to control variable airflow into and out of laboratory rooms. The exhaust flow rate of a laboratory fume hood shall be precisely controlled to maintain a constant average face velocity into the fume hood. The laboratory control system shall vary the amount of makeup/supply air into the room to operate the rooms 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 be capable of operating as a stand-alone system and as a system integrated with the Building Management System (BMS).

Be sure to schedule all applicable airflow setpoints (design, minimum occupied, unoccupied, etc.)

- B. Control Protocol: Each room in the suite shall be operated as a variable volume occupied/unoccupied mode system with room pressurization via supply/exhaust offset as shown on the drawings. Unoccupied mode shall reduce the room supply air volume to the scheduled value while maintaining pressure control offsets. The unoccupied mode shall be implemented

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 4

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

based on occupancy status either by time of day scheduling or occupancy sensors through the BMS system.

Coordinate with electrical.

- C. Airflow Device Actuation: Airflow device actuation shall be DDC modulated electric actuation. Electrical power shall be supplied from the building [120] volt power supply.
- D. Airflow Device: Airflow device is to be a Venturi-style air valve. Air valves shall be installed to allow for maintenance. Refer to manufacturer's installation instructions for minimum clearance requirements. At minimum, provide three feet clear on side of air valve with controller.
- E. Each room shall have a dedicated network and controller as part of the building-wide LCS. Each room or suite network shall support a minimum of twenty (20) network-controlled airflow devices.
- F. There shall be no reliance on external or building-level control devices to perform room-level control functions. Each LCS shall have the capability of performing fume hood control, pressurization control, temperature control, humidity control, and implementing occupancy and emergency-mode control schemes.
- G. The LCS 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 face velocity over the scheduled airflow range for each fume hood. Generally, the corresponding minimum hood exhaust flow turndown ratio shall be at minimum 5 to 1.
- H. The hood exhaust airflow control device shall respond to the fume hood sash opening by achieving 90% of its commanded value within one second of the sash reaching 90% of its final position (with no more than 5% overshoot/ undershoot) of required airflow. Rate of sash movement shall be between 1.0 to 1.5 feet per second.
- I. The LCS shall maintain specific airflow ($\pm 5\%$ of signal within one second of a change in duct static pressure) regardless of the magnitude of the pressure change airflow change or quantity of airflow control devices on the manifold (within 0.6" to 3.0" wk.)
- J. The LCS 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 using differential pressure measurement or velocity measurement to control room pressurization are unacceptable.
- K. The LCS shall maintain specific airflow with a minimum 10 to 1 turndown while maintaining 5% of measured flow to ensure accurate pressurization at low airflow and guarantee the maximum system diversity and energy efficiency.

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 5

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

- L. Control Accuracy of LCS: Unless more stringent requirements are indicated, accuracy shall meet the following end to end overall system accuracy, including errors associated with the sensor, transmitter, lead wire, and analog to digital converter.
 - 1. Temperature:
 - a. Air system: Within 0.5 degree F.
 - b. Space: Within 1.0 degree F.
 - 2. Relative Humidity: Within 2 percent RH.
 - 3. Airflow: Within 5 percent of design flow rate.
 - 4. Space Pressure: Within 0.5 percent of design setpoint.

- M. Systems Speed: System communication speed and response time at the time of LCS acceptance:
 - 1. Values of analog and digital points connected to the LCS shall be updated at least every 2 seconds.
 - 2. Values of analog and digital points connected to the LCS shall be updated and displayed at least every 10 seconds.
 - 3. Alarms of analog and digital points connected to the LCS shall be displayed within 2 seconds of activation or change of state.
 - 4. Performance indicated shall be through laptop computer connected to the LCS network and/or the BMS.

- N. Reliability: Design, install and configure the LCS to yield a mean time between failure (MTBF) of at least 40,000 hours based on a confidence level of at least 90 percent. The MTBF value shall include any failure for any reason to any part of the LCS. Provide control system redundancy to maintain the system and equipment that is being controlled operational and under automatic control in the event of a failure.

- O. Interface to Building Management System (BMS):
 - 1. Provide a LCS control panel for each room being controlled by the LCS.
 - 2. The LCS shall digitally interface with the BMS.
 - 3. All points of the LCS shall be monitored through the BMS. All analog points shall be trended and shared with the BMS. The LCS shall maintain a cache of all points to be monitored by the BMS. The LCS shall continuously update the cache.
 - 4. Point naming shall comply with Section 25 1500 "BMS Software and Programming".

2.3 AIR VALVE SOUND SPECIFICATIONS

[Edit sound data to suit project.](#)

- A. The air valve shall not exceed the radiated sound power levels (decibels) indicated on the Drawings, or below, when tested in accordance with ARI-880 or ASHRAE 130 while operating at maximum scheduled airflow with a static pressure drop across the valve of 2 inches w.c.

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 6

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert U of H Proj #>

<Insert Issue Name>

<Insert Issue Date>

1. 125 Hz: 58
2. 250 Hz: 61
3. 500 Hz: 59
4. 1000 Hz: 57
5. 2000 Hz: 56
6. 4000 Hz: 50

- B. The air valve shall not exceed the discharge sound power levels (decibels) indicated below when tested in accordance with ARI-880 or ASHRAE 130 while operating at maximum scheduled airflow with a static pressure drop across the valve of 2 inches w.c.

