University Contact: Sustainability, Energy & Engineering Group

# SECTION 23 09 00_BUILDING AUTOMATION SYSTEMS GENERAL REQUIREMENTS

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Controllers

B. Space Temperature Sensors

C. Humidity Sensors

D. Air Differential Pressure Sensing

E. DDC controls

F. Wiring

G. Control Panels

H. Valves

I. Air Flow Measurements

J. Water Flow Measurements

K. Safety Controls

L. Lab Design Criteria

### 1.2 THIS DOCUMENT WILL GIVE GUIDANCE ON SUCH THINGS AS:

A. How controllers of individual units will be set up.

B. What sensors shall be integrated into the system to ensure proper functionality.

C. What type of controls will be used to generate the desired effect.

D. How the controls will be installed and wired

E. What safety measures will be taken with the system

F. What are design criteria centered around laboratories

### 1.3 REFERENCE DOCUMENTS

A. 26 22 00 Low Voltage Electrical specifications

B. 23 00 00 HVAC Design Guidelines

C. NFPA 70 National Electric Code

D. ASHRAE 90.1 Standards

## PART 2 REQUIREMENTS

### 2.1 CONTROLLERS

A. Terminal unit controllers will not have onboard HOA for the outputs. (VAV (Variable Air Volume controller), FCU (Fan Coil Unit), RH (Relative Humidity sensor), CUH (Cabinet Unit Heater), UH (Unit Heater), small AHUs (Air Handling Unit), small RTUs (Roof Top Unit), etc.)

B. Secondary and primary equipment will be provided with onboard HOA for each output. (Chillers, cooling towers, boilers, primary pumps, AHUs, Heat Exchangers, RTU s, etc.)

C. In most cases each individual piece of HVAC equipment will be furnished with its own controller. Common exceptions to this are zone reheat coils and exhaust fans.

D. Inputs needed for direct control of an output will be wired to the same controller. The information should not be shared across the BAS network.

### 2.2 SPACE TEMPERATURE SENSORS

A. When controlling individual room/HVAC equipment where local temperature setpoint adjustment is required, a display and a "Smart" space sensor shall be used (LCD with 6 custom programmed buttons).

B. Other locations (i.e. fin radiation controlling multiple rooms, VAV's, FCU's etc.) will be provided with the standard plastic sensor with an occ/unocc override push button. Mechanical spaces and common areas (determined by the design team) may use a Stainless-Steel plate-type temperature sensor in lieu of plastic.

C. All space temperature sensors will be labeled to indicate what it is tied to (For instance: VAV-1).

### 2.3 HUMIDITY SENSORS

A. Humidity sensors shall be manufactured by Vaisala.

### 2.4 AIR DIFFERENTIAL PRESSURE SENSING

A. When sensing duct static or filter differential pressure use a (1 %) accuracy device (Veris).

B. When sensing an air measuring station (pitot tube), laboratory hood differential pressure and space differential pressure a (0.4%) accuracy device (Ashcroft) shall be used.

## 2.5 DDC VS CONVENTIONAL CONTROL

A. Conventional controls will be used only when small additions are being made to a control structure that already contains conventional pneumatic controls.

B. Safeties will be installed using all hardwired interlocks.

C. DDC will be used to achieve the controls required for all other applications.

## 2.6 WIRING

A. Electrical metallic tubing (EMT) shall be used in spaces where the wiring is to be surface mounted.

B. Wiring in inaccessible areas shall be installed in EMT conduit.

C. Wiring installed outdoors shall be installed in rigid steel galvanized type conduit.

D. Wiring installed above drop in tile ceilings shall not have conduit. Instead they shall be supported by a hanger type raceway system. This wiring shall use plenum rated wire/cable, unless otherwise approved.

E. AC and DC signals will not be run in same multiconductor.

F. All BAS Wiring is to be Class 2 wiring.

## 2.7 CONTROL PANELS

A. Some panels may be provided by equipment manufacturers (not ATC contractor) and must be specified in the equipment portion of the specification. (VAV terminals)

B. Primary and secondary equipment panels shall be NEMA 1 when indoors and NEMA 3R or greater when outdoors with hinged doors, enamel paint with removable back plates. Panels for terminal units mounted above the ceiling shall be screw-cover type.

C. Primary and secondary equipment controllers shall have all wiring terminations to a separate terminal block.

D. Power (120 volts) shall be separate from low voltage and fused in the control panel.

E. A separate 120 Volt utility un-switched receptacle shall be provided in the panel.

F. A laminated input/output schedule shall be attached to the door and a panel wiring schematic in the panel.

G. 120V/20A Breaker should be used and dedicated to the BAS. Multiple BAS panels can share circuits on a case-by-case basis.

H. Panels shall not have locks on the doors.

2.8 VALVES

A. All control valves shall have electric actuation. Any deviation will need Maintenance & Operations and Sustainability, Energy & Engineering personnel approval based on design needs and justification.

