233816S01 FUME HOODS

(00000 - Design Guideline for Fume Hoods EH&S supercede if conflicts occur.)

Part 1 GENERAL REQUIREMENTS

1.01 FUME HOOD GENERAL INFORMATION

1. Each fume hood system is to be designed to meet the needs of the specific application. Most university hood installations will be for general laboratory use, however; many hoods require a special, unique design effort. Document the special case hood designs that deviate from this standard.

2. Although the hoods are normally specified in an architectural section, the engineer is responsible for design and coordination of the engineered systems. This will include utilities, air flow, compatible materials, noise, testing, balancing, alarms, etc.

3. Provide an audio and visual alarm to indicate that the hood is not properly working. The alarm is to be serviceable and have a test feature. A calibrated airflow readout is required to be displayed on a hood-mounted monitor.

4. Evaluate each hood and provide water, air, gas, electricity, light, etc. as needed.

5. Provide a nameplate for each hood station stating the air flow, intended use, restrictions, special requirements and fan identification.

6. Overhead and vertical exhausts (such as a canopy) are not acceptable for the removal of hazardous fumes.

7. Some applications will require the use of HEPA filters, wash down, incinerator, scrubbers or charcoal filters to remove hazardous materials. Such equipment must be installed to facilitate servicing by qualified personnel and not create additional hazard. The consultant is to evaluate each application and provide such systems as needed.

8. The consultant is to determine if an explosionproof exhaust system is required and provide such systems as needed.

9. Do not locate solvent storage under fume hoods.

10. If the base cabinet requires ventilation, air movement must be maintained even when the hood is not in use. Extend cabinet vents four (4) inches into the baffle.

1.02 GENERAL FUME HOOD SPECIFICATIONS

1. Generally, the hoods will be made of nonflammable materials, bypass-type with a vertical sash, airfoil and internal baffles. Other type hoods may be used as required. Sash frames are to be welded steel with 7/32-inch. (min) laminated safety glass or equal material that will not shatter in the event of an explosion. Utility controls and receptacles should be mounted outside of the hood.

2. Provide sash stops at the normal operating position, 12-inch height. These stops can be overridden to allow the sash to be fully open to place equipment.

3. When sink cups are in the hood, provide a lip around the sink to contain spills.

4. Fume hoods shall not contain asbestos (transite).

5. In general, vertical sash hood operation will be intended for use with the sash at 12 inches. Specify that the bypass not begin to open until the sash is at 12 inches.

6. Horizontal sashes should be used where whole-body protection is needed.

7. Adjustments and controls for utilities and baffles must be located such that they can be accessed without exposing the operator to the fumes in the hood.

8. Hoods that have adjustable baffles shall have easily identified controls.

9. Color code utility services.

10. Hoods are to have a bottom air foil.

11. Hood interiors must be made of material and designed to facilitate cleaning of visible and non-visible areas.

12. Hoods are to have UL-Listed interior light fixtures.

13. Electrical outlets are to be located outside of the hood.

14. Seal or gasket any openings and access panels.

15. Hoods should be pre-piped, pre-wired and factory tested. Utility connections should be at the top of the hood unless existing conditions dictate otherwise, or utilities are provided behind the casework. Identify on the drawings the type and location of each utility connection.

16. Provide a "work line" six (6) inches inside the hood face.

17. Specify coated rock or poly-resin liners, no bare rock.

18. Work surfaces are to be recessed to contain spills.

1.03 POLYVINYL COATED GALVANIZED STEEL DUCT MATERIAL

1. The university may approve the use of polyvinyl-coated galvanized steel (PVS) for limited applications in fume exhaust systems. Each application must be approved, in writing, by the University's Project Manager.

2. Specify proper material handling to avoid damage and scratches.

3. All exposed steel caused by scratches, cuts, manufacturing, installation, etc. are to be totally coated using the material recommended by the manufacturer.

4. All fasteners are to be stainless steel. Fasteners and their holes are to be coated inside and outside with the appropriate material. While 100% coverage is not possible, a significant portion can be protected.

5. Seal all holes with the appropriate material. This includes holes in rivets (if used).

6. Connections are to be made using the manufacturer's connectors or other appropriate piece. The connectors are to be assembled air tight using a bead of sealant and fasteners. Coat all exposed edges.