1. 125 Hz: 75
2. 250 Hz: 74
3. 500 Hz: 70
4. 1000 Hz: 75
5. 2000 Hz: 69
6. 4000 Hz: 65

- C. If the air valve cannot meet the sound performance, retrofit the air valve and/or duct distribution with sound attenuation to achieve the sound levels indicated. Provide independent laboratory sound testing and report to validate the performance.

2.4 MATERIALS

- A. General: Provide LCSs using standard materials and components designed and constructed as recommended by the system manufacturer and as required for a complete installation in compliance with these Specifications.

- B. Control Calibration:

1. Each airflow control device shall be factory calibrated to the scheduled airflow. Refer to the Drawings for airflows. Each factory calibrated control/measuring device shall be electronically calibrated/characterized at the factory. Calibration shall be included in the product cost or related labor hours. No device shall be installed without verification or certification of accuracy or airflow measurement calibration.

- C. A final field verification of accuracy and control stability shall be made by the balancing contractor where so directed by the Owner. Accuracy and performance shall be guaranteed as specified, irrespective of field conditions and device inlet conditions.

- D. Each air valve shall be individually marked with valve specific factory calibration data by the equipment supplier. At a minimum, data shall include valve tag number, serial or unit number, model number, valve characterization information or field test results, and quality control inspection numbers.

- E. A final calibration list (electronic data format) of all settings and test results, in MS Excel format, shall be provided to the Owner.

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 7

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

2.5 AIRFLOW CONTROL DEVICES - GENERAL

- A. The airflow control device shall be pressure independent over its specified differential static pressure operating range. An integral pressure independent assembly shall respond and maintain specific airflow within one second of a change in duct static pressure irrespective of the magnitude of pressure and/or flow change or quantity of airflow controllers on a manifolded system.
- B. The manufacturer shall provide comprehensive leakage charts generated from ASME N510 pressure decay testing. Standard shut-off devices shall be tested up to and including 5" WC static pressure. Low-leakage shut-off devices shall be tested up to and including 30" WC static pressure.
- C. The airflow control device shall maintain accuracy within $\pm 5\%$ of signal over the design airflow range without exceeding 2200 FPM velocity through any airflow device and have no deviation or loss of accuracy through the entire range of the flow device.

[Edit leakage requirements if more stringent leakage requirements are needed.](#)

- D. Valves shall comply with the following minimum leakage requirements.
 - 1. Casing leakage: When operating at a static pressure of 4 inches w.c. the maximum leakage through casing penetrations shall not exceed one cubic foot per minute (CFM).
 - 2. Shut-off leakage: When operating at a static pressure of 4 inches w.c. the maximum leakage across the valve (inlet/discharge) for sizes through 12 inches shall not exceed 5 CFM.
 - 3. No minimum entrance or exit duct diameters shall be required to ensure accuracy and/or pressure independence.
- E. Pressure independent airflow control shall be maintained during power failure.
- F. Unless otherwise noted, valves shall be provided with flanged duct connections.
- G. Provide each air valve with a factory installed pressure differential switch to detect low operating pressure across each air valve. Switch shall signal the LCS of an alarm condition when pressure drops below allowable limits. The pressure setpoint shall be adjustable.
- H. Air valves shall be suitable for operation in multiple orientations (horizontal, vertical up, vertical down). For valves that cannot operate in multiple orientations as standard from the factory provide reorientation kits that will allow for field modification of the valve for other orientations.

[Air Valve Schedule shall clearly indicate the construction class for each air valve.](#)

- I. The airflow control device shall be constructed of one of the following four types:

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 8

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

1. **Class A** – Aluminum [**or galvanized steel**] body with stainless steel or aluminum shaft and linkage. All shaft bearing surfaces shall be made of a Teflon, or polyester, or PPS (polyphenylene sulfide) composite.
 2. **Class B** – Aluminum [**or stainless steel**] body with baked-on corrosion resistant phenolic coating. Type 316 or 303 stainless steel shaft, linkage, spring pivot arm and internal mounting link. The internal nuts, bolts and rivets shall be stainless steel. All shaft bearing surfaces shall be made of a Teflon or PPS (polyphenylene sulfide) composite.
 3. **Class C** – Constructed as defined for Class B and, in addition, shall have no exposed aluminum or stainless steel components and have a baked-on corrosion resistant phenolic coating. Shaft, shaft support brackets, springs, pivot arm, internal mounting link, and pressure independent springs shall have a baked-on corrosion resistant phenolic coating. The internal nuts, bolts, and rivets shall be titanium or phenolic coated stainless steel.
 4. **Class D** – Constructed as defined for Class B and, in addition, shall have no exposed aluminum or stainless steel components and have a PVDF liner that covers all metal parts. The internal nuts, bolts, and rivets shall be titanium or PVDF coated stainless steel.
- J. Sound attenuating devices shall be constructed of the same material as the air valve that the sound attenuating device is connected to. No sound absorptive materials of any kind shall be used.
- K. For corrosive applications, 304 Stainless steel materials are not acceptable.