B. Valves serving equipment where the possibility of equipment or piping could be frozen and damaged shall have fail open valves and hardwired to do so. This shall be discussed and determined on a job by job basis.

C. All modulating ball valves shall have a characterized disc, with stainless steel ball and stem.

D. All two position valves shall be full port, with stainless steel ball and stem.

E. Steam valves shall have stainless steel trim.

F. VAV terminal reheat, zone reheat and fan coil unit valves shall be modulating 0-10vdc actuators, and fail in the last position.

G. Cabinet unit heaters, unit heaters and fin tube radiation shall be two-position and fail open.

H. Air handling units shall have ball or globe type valves, modulating 0-10 vdc fail open valves. Failsafe mode on reheat valve will be determined on a case by case basis.

   1. Steam heat exchanger valves shall be globe type, modulating 2-10 vdc and fail closed.

I. Primary flow isolation valves shall be butterfly type, two-position, fail in last position and have full open and closed end switches.

J. A capacitor type failsafe actuator will be used on preheats which can be set to 10% open when in failure mode. This can help prevent damage of overheating air handling equipment.

   1. Valves shall be manufactured by Belimo. Any deviation will need Maintenance & Operations and Sustainability, Energy & Engineering personnel approval based on design needs and justification.

2.9 AIR FLOW MEASUREMENT

A. Pitot type air flow measurement is preferable providing the conditions for acceptable accuracies exist.

B. Where lower velocity measurement is required or poor duct configuration, hot wire or vortex shedding devices may be required.

C. EBTRON Gold series is the preferred airflow monitoring station.

## 2.10 WATER FLOW MEASUREMENT

A. A magnetic insertion type meter shall be used. (Onicon). Please reference University of Delaware's Energy Metering Design Guideline 25 05 00.

## 2.11 SAFETY CONTROLS

A. Safety controls will be used to prevent injuries and loss of equipment. Safeties will be hardwired to devices to perform specific actions. All safety controls should also be wired as inputs for monitoring/alarming.

B. A freeze stat will be used to protect equipment that may freeze. Manual Reset type will be used.

C. A manual-reset high and/or low pressure switch shall protect air handling apparatus from duct damage. Switch to be installed in a location accessible without a ladder if possible.

D. An aquastat installed on HTX (Heat Exchanger) leaving piping (set to 200 degree F.) will be interlocked with the steam valves to prevent water side steam creation.

E. A local exhaust duct pressure sensor and hood monitor shall alert laboratory operators upon a loss of exhaust air flow. The pressure sensor acts as an input to the lab controller with the monitor wired as an output.

F. Smoke detection shall be provided by others. For addressable systems, a fire control relay shall be mounted within 3 feet of the BAS panel. This relay will be hardwired to shut down the associated equipment.

G. Isolation dampers shall be furnished with end switches hardwired to fan start circuit preventing fans from starting with dampers closed.

H. Safeties will be maintained whether an HOA is in hand or auto.

I. Humidifiers will be provided with high limits and shall be inputs to the BAS.

## 2.12 LAB DESIGN CRITERIA

A. The lab airflow control is based on hood operating (high) flow (CFM) and hood standby (low) flow (CFM).

B. The design air change rate is 8 during the occupied hours and 4 during unoccupied hours.

C. Fume Hood design face velocity is between 100-125 fpm, feet per minute.

D. Design hood maximum flow is based on 50% of the full hood face opening. This would be horizontal sashes full open and vertical sash hoods at 50% open (normally 18 inches).

E. The lab/hood control is DDC controlled. (Not Phoenix).

F. The Phoenix air valves are electronically actuated and two flows only. Phoenix valve fail to occupied flow (when electric control voltage is not present).

G. Each hood valve has a sister supply valve actuated by the same signal.

1. The air valves are the only Phoenix equipment used.

H. The fume hoods in low hood density labs, as indicated by hood flows below 4 air changes per hour, shall use constant volume Phoenix valves. The lab shall also have VAV air terminals for air flow tracking and temperature control.

I. Vertical sash hoods use sash position sensors to alarm locally at the hood when above 50% open and for hood mode control.

J. Horizontal sash hoods use hood differential pressure for hood mode control.

K. Two position hoods will be provided with a manual-reset emergency illuminated pushbutton. When depressed, the hood will be indexed to the high/occupied flow mode (hard-wired).

L. A local exhaust duct pressure sensor and hood monitor shall alert laboratory operators upon a loss of exhaust air flow. The pressure sensor acts as an input to the lab controller with the monitor wired as an output.

M. Air flow measuring devices (pitot or thermal type) shall not be used in any ductwork containing chemical fumes or particulates.

N. There shall be no recirculation of fume hood exhaust, local ventilation exhaust or general HVAC make-up air in laboratories or spaces where airborne non-nuisance contaminants can be generated. In areas where there is a high rate of generation of airborne nuisance contaminants generated or expected, a risk evaluation must be performed to determine if the air can be recirculated.

END OF SECTION