7. The hood and ductwork assembly is to be air tight. Perform an air or smoke test.

8. Slope the ductwork to drain at the hood or intake.

1.04 FUME HOOD AIR FLOW

1. Fume hoods are to be designed and tested for proper air volume and to have an average face velocity of 100 FPM (+/- 20 FPM) in occupied mode. Setback to reduced face velocity is possible during unoccupied periods with the approval of the University engineer and Environmental Health & Safety.

2. Avoid the use of auxiliary air supplies at the hood. This air must be tempered and supplied in such a way to minimize turbulence.

3. Avoid air flow disturbances near the hood. Locate the hood away from air diffusers, doors and passageways. (NOTE: Never locate a hood adjacent to a required means of egress.)

4. Provide occupied/unoccupied controls, where applicable. The hood should never be completely off - this could be by use of a hi/low fan speed control.

5. State on the drawings the hood air volume, face velocity, duct velocity and stack discharge velocity.

6. State on the drawing the number of additional fume hoods (at 800 CFM per typical hood) that can be added to the exhaust system without major HVAC rework.

7. The laboratory room pressure is to be maintained at a slight negative.

8. Laboratory air flow must be designed to minimize drafts. Consider diffuser placement or oversized diffusers.

9. Baffle adjustments must not change the face velocity and air flow by more than 5%.

10. Provide forward or backward curved fans that operate at a low tip speed. Fan construction must be compatible with chemicals in exhaust airstream.

11. The maximum noise criteria level for a fume hood is NC-40, measured four foot above the floor, four foot from the sash with the sash fully opened. Sound traps may be used if approved by the University Environmental Health & Safety Department. These traps must be pack-less and of the same material as the duct work or an approved compatible material. Traps must have provisions for cleaning and draining.

12. Locate hoods away from exits and high traffic areas.

13. Hoods should be specified as low static pressure and low sound level. These values should be measured.

14. Laboratories are to have 100% outside air. The exception would be clean rooms such as Micro-Electronic labs and special hood systems that recirculate lab air to maintain cleanliness.

1.05 FUME HOOD DUCTS & EXHAUST

1. Duct velocity is to be between 1000 - 2000 FPM (higher levels may be required for radioactive applications.

2. All interior fume hood duct systems are to operate under negative pressure. This includes ducts in mechanical space and penthouses.

3. Each hood is to have a dedicated exhaust duct, connected to a roof mounted fan or plenum exhaust system.

   a. With specific written approval, fume hood exhausts may be manifolded under the following conditions:

      i. Minimize the number of the hoods on a manifold.
      ii. Hoods must be in a limited, controlled area (supervised).
      iii. Hoods must be used for the same or similar purposes.
      iv. There is no chance to create a hazardous mixture in the ducts.
      v. The manifold must be designed to handle any special material.
      vi. Insure that proper air flow and face velocity is maintained under all operating conditions.

4. If energy recovery systems are employed, protect the recovery coils and equipment from corrosion.

5. Do not use volume, fire or smoke dampers in the fume hood exhaust duct work.

6. Duct systems are to have zero (0) leakage within recognized tolerance.

1.06 FUME HOOD TESTING

1. Hoods are to be tested installed and under normal operating conditions. Tests must demonstrate minimal turbulent air flow and that no fumes migrate out of the hood at any point. Adjust the baffles as required.

2. Hood tests are to be conducted as stated in the scientific apparatus makers association (SAMA) standard LF 10-1980. Generally, this will require air flow testing with the sash in the maximum open position. (fully open for vertical sliding sash hoods)

3. The owner is required to conduct tests on each installed hood and certify proper operation. These are to be tracer gas tests in accordance with ASHRAE-110, provided by a certified third-party technician. Certification must be submitted to university Environmental Health & Safety Department prior to hood operational approval.

1.07 PERCHLORIC ACID FUME HOOD INSTALLATION NOTES

1. This standard deals specifically with the installation of perchloric acid fume hoods. As such this standard is supplementary to other related standards. Refer to these other standards for generic information not covered here. Note: See also typical installation drawing diagram 15915D01.

2. Provide a complete duct and hood automatic washdown system with 100% coverage. This system is to operate automatically when the fan is shut off.