[Coordinate requirement with UH project manager and UH EHS.](#)

- L. An electric actuator shall be factory mounted to the valve. Loss of control power shall cause normally open valves to fail to maximum position, normally closed valves to fail to minimum position and fail-to-last valves to fail to last known position and to stay at last position until issue is resolved. **[Actuators that fail in last position are not acceptable when used in fume hood and make-up air control applications.]**
- M. Certification: Requirements to ensure Quality Assurance for Critical Airflow Devices
1. Factory calibrate each new air valve to the job specific airflows as detailed on the Drawings using NIST traceable air stations and instrumentation having a combined accuracy within one percent of signal over the entire range of measurement. Electronic airflow control devices shall be further calibrated and their accuracy verified to within 5 percent of signal at a minimum of forty-eight different airflows across the full operating range of the device.
 2. Air valves shall be individually marked with device specific, factory calibration data. At 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 stored by the manufacturer for use with as built documentation.
 3. Provide manufacturers and independent test lab certification of test results, signed by an authorized officer of the company. The LCS provider shall be an entity that designs, develops, manufactures, and sells products and service to control the environment and airflow of critical spaces using a Quality Management System registered to ISO: 9001.

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 9

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

Verify if 100% shut-off air valves are required. Not all air valves are able to be 100% shut-off. If not required, remove from specifications.

N. 100% Shut-off Air Valves

1. The air valve shall have an option for 100% shut-off capabilities.
2. 100% Shut-off confirmation is available through a local digital output or an integrated point. The 100% shut-off confirmation is required by positive position verification. Airflow readings for 100% shut off conditions are not acceptable.
3. 100% Shut-off sequence can be initiated through a universal input or remotely via the local area network from the BMS or a local controller connected to the LCS.
4. 100% shut-off valves shall meet the following leakage requirements:
 - a. Casing leakage: When operating at a static pressure of 5 inches w.c. the maximum leakage through casing penetrations shall not exceed 0.07 cubic foot per minute (CFM).
 - b. Shut-off leakage: When operating at a static pressure of 5 inches w.c. the maximum leakage across the valve (inlet/discharge) for sizes through 12 inches shall not exceed 0.01 CFM.

2.6 FUME HOOD DISPLAY

A. General

1. The laboratory control system manufacturer shall supply a fume hood control system to directly measure the area of the fume hood sash opening. The measured sash area shall proportionally control the hood's exhaust airflow in a variable volume mode to maintain a constant face velocity. Hood airflow shall be varied to maintain a constant face velocity over no less than a 5 to 1 change in the sash open area (change in sash position).
2. Fume hood control system shall respond to and maintain the face velocity set point to ensure fume hood containment. Response time shall be less than one second with no more than a 5% of set point overshoot and undershoot when the sash is raised or closed. Sash raise time for this test shall be one second with a 5 to 1 change in sash area.
3. An approved horizontal and/or vertical sash sensor shall be provided by the lab system supplier as an integral part of the lab air volume control system (single source responsibility) to measure the height of each vertically and/or horizontally moving fume hood sash. The sash sensor shall be an approved method of sash position sensing that has a proven application history. Through-wall pressure sensors for a means of control are not acceptable.
4. A fume hood monitor shall be provided to receive the sash opening signals from the vertical and/or horizontal sash sensors. The monitor shall compute the total open sash area and output an exhaust airflow control signal to the appropriate volume control device (valve) to maintain a constant face velocity.
5. The fume hood monitor shall modulate the airflow in response to the sash opening signals from the vertical sash sensors between closed and 18 inches open or the stop set point. Above the stop set point, the exhaust valve shall maintain a constant airflow and allow the face velocity to reduce proportionately to the face opening.

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 10

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

6. Fume hood monitor shall contain a visual and audible alarm to indicate a low face velocity. Muting of the alarm shall only silence the audible portion, while the visual alarm shall be maintained until the low flow condition has returned to normal. Alarm shall be triggered by:
 7. A push button switch shall be provided to mute the audible alarms. The mute mode is automatically reset when the alarm condition ceases.
 8. In labs without fume hoods, a lab emergency push button (equipment and control option) may be installed at the exit to the lab. Switch shall activate all exhaust and supply valves causing the exhaust and supply system to flush the lab and sound an audible alarm to signal lab emergency condition.
- B. The fume hood display screen shall support input configurations for fume hood operational parameters done at the touch panel and at a minimum include:
 1. Sash Dimensions
 2. Hood ID
 3. Hood Certification Reminder
 4. Hood Occupancy Status
 5. Stopwatch Timer
 6. Message display
- C. The enclosure shall be made from material that is resistant to chemicals that are typically used in the lab for wipe down and general cleaning agents. At minimum the unit's exposed surfaces shall be chemically resistant to vaporized hydrogen peroxide (VHP), formaldehyde, chloride dioxide, Perchloric acid, sodium, hypochlorite 3-6% bleach, and quaternary ammonium 7% in 1:128 tap water (ammonia).
- D. Two mechanical membrane buttons shall be provided at the front panel of the display to enable users to quickly activate emergency mode and mute without having to remove protective gloves.
- E. Timer feature shall be provided to enable users to set specific time to time the durations of experiments and provide visual and audible alarms when the set time is expired.
- F. The fume hood display shall have the ability to receive a **[digital]** signal from other devices. The signal shall only be for monitoring and alarm capabilities.
- G. Power shall be 24VAC +/- 15% at 10VA, 60 Hz.
- H. Configuration
 1. Configuration shall be performed from the touch display, user interface keypad and/or manufacturer's software tools
 2. The device shall display fume hood performance data based on control logics embedded inside the valve controller.

