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1. **Design Criteria:**
 - a. The specific design criteria for Air Terminal Box Controls is described below.
2. **Reference Standards:** To be referenced by the Project Design Professional.
3. **Submittals to be reviewed by University:**
 - a. Provide a separate VAV Box submittal with a room schedule to include cooling maximum, cooling minimum, heating maximum, heating minimum, occupied & unoccupied set points.
 - b. Provide panel layout wiring detail to VAV box manufacturer with specified wire manufacturer, wire size & number, tubing manufacturer and part number.
4. **Products, Materials & Equipment:**
 - a. All air terminal boxes shall be purchased by the HVAC contractor. Successful terminal box manufacturer shall receive the terminal box controller and actuator from the Automatic Temperature Control Contractor and mount them onto the boxes at the box factory. The HVAC Contractor shall pay for the installation of the controllers, actuators, etc., onto the boxes. The HVAC Contractor shall coordinate shipment of the controllers to the air terminal box manufacturer and provide the controls to the box manufacturer in a coordinated sequence to enhance the construction phasing.
 - b. The following control manufacturers shall be acceptable for CFM tracking air terminal box controls contingent on compliance with the specifications. Only branch marketed (factory provided) versions of manufacturer's hardware and software shall be acceptable.
 - i. Johnson Controls
 - ii. Honeywell
 - c. The DDC CFM tracking air terminals shall be totally integrated with the central automation system.
 - d. While the following type of air terminal configurations shall be required, ALL air terminal controllers shall be a full variable air volume type:
 - i. Variable Air Volume Supply
 - ii. Constant Volume (with heat coil) Supply.
 - iii. Combination Variable/Constant Volume (with heat coil) Supply.

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- iv. Variable Volume Exhaust.
- v. Variable Control Volume Exhaust.
- vi. The Automatic Temperature Control Contractor shall provide all necessary factory and/or field labor for complete calibration and adjustment of the airflow control components and shall be responsible for setting all control setpoints, operating sequences and alarming systems contained within the airflow control centers to produce the following overall system performance.
- vii. Air terminal reheat valves shall be installed by the HVAC contractor. Air terminal and actuators shall be separate devices. Actuators shall be fully modulating electronic type (0-10V) and furnished by the Automatic Temperature Control Contractor.
- viii. Air velocity sensor shall be sized by the Automatic Temperature Control Contractor to control through full range of minimum and maximum CFM's as specified in the Contract Documents.
- e. Room Temperature Sensor (with Setpoint Control)
 - i. In general, only enclosed private offices shall have open setpoint adjustment sensors. Room sensors with integral setpoint adjustment shall be provided where shown on the Drawings. Controller shall be capable of receiving both adjustments from the sensor and separate EEPROM communications interface. The sensors shall be supplied by the controller manufacturer. The room temperature sensors shall be an RTD type room temperature sensor and shall have an RS232C communications port. A single cable interface from RS232 to an RJ48 jack on the space sensor is acceptable. Room sensors shall have an accuracy of $\pm 2\%$ at 70°F with a tolerance of 0.4°F. The unit shall provide room temperature data to the controller. The communication port shall allow direct communication to both of the pair of air terminals directly associated with the sensor, via handheld laptop computer.
 - ii. Control of each pair of terminal boxes shall be stand-alone (one [1] controller) and shall not depend on control information from any other Air Terminal box controller for primary control. Failure of any component, including the individual microprocessor controlling the unit, shall not cause interruption of the control of any other VAV box controller. Controller shall have programmable parameters stored in a

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non-volatile EEPROM. Each controller shall be capable of addressing read-only memory for a specific integrated circuit containing all logic analog amplifiers with programmable gain and offset, analog to digital converter for RS-485 communication. No battery back-up shall be necessary. Controller shall also have capabilities of random-access memory operating at a communication rate of 4800 baud as standard. Software capabilities shall have multiple stand-alone control strategies which shall be programmed at the factory through service tool or laptop computer, or BAS active strategy initiated through BAS communications or physical device such as pressure switches, duct sensors, etc., as indicated. The control system shall be capable of tracking one exhaust box based upon the combined supply airflows of multiple supply boxes.

- iii. Temperature sensors shall reside on the controller bus, not the main network bus.
- iv. The following information shall be communicated into the front end and the local room sensors:

Room Without Fume Hood			
Item	Readout	(Units)	Adjustment
Room CFM Differential (Actual	Yes	(Vol.)	Yes
Room Temp. Differential (Actual)	Yes	(°F)	Yes
Supply Volume	Yes	(CFM)	Yes
Exhaust volume	Yes	(CFM)	Yes
Temperature Setpoint	Yes	(°F)	Yes
Differential Volume Setpoint	Yes	(CFM)	Yes
Discharge Air Temperature	Yes	(°F)	Yes
Discharge Air Temp. Reset Setpoint	Yes	(°F)	Yes
Min./Max. Htg & Cooling Setpoints Occupied & Unoccupied	Yes	(°F)	Yes

5. **Installation:**

- a. All work to be installed per manufacturer's instructions and recommendations.
- b. All sensors to be labeled according to the controls submittals.
- c. All bus wiring shall have labels on each end of wire indicating to & from which devices.
- d. Transformer banks shall be sized appropriately and located in serviceable locations.

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- e. Graphic representations of rooms to include:
 - i. Occupied cooling max; cooling min.; heating max.; heating min.
 - ii. Unoccupied cooling max; cooling min.; heating max.; heating min.
 - iii. Discharge air temperature and reset setpoint.
 - iv. Space temperature & setpoint/damper command/actual CFM's.
 - f. In conjunction with the system start-up, the Automatic Temperature Control Contractor shall instruct the Owner's personnel in the proper operation of the airflow system.
6. **Warranties:**
- a. The Automatic Temperature Control Contractor shall guarantee the proper operation of the system and furnish all required service for one (1) year from the date of system acceptance.