3. Protect the washdown system from freezing. Isolation/operation valves are to be normally open to drain. Exterior piping and ducts are to be insulated together to retain heat.

4. Interlock the washdown system so the water spray will not operate while the fan is running.

5. For lone duct runs, sequence the spray nozzles from top to bottom to avoid excessive water from flooding the hood.

6. The ducts are to be vertical and as short as possible. In some cases, such as a renovation, a horizontal run may be required. The following will apply:

   a. Horizontal runs are not to exceed ten (10) Ft. Extended runs may be used if a scrubber is placed at the hood, written approval is required.
   b. The duct system will slope to drain in the hood.
   c. No horizontal bends.
   d. The spacing of the washdown nozzle will not exceed 2.5 Ft.
   e. Completely wash the vertical bends.

7. Materials used in the fume flow path are to be impervious and compatible with perchloric acids. Sealants and other materials are to be inorganic. Use tetrafluoroethylene (teflon) plastic sealants, do not use A Glycerin-Litharge Sealant.

8. Inner surfaces are to be smooth and rounded to permit a complete washdown without the possibility of trapping fumes, liquids or particles. Duct radii are to be 2 times the duct diameter (min). Surfaces are to be water tight.

9. Fans are to be of non-sparking construction and have explosion proof motors. Lubricants, seals and gaskets are to be inorganic and compatible with perchloric acid; provide a label to the affect. Use fluorocarbon greases for lubrication. Sealed bearings should be used. Control the fan speed (air velocity) by adjustable belt drives with static conducting v-belts.

10. Locate electrical switches, receptacle and utility controls outside of the hood. Do NOT provide gas service to the hood. See NFPA.

11. Provide a warning sign which states, "This hood is for perchloric acid use only- other use is prohibited - Contact the environmental health office prior to working on this system - Do not use an open flame in this hood".

12. There are to be no flexible connections. Ductwork is to be a solid assembly rigidly attached (including the fan) to the structure. Vibration must be minimized.

13. The space housing the perchloric acid hood should be of masonry construction with epoxy coatings. The floor should have an acid waste drain. There are to be no wood (or similar) surfaces.

14. Secure the hood to the floor using studs embedded in the floor and sealed. Anchors in the floor are not acceptable.

15. If a perchloric acid hood system is to be disassembled, as a minimum follow the procedure given in the Handbook of Laboratory Safety by Norman Steere, 1971. Contact the University's Environmental Health & Safety Department before doing any work.

16. Spray nozzles are to be designed for this application, rated for 1.4 GPM at 40 PSIA (min).

17. The installation is to permit easy visual inspection of the system.

18. Hoods are to be unpainted metal or stoneware. Hoods should have an explosion proof screen. Laminated glass or transparent PVC are preferred.

19. Provide a flexible hose water spray to wash down the hood.

20. Determine the length of time the spray will operate.

21. The water supply isolation valve is to have a safety lock in the open position.

Part 2 FUME HOOD CONTROLS GENERAL INFORMATION

1. BACnet/IP Device Instance numbers and BACnet/MSTP Network numbers shall only be assigned by Utilities & Energy Management. Device Naming should adhere to UEM Naming Convention.

   a. B-BC devices shall be named using the following format:
      i. BuildingName_BuildingNumber_Floor_RoomNumber_B-BC Device Type OR
      ii. BuidlingNumber_BuildingName_Floor_RoomNumber_B-BC Device Type
   b. All B-AAC points shall be named using the following format:
      i. Building_Floor_RoomNumber_Device Type_Equipment ShortName_Function

2. The names of the servers shall be assigned solely by CPPD IT.

3. Thermostats: Each supply air terminal unit requires a thermostat for operation, unless specifically indicated on the Drawings to be slaved to another unit. Thermostat locations have been identified on the Drawings to the extent possible, but all such locations may not be shown. Provide the required thermostats whether or not shown on the Drawings. For those thermostats not shown on the Drawings, work out an acceptable location with the Architect/Engineer.

4. Provide DDC controls for the air terminal units. Provide operators controlled and monitored by direct digital control systems which shall include, but not be limited to, air handling systems, pumps, terminal units, terminal unit hot water coil reheat valves, etc.