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 11

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>
<Insert U of H Proj #>

<Insert Issue Name>
<Insert Issue Date>

I. Information Display

1. This device shall have the ability to show when the fume hood face velocity is within the normal operating range, energy saving mode, hood certification, hood ID, and hood occupancy status. The device shall be configurable to display one of the following measurement units: cubic feet per minute (CFM) or feet per minute (FPM).
2. This device shall have the ability to display system errors caused by airflow or sash travel malfunctions.
3. This device shall have the ability to show when the hood is due for recertification and shall provide a visual notification at the LCD that that the hood is past certification.

J. Emergency (Purge) Exhaust

1. This device shall have a mechanical membrane button on the lower portion that, when pressed, will initiate an emergency (purge) exhaust mode in the associated fume hood valve.
2. Button shall be mechanical so that users with gloves can easily operate the emergency exhaust button.
3. The emergency (purge) exhaust mode, when initiated, will send the associated fume hood exhaust valve to either the maximum flow of the valve or other predetermined flow.

K. Alarms

1. This device shall have the ability to show alarms on the main screen using visual and audible alerts.
2. The main screen background color shall change to flashing red with text stating the type of alarm.
3. In the alarm state, the annunciator shall remain active until the event that triggered the alarm is removed or fixed.
4. The device shall have the ability to show DIVERSITY alarm for design strategies employing diversity.
 - a. Diversity alarms shall be generated by the LCS or by the BMS.
 - b. Audible alert for the diversity alarm will be generated at the monitor.
5. The device shall have customizable audible alarm levels and customizable mute durations.
6. Users shall have the ability to change the audible alerts to: Low, Medium, or High.
7. The device shall have Alarm Muting options, which silences the audible alarm for an adjustable time period when the mute button is pushed. If another alarm is generated during the mute period, the new alarm shall override the mute delay, and the alarm shall sound again.

[This section shall be reviewed by UH EHLS prior to design documentation.](#)

L. Energy Conservation

1. The device shall have the ability to enable Fume Hood Hibernation Mode.

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 12

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert U of H Proj #>

<Insert Issue Name>

<Insert Issue Date>

- a. When activated, the exhaust flow through the fume hood goes to the minimum allowed by the exhaust valve (or shut-off where available) when the sash is fully closed and no chemicals are present in the hood.
 - b. The mode shall be initiated by a sequence including entering menu and a password on the touch display, an external momentary switch input or network command via the BMS.
 - c. When activated, the LCD Display shall show “Hood in Hibernation” or similar text and the exhaust valve shall move to its minimum position or shut-off position if available.
 - d. Safety shall be built into the decommission option, whereby opening the fume hood sash shall automatically return the fume hood exhaust to an in-use operating volume as determined by the sash sensor. Fume hood hibernation shall be a point that can be integrated to the BMS.
2. The device shall provide night time energy waste alarming to generate a visual and audible alarm to notify when the fume hood sash is open beyond its minimum flow position and occupancy status is set to unoccupied either by time of day scheduling or an occupancy status.
- a. When activated, the LCD display shall show “Energy Waste Close Sash” or similar and the audible alarm shall sound until the sash is closed.
 - b. The light levels at which the alarm is both initiated and cancelled shall be configurable.

Confirm with UH project manager if the requirement below is desired for the project.

3. The device shall provide sash energy waste alarming, which generates a visual and audible alarm to notify when the fume hood sash is open beyond a configurable set position and no one is in front of the fume hood.
- a. When activated, the LCD display shall show “Energy Waste Close Sash” and the audible alarm shall sound until the sash is closed.

Confirm with UH project manager if the requirement below is desired for the project.

M. Security

1. Only end users shall have the ability to enable a PIN pass code to prevent unauthorized changes to sash heights, air flow settings and other editable parameters.

N. Compliance

1. The unit shall be certified as meeting regulatory compliance with CE, CUL, and RoHS.
2. The unit shall be suitable for use with non-solvent wipe down and is designed to meet IP44 test standards.
3. The device shall comply with part 15 of the FCC Rules. Operation is subject to the following two conditions:

<Insert A/E Name>

AE Project #: <Insert Project Number>

Laboratory Airflow Controls

UH Master: 05.2020

25 0910 – 13

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

- a. This device shall not cause harmful interference.
- b. This device shall accept any interference received, including interference that may cause undesired operation.

2.6 INDIVIDUAL ROOM AIRFLOW CONTROL UNITS

- A. Provide a room airflow control or control panel for each room to control the airflow pressurization of each individual room or laboratory. The room controller shall be panel mounted in the location shown on the Drawings to provide ease of maintenance. Room controllers shall allow for web-access and remote configuration per controlled room.
- B. If the room airflow controller fails by network failure or loss of power, the zone balance, temperature control, or fume hood devices shall be able to operate before failure and not lose control. The individual air valve controllers shall operate independently of the room airflow controller.

