AirTest™
Sensors That Make Buildings Smart!

Suggested CO_2 Control Sequence Of Operation

Installation

Coverage: One sensor should be used for each zone of major occupancy or per air handling device if a number of devices serve a large zone. If occupancy density/patterns/usage are different in two adjacent areas each area should be considered a separate zone.

Generally one sensor can serve up to 5,000 sq feet. Larger coverage is possible in theaters, gyms and large open retail spaces. An open office space with parameter offices can generally be controlled with one sensor in the central space (up to 5000 sq ft). In office building floor plates divided up into separate suites, at least one sensor per suite is recommended.

Sensor Placement: Sensors should be placed so that they can take a representative sample of CO_2 concentrations in each major occupied zone. Sensors can be placed in the space using similar location criteria to thermostats. An addition consideration is that the sensor should not be in a location where people might regularly breath directly into the sensor. The TR9290 and TR9293 CO_2 sensors from AirTest are designed for wall mounting. Sensors should be placed 4-6 Feet above the floor.

An alternative location is to place the sensor inside or above the return air grill leaving the space. The AirTest TR9291 CO_2 sensor is designed for this application.

Sampling in central return air ducts is not recommended for two reasons:

1. In many installations with ceiling return plenums, leaky supply air duct will dilute CO_2 concentrations in the plenum and potentially provide a lower reading of CO_2 than is actually occurring in the space.
2. In returns serving multiple zones, the CO_2 measured will reflect an average of conditions in all spaces. This means that some spaces could be highly under ventilated, and others over ventilated. Typical ventilation design practice requires an engineer to ensure the system provides ventilation to specific zones based on their actual or design occupancy. Return sensing does not meet these criteria.

Sequence Of Operation

Economizer Control: The CO_2 sensor should provide control to the air handler outside air damper whenever the fresh air economizer cannot be used. If outside air is suitable for free cooling, and there is a demand for cooling the economizer shall have priority.

Minimum Position for CO_2 Control: The system shall be configured to provide a base ventilation rate to the space to control non-occupant related sources in the space. For most applications this base ventilation rate is 20-30% of the **design ventilation rate** (DVR) for the space (DVR= maximum occupancy X target ventilation rate per person). This base level of ventilation should be provided during all occupied hours. The damper can be closed during unoccupied hours.

Maximum Position for CO_2 Control: The maximum position of the damper during CO_2 control should be set to equal the DVR for the space.

Control: The outside air damper will be modulated between the minimum position described above and the maximum position described above necessary to provide the DVR to the space based on CO_2 concentrations. It is highly recommended that a proportional control approach be used to modulate the damper based on CO_2 readings between a lower and upper control limit. This proportional modulation will ensure that 15 cfm per person of outside air is provided at all times based on actual occupancy.

> **Upper Control Limit:** The proportional control strategy should be designed to position the damper to provide the DVR when the CO_2 levels are equivalent to the equilibrium concentration Of CO_2 corresponding to the target CFM per person ventilation rate in the space. For 20 cfm/person the upper set point is 930 ppm, for 15 cfm per person the upper set point is 1100 ppm. (This assumes a typical outside concentration of 400 ppm)
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> **Lower Control Limit:** The proportional control strategy would position the damper in the minimum position until indoor levels exceed a certain CO_2 threshold above outside levels. Typically this threshold should be set at 150 to 200 ppm CO_2 above outside levels of at 550 to 600 ppm.
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> **Multiple Sensors Controlling a Single AHU:** Control should be based on the highest CO_2 concentration measured in all spaces served by the air handler. This can be accomplished within the programming capabilities of most building control systems. Alternatively, transducers are available that can take in multiple inputs and pass through the highest value. Contact AirTest for recommended vendors.

Sensor Self-Calibration: All AirTest CO_2 sensor are self calibrating and require no maintenance over their rated life of 15 years. The self-calibrating feature used by these sensor is based on the fact that when buildings are unoccupied, inside concentrations of CO_2 will typically drop to outside levels, which are typically around 400 ppm. The CO_2 sensor is programmed to look for these low points that might occur over a 3-week period. If the sensor sees that it is out of adjustment with the lowest concentration measured over three weeks, the sensor automatically adjust its calibration. To ensure optimum operation of this self-calibration feature, it is highly recommended that the control sequence of the system include a periodic per occupancy purge of the space to ensure that the sensors see true outside/background levels.

For further information on the self-calibration feature in the AirTest CO_2 sensors go to:
http://www.airtesttechnologies.com/support/reference/autocalpaper.pdf

Please contact AirTest if you need further guidance on installation of CO_2 sensors or assistance with your other building sensing needs.
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