5. Provide and install and fully commission a complete system of Automatic Temperature Controls as specified herein, and as illustrated on the contract drawings to allow for a complete and operational temperature control system. The Temperature Control system shall be a electronic Direct Digital Control (DDC). All necessary control panels, relays, switches, system software, valves, valve actuators, sensing devices, and damper operators shall be provided, installed, and commissioned to insure proper operation of the temperature control system as detailed in the sequence of operation, whether noted on the plans and specifications or not. The systems shall be properly connected, piped and wired in a manner conforming to the laws, ordinances and codes now in force in the Commonwealth of Kentucky.

6. The Control System specified for this project shall seamlessly interface to the existing building controls management system, facility management system. If the existing facility management system cannot meet the requirements specified in this section, the controls manufacturer shall provide all hardware, software, installation, control wiring, engineering and programming etc. to upgrade the existing facility management system to meet the requirements of this section. All new and existing manufacturers specific hardware points, software points, DDC controllers, Network Controllers, Workstations and software system objects shall be monitored, controllable and accessible as described in this section from either the BMS Operator Workstation, located in the Peterson Service Building Delta Center Providing additional computer workstations, Internet IP Protocol Access, Java script

programming, windowing between different or loading separate facility management system software on one of the above Workstations for interface to the new and existing facility management system is not acceptable.

7. The Control System shall interface to the existing Campus FDDI segmented WAN network via 10BASET communication hub(s). With respect to all new and existing DDC controllers, Network Controllers and workstations communicating over the campus WAN network, all control points and software features described in this section shall be operable from one of the existing operator terminals located in the Peterson Service building. Modem communication is not acceptable for this application. The FMS network with in the chiller plant shall be segmented to insure peer to peer communication between network controllers and Work Stations (within the build) if communication with the campus FDDI WAN network is lost. There shall only be one physical connection to the campus FDDI WAN network.

8. All controller programs shall have the ability to download and upload over the campus Ethernet network.

9. UK Communications department shall provide all required HUB's routers and switches required to interface to the campus WAN network. The cost for this work shall be included by the control's manufacturer. Obtain pricing from the UK Campus Communication Department prior to bid.

10. EMS Connections to Third Party Equipment: Provide these connections and points as indicated in the Sequence of Operation and/or the I/O Summary Sheets. Third Party equipment includes but is not limited to, computer room air conditioning units, condensate pumps, transfer switches, HVAC variable speed pumping systems, sump pumps, fire alarm systems, lighting systems, etc.

11. Coordinate with third party equipment suppliers to determine equipment devices, such as, printed circuit boards, contacts, etc. required for EMS connections. Provide any necessary connection devices not provided by the third-party equipment suppliers.

12. Electrical power wiring and interlock wiring for all controls, signal devices, alarms, etc., shall be in accordance with diagrams and instructions from the supplier of the systems. All power and control wiring, conduit and wiring connections required for the complete installation, including wiring to smoke dampers and combination fire/smoke dampers and their motors, shall be provided by this Contractor in accordance Electrical 26 specification requirements.

13. Provide and be responsible for the laboratory control systems and their control. Controls for these systems shall be DDC. <u>Pneumatics controls shall not be used</u>.

    a. Specifications for this work are included in this Section. Work shall include:

        i. Furnishing the control and control component materials, such as, airflow controllers and electronic actuators, control units, interface boxes, sash sensors, proximity sensors and fume hood monitors, delivered to the project site.
        ii. Installing the interface boxes, sash sensors, proximity sensors and fume hood monitors on the fume hoods.
        iii. Periodic visits to the project site to supervise fume hood controls installation.
        iv. Startup, testing and Owner training for fume hood controls.

            a) The BAS Contractor shall instruct the Owner's designated representatives in these procedures during the start-up and test period. The duration of the training period shall be no less than four (4) hours during two 2 hour sessions. (Number of hours may be adjusted to a max of 40 depending upon the size and scope of project. For larger projects, training vouchers for instructional training at the manufacturer's facilities may be requested in lieu of on-site training.) These instructions are to be conducted during normal working hours at the Owner's convenience and are to be prearranged with the Owner. The owner can request this training any time within the one year warranty period and may request any number of classes adding up to the total number of hours. The contractor shall provide an hourly unit price for additional on-site training.