If humidity control is required, please specify.

- C. The room airflow controller shall be capable of implementing the Sequence of Operations from the Drawings and controlling the room or laboratory per the project requirements. Generally, the controller shall modulate supply and exhaust airflow to maintain an adjustable airflow offset. The controller shall also control space temperature through a combination of airflow control and heating water reheat control valve control.
- D. The room airflow controller shall maintain a variable negative or positive offset as scheduled on the lab airflow schedule between the sum of the room's total exhaust and the make-up/supply air volumes. This offset represents the volume of air that will enter or exit the room from the corridor or adjacent rooms.
- E. The room airflow controller shall be capable of changing the airflow set points based on a change in occupancy, either from time of day scheduling or from an occupancy sensor located in the room.
- F. The room airflow controller shall be electronic or a DDC microprocessor-based digital controller. The controllers shall control and communicate digitally via a high-speed Peer to Peer digital network. A polling sub-local area network requiring a primary controller to provide communication and distribution of information between the secondary lab controllers is not acceptable. The inputs shall accept signals proportional to general, auxiliary, fume hood, exhaust, and space supply flows. The output signals shall control supply valves and exhaust/return air valves, with signals proportional to the desired supply or exhaust volumes.
- G. Integral field adjustable controls shall be provided for all required calibration and scaling adjustments.
- H. A power supply for the control panel mounted unit shall be included to power the LCS from one dedicated 120 VAC line connection per interface panel.

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 14

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert U of H Proj #>

<Insert Issue Name>

<Insert Issue Date>

- I. The room airflow controller shall be able to be integrated into a BMS.
- J. Room airflow controller shall be able to Integrate to BMS through BACnet/IP through on board communication adapters and shall be field configurable/upgradable.
- K. At minimum, the room airflow controller shall be able to display the following I/O:
 1. Valve Level (Per Valve)
 - a. Flow Setpoint – Read Only
 - b. Flow Feedback – Read Only
 - c. Jam Alarm – Read Only
 - d. Flow Alarm – Read Only
 2. Temperature Control (Per Zone)
 - a. Space Temperature – Read Only
 - b. Discharge Air Temperature (if applicable) – Read Only
 - c. Occ/Unocc Cooling Temperature Setpoints – Read/Write
 - d. Occ/Unocc Heating Temperature Setpoints - Read/Write
 - e. Effective Temperature Setpoint – Read Only
 - f. Heating Demand – Read Only
 - g. Cooling Demand – Read Only
 3. Zone Balance Control (Per Zone)
 - a. Room Offset Setpoint – Read Only
 - b. Room Offset – Read Only
 - c. Occupied Min Ventilation Setpoint (if applicable) – Read/Write
 - d. Unoccupied Min Ventilation Setpoint (if applicable) – Read/Write
 - e. Total Supply Flow – Read Only
 - f. Total Exhaust Flow – Read Only
 - g. Total Hood Flow – Read Only
 - h. Diversity Alarm (if applicable) – Read Only
 4. Fume Hood Control (Per Fume Hood)
 - a. Flow Setpoint – Read Only
 - b. Flow Feedback – Read Only
 - c. Jam Alarm – Read Only
 - d. Flow Alarm – Read Only
 - e. Face Velocity – Read Only
 - f. Sash Position – Read Only
 - g. Fume Hood Emergency Purge Alarm – Read Only
 - h. User Status (If applicable) – Read Only
 - i. Broken Sash Cable Alarm –Read Only

<Insert A/E Name>

AE Project #: <Insert Project Number>

Laboratory Airflow Controls

UH Master: 05.2020

25 0910 – 15

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

L. Room Integrator / Room Controller Configuration Tools

1. All configuration tools required for system programming, configuration, and startup will be available at the room level. All tools will be web-based and able to be password protected. Third-party software requirements are not acceptable.

2.7 EXHAUST AND SUPPLY AIRFLOW DEVICE CONTROLLER

- A. Each air valve shall be provided with a unit-mounted airflow device controller to individually control each air valve. The airflow device controller shall be connected to the room airflow controller.
- B. The airflow control device shall be a microprocessor-based design and shall use closed loop control to linearly regulate airflow based on a digital control signal. The device shall generate a digital feedback signal that represents its airflow.
- C. The airflow control device shall store its control algorithms in non-volatile, re-writable memory. The device shall be able to stand-alone or to be networked with other room level digital airflow control devices using an industry standard protocol.
- D. Room-level control functions shall be embedded in and carried out by the airflow device controller using distributed control architecture. Critical control functions shall be implemented locally; no room-level controller shall be required.
- E. The airflow control device shall be **[24V][120V]** power.
- F. The airflow control device shall have provisions to connect a notebook PC commissioning tool and every node on the network shall be accessible from any point in the system.
- G. The airflow control device shall have built-integral input/output connections address fume hood control, temperature control, humidity control, occupancy control, emergency control and non-network sensors switches and control devices. At a minimum the airflow controller shall have:
 1. Three (3) Universal Inputs.
 2. One (1) Digital Input.
 3. Two (2) Analog Outputs.
 4. One (1) Relay capable of driving air valve actuator.
- H. The airflow control device shall meet FCC Part 15 Subpart J Class A and be UL916 listed.

