# DESCRIPTION

**Sequence of Operation**

The AQMS will generate a value used to execute DCV for the BMS. This value is often called "percent contaminated". See {space}_contaminated in the BACnet Points cutsheet.

The BMS will control the airflow control valves in response to the greatest of the following demands:
1. Temperature control
2. DCV value from the AQMS

The temperature controls will operate independent of the AQMS and shall override the DCV value when required to maintain comfort, space pressurization, and well-being. The AQMS shall provide a value to be used for DCV that corresponds to the greatest contaminant concentration sensed through the duct probes and/or faceplates.

The sensed contaminants, as selected above, shall be measured against a clean supply air reference point that shares the same sensor pack and is representative of the air being supplied to the monitored space. This methodology cancels sensor drift and provides a differential measurement that is ultimately converted into a DCV value.

The value to be used for DCV shall correspond to an Air Change per Hour (ACH) ventilation rate that is defined by the BMS. The concentration trigger limit of each contaminant shall be determined by the BMS. Although establishing the ACH is not part of Antrum's scope, Antrum, or the Antrum supplier, will participate in meetings or calls with the necessary parties as needed.

- When contaminant concentrations sensed by the AQMS are all below their low thresholds as defined, the DCV value shall be 0.
- When contaminant concentrations sensed by the AQMS are all at or above their high thresholds as defined, the DCV value shall be 100.
- When contaminant concentrations sensed by the AQMS are all between their low and high thresholds as defined, the DCV value shall be between 0 and 100, and shall represent the percentage of contamination, as defined by the thresholds, of the contaminant with the greatest percentage of contamination.

For example, using Table 1 below if the $CO_2$ reading was 75ppm above the clean air reference measurement of 400, then the percent contamination according to $CO_2$ see equation 1:

(475 – 400) / (3000 – 475) = 0.285 = 3% Contaminated **(Equation 1)**

Then the DCV or '{space}_contaminated' value would then be 3. The suggested sequence for scaling the contamination reading to an ACH and ultimately a control signal can be seen in Appendix A.

The actual ACH shall be dynamic and equal to the higher of the temperature control demand and the DCV value from the AQMS.

Table 1 shows the default contaminant thresholds. These can be changed using the System Config app in antrumEYE.

**Table 1: Default Contaminant Thresholds**

| | **0** | **100** | **%** |
|---|---|---|---|
| **$CO_2$** | 400 | 3,000 | ppm |

***Test Mode***

The AQMS shall come equipped with a test mode that can be entered by writing to the antrumX Gateway from the BMS (see test_mode in the BACnet Points cutsheet). The purpose of entering test mode is primarily for commissioning to allow users to test the functionality of their DCV sequence by passing a preset data package from the antrumX Gateway to the BMS to ultimately observe the resultant change in ACH. To facilitate this, when test mode is initiated, all contaminant levels will be set to the 100% contaminant level as specified in System Config. Test mode can be initiated or terminated at any point by setting the value of the BACnet point.

# APPENDIX A

**Suggested Control Sequence**

A proportional control scheme is recommended where the Gain is adjustable and the Integral time is 0 and the Rise/Fall time is 1.

Air samples are taken from each monitored space about every 15 minutes. The AQMS determines a "percent contaminated" value. That value can be subscribed to by, or written directly to, the BMS or other BACnet device. The control loop in the application shall be configured to accept the percent contaminated value from the AQMS and have a setpoint of zero. The loop will therefore be active anytime the percent contaminated is over 0.

The output of the controller shall be used to scale the air change rate in the monitored space from the minimum to the maximum ventilation setpoint.

**Example 1:** Loop Setpoints: Gain 1.0, Integral Time 0, Rise/Fall time 1

The output of the ventilation controller directly tracks the '%_contaminated' point (red line) from the AQMS.

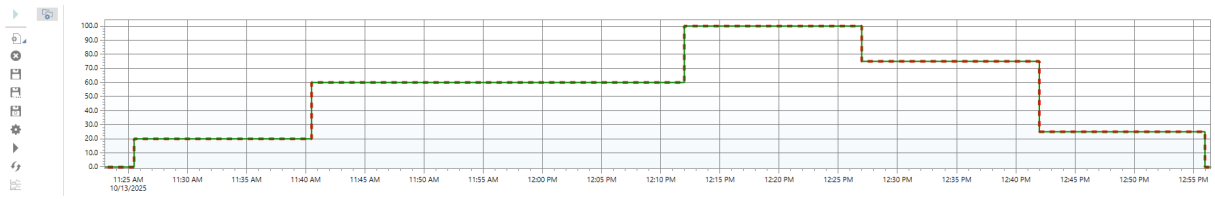

**Figure 1: Proportional Loop with Gain of 1**

**Example 2:** Loop Setpoints: Gain 2.0, Integral Time 0, Rise/Fall time 1

The output of the ventilation controller is two times the '%_contaminated' point (red line) from the AQMS. The output of the ventilation controller will be 100% when '%_contaminated' is greater than or equal to 50%.



**Figure 2: Proportional Loop with Gain of 2**

Furthermore:

- A Gain of 4.0 will result in the output of the ventilation controller being at 100% when '%_contaminated' is greater than or equal to 25%.
- A Gain of 5.0 will result in the output of the ventilation controller being at 100% when '%_contaminated' is greater than or equal to 20%.
- A Gain of 10.0 will result in the output of the ventilation controller being at 100% when '%_contaminated' is greater than or equal to 10%.