b) The training shall consist of both hands-on at the job site and classroom training at a classroom location on the University of Kentucky campus coordinated with the Project Manager and UEM.

c) Upon completion, the attendees shall be able to operate the system and implement system changes including start-up, boot load, add point to the data base, enter messages, and down line load field units.

d) Prior to the scheduling of the sessions, an agenda outlining the training topics must be submitted for approval. Agenda items shall include, but not be limited to, the following topics:

I. Explanation of control sequences. Include which sensors are used and how output device operates.
II. Explanation of control drawings and manuals, including symbols, abbreviations, and overall organization.
III. Walk-through of project to identify controller locations and general routing of network cabling.
IV. Review of operation and maintenance of hardware devices including air compressor, air dryers, controllers, instruments, and sensors. Include schedule for routine maintenance.
V. Programming Application Specific Controllers
   1) Backing up and Restoring Application Specific Programming
   2) Adding/Deleting/Editing points on Application Specific controllers
   3) Troubleshooting Application Specific controllers (inputs/outputs/logic/master – slave relationships/bus issues)
VI. Programming Building Specific Controllers
   1) Backing up and Restoring Building Specific Controllers Programming
   2) Adding/Deleting/Editing points on Building Specific Controllers
   3) Troubleshooting Building Specific Controllers (inputs/outputs/logic/network issues)
VII. How to use tools and cables

b. Air supply valves on offices with doorways opening into the laboratory space shall operate independently and be included with the lab air totals so the laboratory negative pressure can be maintained at the corridor door.

Part 3 LABORATORY AIRFLOW CONTROL SYSTEM

3.01 CONTROL INTEGRATION

1. Integration between the Fume Hood control system and the Temperature control system shall be performed using BACnet/MSTP.

2. Provide all necessary hardware and software to meet the system’s functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers. These must be in compliance with Front End systems PICS and BIBBS and attached Tridium PICS and BIBBS.

Provide all hardware and software to backup, restore, troubleshoot and install system. Software, backups, unitary, and ASC files shall be delivered to UEM (Utilities & Energy Management) for archiving purposes.

3. It is the contractor's responsibility to ensure that the University of Kentucky Facilities Management's head-end system's licensed device/point count is increased to accommodate the number of devices and/or points that are added to fulfill the contractor's obligation to meet the requirements of the project.

4. Provide laboratory airflow control systems to control the airflow into and out of laboratory rooms. The exhaust volume of a laboratory fume hood shall be precisely controlled to maintain a constant average face velocity into the fume hood. The laboratory control unit shall vary the amount of air into the room to maintain temperature control, minimum ventilation, airflow balance, and laboratory pressurization in relation to adjacent spaces (positive or negative).

3.02 ACCEPTABLE MANUFACTURER

Phoenix Controls Corp.

Antec Critical Controls by Price HVAC

1. Acceptable controls manufacturers shall include any controls manufacturers which utilize a BACnet protocol in accordance with the specification. If the bidding manufacturer is not listed above, documentation for approval as an equal must be submitted 10 days prior to the bid opening date to allow for evaluation by the university.

2. Installing Contractor: Installing controls contractors must comply with the following requirements:

   a. The installing systems integration contractor has been in the business of installing BACnet controls for the last 5 years minimum. In addition, the installing systems integration contractor needs to demonstrate with documentation that they have provided the controls in a minimum of (3) hospital or university renovation projects of similar size and scope where they utilized a BACnet system.

   b. The systems integration contractor must have on staff the following number of key personnel as a minimum, each with a minimum of 5 years of related BACnet controls installation experience: Project Manager - 2, Controls Applications Engineer - 2, Programmer - 2, Installation Supervisor - 2, Controls Technician - 5.

   c. Prefer contractor staff to include Niagara Tridium AX/N4 certified technicians.

   d. Contractor to have experience with successful integrations of controls with Niagara Tridium systems.

   e. Contractor to have a minimum of 3 years of installation history with the brand of controls being bid.

   f. Contractor must have a help desk operation or staff available for phone contact 24/7 for providing technical support to university staff. Call forward and emergency service numbers are not acceptable during normal business hours.