Coordinate with UH Project Manager on whether a web-based supervisor dashboard is required for project. If not required, remove article below.

2.8 WEB-BASED SUPERVISOR DASHBOARD

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 16

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

- A. The LCS shall have a complete web-based system “Supervisor” product, to provide web access, monitoring, trends, and alarming as a supplement to the Building Management System.
- B. The LCS Supervisor software application shall be provided by the LCS Manufacturer (Third Party Application Software is not acceptable). This Supervisor package shall be a web server for visualizing and controlling laboratory airflow control equipment via web browsers. User-friendly dashboards served by the Supervisor provide device feedback, historical trend data, alarms, system health, scheduling, and control functions. The Supervisor also supports centralized trend logging and historical data pushes through to a database on a different computer from the one where its software resides.
- C. To visualize lab control devices, the Supervisor must be used in conjunction with laboratory airflow control server or Room Manager. The Supervisor can also pull in any third party information (including Facility Air Monitoring Systems) that is on the BMS through BACnet. Data is displayed on the dashboard using graphics representing laboratory airflow control room applications and a wide range of customizable templates (gadgets). The Supervisor also supports multiple users; each user can customize the base graphics as well as build their own My Dashboards.
- D. Pre-built Gadgets should include the following as a minimal offering;
 1. Alarm Gadget
 2. Chart Gadget
 3. Hood Flow Usage Gadget
 4. Zone ACH Gadget
 5. Zone ACH Status Gadget
 6. All Gadgets provide “Smart” capabilities of mining data based upon their location within the database navigation tree.
- E. The Supervisor software shall have the following features at minimum:
 1. View real-time and historical environmental data. Ready to use without the need to integrate to the BMS.
 2. Consolidated building view down to device level status. Ability to see the status of the building’s health, energy usage and safety and quickly drill down to the device level to troubleshoot alarms.
 3. Customizable based on user. Customize dashboards to present only the information of interest. The safety officer can see different dashboards from facilities personnel to ensure only information critical to the safety officer’s role is presented.
 4. Third party devices shall support viewing information from devices such as building utility meters and room air quality sensors (Facility Air Monitoring System) that may not have a user interface.
 5. Track energy usage down to device level. Ability to monitor real-time energy usage and allow comparisons with historical usage and benchmarks.
 6. Air Changes per Hour optimization. Ability to reduce energy usage while maintain a safe environment through the visualization and control of the air flow vent rate based on air quality and occupancy of the space.

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 17

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

7. Consolidate building submeters with lab energy usage. Ability to integrate BACnet capable submeters into the dashboards for a consolidated energy profile.
 8. Actively monitor fume hood safety. Actively monitor the face velocity at each hood through the dashboards and quickly respond to alarms when any issue arises.
 9. Front-end for air quality sensors. View sensor data in dashboards for a consolidated view of all environmental data without going through the BMS.
 10. Compliance reporting. Consolidate all environment data from laboratory airflow control system and other room devices into the Supervisor for a single resource to develop safety and compliance reports.
 11. Enterprise-level information exchange using an SQL database and HTTP/HTML/XML text formats.
 12. Security and password protection using standard Java authentication and encryption.
 13. Optional security via an external LDAP connection.
 14. Export archived trend and alarm data to SQL.
- F. The Supervisor software shall be installed on an Owner-provided server or computer. Coordinate with Owner for minimum requirements.
- G. The Supervisor software shall be able to integrate with the Owner's existing BMS/LCS network.

Coordinate with UH Project Manager on whether direct differential pressure measurement of labs is a project requirement. If not required, remove article below.

Coordinate with basis of design manufacturer. Direct differential pressure measurement may be able to be accomplished with a user interface touch screen. Edit specification accordingly.

2.9 DIFFERENTIAL PRESSURE MONITORS

- A. The room pressure controller (Controllers) shall be capable of measuring the differential pressure between two individual spaces at all locations shown on the Drawings. Each room shall have its own controller capable of stand-alone operation. Each monitor shall be capable of both visual and audible alarms. Each monitor shall use direct pressure measurement utilizing industrial quality, differential pressure transducer technology. Implied pressure measurement systems utilizing thermal (hot wire or thermal mass) air velocity measurement are not an acceptable means or pressure measurement.
- B. The sensor shall continuously monitor and or control bi-directional room pressurization using direct pressure sensing referenced to the adjacent space. Wall / ceiling mounted assembly fittings and cover plate for room shall be provided with the controller as a complete unit.
- C. Provide pressure-to-current transmitters with the following minimum specifications:
1. Color, touch-screen display.
 2. Resistant to spray washdown.
 3. Standard accuracy RSS of at least $[+/-0.5%][+/-0.25%]$ full scale (non-linearity, hysteresis and non-repeatability).

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 18

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

4. Integral zero and span adjustment.
5. Temperature effect on zero/span shift ± 0.03 % FS/ $^{\circ}$ F.
6. Pressure ranges, selected by engineer shall be up to (-1.0" to +1.0").
7. Temperature Range: 32 to 120 deg. F.
8. Programmable visual alarm and adjustable audible alarm.
9. Alarm generation.

[Coordinate with UH Project Manager on whether room touch screen displays are required for project. If not required, remove article below.](#)

2.10 USER INTERFACE TOUCH SCREEN DISPLAYS

- A. Provide a touch screen monitor for each laboratory or room that can be networked to the LCS and has a user interface to display data, edit setpoint variables, create alarms, and provide unique messages for notification.
- B. The user interface shall have the following:
 1. 7-inch capacitive touch screen.
 2. Easy to navigate "tile based" display.
 3. Template based tile setup pages.
 4. Multiple faceplate color/finish options. Provide samples for Architect's selection.
 5. Light or Dark user interface themes.
 6. Read and Read/Write access.
 7. Pin Protection.
 8. Resistant to spray-down.
 9. Alarms configurable for tile or point by point.
 10. Up to 48 points that can be displayed (24 at a time).
 11. Alarm capable as High, Low, Change of State, or Multistate.
 12. Easily upgradable for future implementation to existing installations.
 13. Able to display positive or negative pressure relationship.
 14. Android or similar-based Operating System.

2.11 INTERFACE TO BUILDING MANAGEMNT AND CONTROL SYSTEMS

[Coordinate with UH project manager on project requirements for server.](#)

- A. The LCS network shall digitally interface with the BMS. **[The required software interface drivers shall be developed and housed on a Server, which is a dedicated interface device furnished by the LCS supplier or a facility-provided Server partition that resides on the Facility Wide Intranet.]**
- B. Any or all room-level points shall be available to the BMS for monitoring or trending. The Server / room manager software shall maintain a cache of all points to be monitored by the BMS. The room-level airflow control devices shall update this cache continually.

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 19

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

- C. The building-level network shall be a high-speed BACnet/IP communications protocol. The building-level network shall support up to one hundred (100) sub nets, or pressurization zones, or six thousand (6,000) data points.
- D. A commercially available interface card shall be provided with the Server or utilize standard Ethernet communication to connect to the building-level network.

2.12 ACCESSORIES

- A. Provide accessories, sensors, actuators, raceways, conduits, transformers, power line conditioners, power supplies, UPS, etc. that are not specified herein but required to provide a complete and functioning LCS.
- B. Refer to the applicable Division 25 section for requirements.

PART 3 - EXECUTION

3.1 TEMPERATURE AND HUMIDITY SENSORS

- A. Provide room temperature sensors with digital display and humidity sensors (if required by the Drawings) to provide control inputs to the LCS.

Edit to suit project. Remove article below if not applicable to project.

3.2 ROOM DIFFERENTIAL PRESSURE ALARM PANELS

- A. Room differential pressure monitors shall be provided as shown on the Drawings to provide individual room pressure differential monitoring and alarms. Room alarm panels shall also be connected to an alarm when a system failure condition that affects the room is detected by the LCS.

3.3 CONTROL WIRING

- A. All wiring required for a complete and operational LCS shall be provided under this Section.
- B. All line voltage control wiring and all low voltage control wiring and the main data communications loop shall be installed in conduit.
- C. Minimum requirements for control wiring shall be as follows:
 - 1. Control wiring for digital functions shall be No. 18 AWG copper minimum, with 600 volt insulation. Multi-conductor wire shall have an outer jacket of polyvinyl chloride (PVC) or UL-listed plenum rated jacket.

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 20

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

2. Control wiring for analog functions shall be No. 18 AWG copper minimum, with 600 volt insulation, twisted and shielded, 2-, 3- or 4-wire to match analog function hardware. Multi-conductor wire shall have an outer jacket of PVC or UL listed plenum rated jacket.
3. Sensor wiring shall be No. 18 AWG copper minimum, twisted and shielded, 2-, 3- or 4-wire to match analog function hardware. Multi-conductor wire shall have an outer jacket of PVC or UL listed plenum rated jacket.
4. Class 2 low energy conductor sizes specified for digital and analog functions shall take precedence over any requirements for Class 2 low energy remote control and signal circuit conductors specified elsewhere, unless a larger conductor size is required by the NEC.
5. Line and low voltage control wiring shall not be installed in the same conduit.
6. Control wiring shall not be installed in the same conduit with power wiring.
7. All conduit shall be run in a neat manner and shall be perpendicular and parallel to building lines. Coordinate conduit routing with field conditions so as not to interfere with code clearances, maintenance access and walkways.
8. Permanently mark terminal blocks for identification. Protect all circuits to avoid interruption of service due to short-circuiting or other conditions. Line-protect all wiring that comes from external sources to the Site from lightning and static electricity.
9. Label or code each field wire at each end. Permanently label or code each point of all field terminal strips to show the instrument or item served. Color-coded cable with cable diagrams may be used to accomplish cable identification.
10. Refer to applicable Division 26 Sections for additional requirements for conduit and wiring materials and installation. All conduit and wiring shall be installed in accordance with all requirements of applicable codes.