Manufacturers other than Phoenix or Price

1. Systems and equipment other than by Phoenix or Price controls shall be equal in every respect to the operational characteristics, capacities, turn down ratios, speed of response and control sequences specified herein and an independent test is conducted to verify performance compliance.

2. Before the contract is awarded, an Independent test shall be conducted. The manufacturer shall pay for all testing expenses including travel and test cost for the owner and engineer. The engineer shall approve the testing laboratory, procedures and test equipment.

3. The engineer shall be the sole judge of quality and equivalence of equipment, materials, and methods.

3.03 WARRANTY

1. Warranty shall commence upon the date of substantial completion and extend for a period of one year whereupon any defects in materials or system performance shall be repaired by the manufacturer at no cost to the owner.

2. After one year the contractor shall recalibrate and verify face velocities of the system & controls and provide test results in written form to the Engineer.

3.04 LABORATORY AIRFLOW SYSTEM PERFORMANCE REQUIREMENTS

1. The laboratory airflow control system shall be fully stand-alone for each individual laboratory. The system shall not use or rely on information from controllers in other laboratory areas to control the functions within its laboratory.

2. The laboratory airflow control system shall employ individual Face Velocity controllers that directly measure the area of the fume hood sash opening and proportionally control the hood's exhaust airflow in a variable volume mode to maintain a constant face velocity over a minimum range of 20 to 100% at full sash opening. Response time shall be less than one second with no more than a 5% overshoot or undershoot. The system shall achieve 90% of its commanded volume within one second of the sash reaching 90% of its final value with a full height sash movement of one second.

3. The laboratory airflow control system shall respond and maintain specific airflow (±5% of signal) and stability (>5% over/undershoot) 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.

4. The laboratory airflow control system shall also maintain intersystem stability within one second of a change in pressure and/or flow to eliminate hunting, system oscillations, and crosstalk between airflow controllers.

5. The laboratory airflow control system shall use volumetric offset control to maintain room pressurization. The system shall respond and maintain room pressurization (negative or positive) within one second of a change in room/system conditions.

6. The laboratory airflow control system shall employ highly accurate airflow controllers (±5% of signal) with a minimum 20 to 1 turndown to insure accurate pressurization at low airflows.

    a. Adaptive Face Velocity Controller

i. Provide a vertical sash sensor to measure the height of each vertically moving fume hood sash.

c. Airflow Controller – General

i. The airflow controller shall be of the venturi valve control type.
ii. The valve shall be pressure independent over a 0.3" to 3.0" W.C. drop across a low-pressure valve, or 0.6" to 3.0" WC. for a medium-pressure valve. 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.
iii. Airflow accuracy shall be ±5% of reading (not full scale) over an airflow turndown range of no less than 8 to 1. No minimum entrance or exit duct diameters shall be required to ensure speed of response, accuracy, or pressure independence. Systems requiring minimum duct diameters shall be required to furnish and install whatever additional ductwork is needed to meet the manufacturer's published requirements. The cost of this additional ductwork, fittings, and engineering shall be included in the lab airflow control systems vendor's bid.
iv. The valve shall be constructed of one of the following two types:

a) Supply and general exhaust air assembly shall be constructed of 16 gauge aluminum. All bearing surfaces shall be made of a composite teflon or teflon infused (versus coated) aluminum. The assembly's shaft, pivot arm, shaft support brackets, and internal mounting hardware shall be made of 316 series stainless steel. Lesser grade stainless steel materials are unacceptable.

b) Fume hood and biosafety cabinet exhaust assemblies shall have two baked-on coats of a corrosion resistant phenolic coating (Heresite P403 or Phenolflex 957). The assembly's shaft shall be 316L stainless steel with two additional baked-on coats of a corrosion resistant phenolic coating. The pivot arm, shaft support brackets, and internal mounting hardware shall be made of 316L stainless steel. All bearing surfaces shall be made of a composite teflon or teflon infused (versus coated) aluminum. Uncoated shafts and lesser grade stainless steel materials are unacceptable.