3.4 LCS INSTALLATION

- A. The LCS Contractor shall install the sash sensors, interface boxes, presence and motion sensor, and fume hood monitor on the fume hood. Reel-type sash sensors and their stainless steel cables shall be hidden from view. Bar-type sash sensors shall be affixed to the individual sash panels. Sash interface boxes with interface cards shall be mounted in an accessible location.
- B. The LCS Contractor shall install all room controllers in an accessible location in or around the designated laboratory room.
- C. The LCS Contractor shall install an appropriately sized and fused 24 Vac transformer suitable for NEC Class II wiring.
- D. All cable shall be furnished and installed by the LCS Vendor. The LCS Vendor shall terminate and connect all cables as required.
- E. The Division 23 Contractor shall install all airflow control devices in the ductwork and shall connect all airflow control valve linkages.
- F. The Division 23 Contractor shall provide and install all reheat coils and all required transitions.

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 21

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

- G. The Division 23 Contractor shall provide and install insulation as required to meet, at minimum, the latest energy code requirements.
- H. Each pressurization zone shall have either a dedicated, single-phase primary circuit or a secondary circuit disconnect.
- I. All 120VAC and power requirements are to be provided by the Division 26 Contractor.

3.5 INSTALLATION PRACTICES

- A. Install system and materials in accordance with manufacturer's instructions, rough-in drawings and details on the Drawings. All components and appurtenances shall be installed in accordance with the manufacturer's instructions and as shown or specified.
- B. Air Valve Locations: Locate each unit accurately in the position indicated in relation to other work. Position unit with sufficient clearance for normal service and maintenance.
- C. Terminal Unit Duct Connections: Provide not less than three duct diameters of straight, unobstructed duct prior to terminal unit inlet to minimize turbulence at terminal unit inlet. If manufacturer's recommended installation instructions require a longer straight, unobstructed duct run prior to terminal unit, provide per the manufacturer's installation instructions.
- D. Air Valve Supports: Support each air valve independently of the surrounding ductwork and in accordance with the manufacturer's installation instructions. Supports shall not be attached to the air valve in any way that penetrates the air valve casing.
- E. Terminal Unit Leveling: Level terminal units to the tolerances recommended by the manufacturer.
- F. Electrical Wiring: Power (120 V, 60 Hz) will be provided at the control panel locations shown on the Drawings. Electrical distribution from those locations shall be the responsibility of the Division 25 equipment supplier/installer.
- G. Raceways: All line and low voltage power and control wiring shall be installed in a raceway or conduit.
 - 1. Pressure Sensors/Transducers: All pressure sensors shall have taps for calibration. Pressure sensors/transducers shall be verified by calibration. Calibrate differential pressure sensors/ transducers. All devices shall be as submitted for and approved during final tests by TAB Contractor.

Keep paragraph below for retrofit projects.

- H. Hood Sash Position Sensors: Sensor type and mounting by this equipment supplier, on existing hoods, shall be properly suited for those existing hood applications to provide reliable operation.

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 22

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

- I. Electrical Wiring: Refer to the applicable Section of Division 26 for electrical wiring incidental to the temperature control system regardless of where shown on the Drawings.
- J. All conduit, wiring, accessories and wiring connections required for the installation of the LCS, as herein specified, shall be provided by the LCS Contractor unless specifically shown on the Drawings under Division 26. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this Section.
- K. Provide firestopping for all penetrations used by dedicated LCS conduits and raceways. All other firestopping shall be by another trade.
- L. All wiring passing through penetrations, including walls, shall be in conduit or enclosed raceway.

3.6 SYSTEM START-UP AND COMMISSIONING

- A. General: System start-up shall be provided by a local factory-authorized representative of the LCS vendor. Start-up shall include calibrating the fume hood monitor and any combination sash 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. Reliance upon factory start-up is not acceptable.
 - 1. Local factory authorized representative must be located within 100 miles of Project location.
- B. Adjustment: After completion of the installation, adjust control valves and similar equipment provided as work of this Section. Final adjustment shall be performed by specially trained personnel in the direct employ of the manufacturer of the primary temperature control system.
- C. Fully commission all aspects of the LCS work.
- D. The TAB Consultant shall be responsible for final verification and reporting of all airflows.
- E. Provide report detailing start-up and commissioning results.

3.7 LCS ACCEPTANCE PERIOD, WHOLE BUILDING TEST AND EXTENDED OPERATION TEST

- A. Refer to Section 25 0800, "BMS Testing and Commissioning" for Acceptance Period, Whole Building Test and Extended Operation Test. LCS supplier, with the assistance of the BMS supplier, shall perform the specified tests on the LCS in addition to the BMS.

3.8 SYSTEM TRAINING

- A. Manufacturer's representative shall provide a minimum of **[eight][sixteen]** hours of Owner training by factory trained and certified personnel. The training will provide an overview of the

<Insert A/E Name>

Laboratory Airflow Controls

25 0910 – 23

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

job specific airflow control components, verification of initial fume hood monitor calibration, general procedures for verifying airflows of air valves, and general troubleshooting procedures.

- B. Refer to Division 23 “Mechanical Scope of Work” for additional training requirements.
- C. Operation and Maintenance manuals, including as-built wiring diagrams and component lists, shall be provided for each training attendee. Refer to Division 23 “Mechanical Scope of Work” for additional requirements.

END OF SECTION 25 0910