v. An electronic actuator shall be factory-mounted to the valve. Loss of power shall cause exhaust valves to fail open to the maximum scheduled design flow for the project, and supply valves to fail to the minimum scheduled design flow. Fail in last position electric actuators actuators/controllers that fail to uncontrolled flows are not acceptable. Constant volume valves do not require actuators.
vi. Supply and general exhaust airflow controllers that use a VAV box, control damper, bladder damper, or an airflow measuring device shall be acceptable provided they meet all the performance and construction characteristics as stated throughout the specifications and:
vii. The airflow controller employs transducers with accuracy no less than ±0.15% of span (to equal ±5% of signal with an 8 to 1 turndown) over the appropriate full scale range including the combined effects of nonlinearity, hysteresis, repeatability, drift over a one year period, and temperature effect. (316L stainless steel materials shall be provided for all exhaust applications.)
viii. Airflow sensors shall be of a multi-point averaging type (316L stainless steel for all fume hood and biosafety cabinet applications).

3.05 CERTIFICATION:

1. Each airflow control valve 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 at least ±1% of signal over the entire range of measurement. Electronic valves shall be further calibrated, and their accuracy verified to ±5% of signal at eight different airflows per valve.

2. All airflow valves shall be individually marked with valve specific, factory calibration data. As a minimum, it should include: valve tag number, serial number, model number, eight-point valve characterization information (electronic valves), and quality control inspection numbers. All information shall be stored on compact disk or DVD in ASCII format for future retrieval or for hard copy printout to be included with as-built documentation.

   a. Exhaust and Supply Airflow Controller:

      i. The controller shall use electronic-based, closed-loop control to regulate air volume linearly proportional to a 0 to 10 volt electronic control signal. The valve shall generate a 0 to 10 volt feedback signal linearly proportional to its airflow for internal volume control, DDC monitoring, or airflow tracking control.

   b. Laboratory Control Unit:

      i. A laboratory control unit shall be supplied to control the airflow balance of the laboratory room. As a minimum, provide one complete, stand-alone laboratory control unit per laboratory.
      ii. The control unit shall be of electronic design with analog signal inputs and outputs. The inputs shall accept signals proportional to fume hood, biosafety cabinet exhaust, and office supply flows. The output signals shall control supply valves, general exhaust/return air valves, with signals linearly proportional to the desired supply or exhaust volumes.
      iii. The control unit shall maintain a constant, adjustable offset between the sum of the room's total exhaust and the make-up/ supply air volumes. This offset shall be independent of the exhaust volume magnitude and represent the volume of air that will enter (or exit) the room from the corridor or other room.
      iv. The control unit shall generate analog signals linearly proportional to all airflow sources, sash sensors, and flow alarms. The signals shall be available for hard wired connection to the facility's direct digital control (DDC) system, or through an integrated control unit that interfaces directly into the facility's DDC system. As a minimum, the following signals (points), shall be available:

         a) fume hood exhaust flow
         b) fume hood exhaust low flow alarm
         c) fume hood sash position
         d) fume hood usage status
         e) supply/make-up airflow
         f) general exhaust flow
         g) total lab exhaust flow
         h) total lab supply flow
         i) room offset
         j) emergency exhaust alarm

   c. The control unit shall also accept direct input signals from the facility's DDC or be carried out by an integrated DDC control unit. As a minimum, the following inputs shall be available:

i. emergency exhaust override
ii. remote offset adjustment
iii. electronic temperature override

d. All points, whether hard wired or totally integrated via one DDC laboratory control unit, shall be stored in the respective DDC system for trending, archiving, graphics, alarm notification, and status reports. Laboratory system performance (speed, stability and accuracy) shall be guaranteed regardless of the quantity of points being monitored, processed, or controlled. Multiple laboratory control units shall be provided to insure at all times the performance of the laboratory is being maintained.

e. Provide an integral or wall-mounted power supply to power the complete laboratory airflow control system from a dedicated 120 VAC emergency power connection (where available). Each circuit shall have no more than 12 amps. maximum load.

f. Provide a fume hood monitor to receive the sash sensor output signal. This same monitor shall generate an exhaust airflow control signal for the appropriate volume control device in order to provide a constant average face velocity. Provide audible and separate visual alarms for both flow alarm and emergency exhaust conditions. Provide display to show average face velocity. Provide audible mute button. Provide emergency purge button on the monitor (where applicable).