ADDENDA

ASHRAE Addendum j to
ASHRAE Guideline 36-2021

High-Performance Sequences of Operation for HVAC Systems

Approved by ASHRAE and the American National Standards Institute on February 29, 2024.

This addendum was approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. Instructions for how to submit a change can be found on the ASHRAE® website (www.ashrae.org/continuous-maintenance).

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(This foreword is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

FOREWORD

The purpose of this addendum is to separate the ventilation logic for the Single Zone VAV Air Handling Units (SZVAV AHU) and VAV terminal units in the generic ventilation zones section. As currently written, variables such as Vmin, unrelated to SZVAV AHU ventilation logic, remain in the generic ventilation sections whether or not they are used.

Note: In this addendum, changes to the current guideline are indicated in the text by underlining (for additions) and strikethrough (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum j to Guideline 36-2021

(IP and SI Units)

Revise Section 5.2.1 as follows:

5.2.1. Zone Minimum Outdoor Air and Minimum Airflow Setpoints

5.2.1.1. For every zone that requires mechanical ventilation, the zone minimum outdoor airflows and setpoints shall be calculated depending on the governing standard or code for outdoor air requirements.

5.2.1.2. For VAV Terminal units, ~~S~~see Section 3.1.2 for zone minimum airflow setpoint Vmin.

The engineer must select between ventilation logic options:

If the project is to comply with ASHRAE Standard 62.1 ventilation requirements, use Section 5.2.1.3 and delete Section 5.2.1.4.

If the project is to comply with California Title 24 ventilation requirements, use Section 5.2.1.4 and delete Section 5.2.1.3.

5.2.1.3. For compliance with the Ventilation Rate Procedure of ASHRAE Standard 62.1-2016, outdoor air and zone minimum setpoints shall be calculated as follows:

a. See Section 3.1.1.2 for zone ventilation setpoints.

b. VAV Terminal Units

1. Determine zone air distribution effectiveness Ez.

i. If the DAT at the terminal unit is less than or equal to zone space temperature, Ez shall be equal to EzC (default to 1.0 if no value is scheduled).

ii. If the DAT at the terminal unit is greater than zone space temperature, Ez shall be equal to EzH (default to 0.8 if no value is scheduled).

2. Vbz-P* is the population component of the required breathing zone outdoor airflow. The normal value of Vbz-P* shall be Vbz-P. Vbz-A* is the area component of the required breathing zone outdoor airflow. The normal value of Vbz-A* shall be Vbz-A.

3. Vmin

   i. Shall be equal to Voz as calculated in Section 5.2.1.3.b.5 below if Vmin in Section 3.1.2 is "AUTO" and the associated air handler has been supplying 100% outdoor air (outdoor air damper fully open; return air damper fully closed) for 10 minutes;

   ii. Else shall be equal to 1.5 * Voz as calculated in Section 5.2.1.3.b.5 below if Vmin in Section 3.1.2 is "AUTO" and the associated air handler is not supplying 100% outdoor air;

   iii. Else shall be equal Vmin as entered in Section 3.1.2.

4. The occupied minimum airflow Vmin* shall be equal to Vmin except as noted in Section 5.2.1.3.b.5.

5. The required zone outdoor airflow Voz shall be calculated as Voz = (Vbz-A* + Vbz-P*)/Ez, where the normal values of Vbz-A* and Vbz-P* are modified if any of the following conditions are met, in order from higher to lower priority:

   i. If the zone is in any mode other than Occupied Mode, and for zones that have window switches and the window is open: Vbz-P* = 0, Vbz-A* = 0, and Vmin* = 0.

   ii. If the zone has an occupancy sensor, is unpopulated, and occupied-standby mode is permitted: Vbz-P* = 0, Vbz-A* = 0, and Vmin* = 0.

   iii. Else, if the zone has an occupancy sensor, is unpopulated, but occupied-standby mode is not permitted: Vbz-P* = 0 and Vmin* = Vmin.

Occupied-standby mode applies to individual zones, is considered a zonal subset of Occupied Mode, and is not considered a zone-group operating mode.

   iv. If the zone has a CO_2 sensor:

   (a) See Section 3.1.1.3~~3.1.1.2.b.3~~ for CO_2 setpoints.
   (b) During Occupied Mode, a P-only loop shall maintain CO_2 concentration at setpoint; reset from 0% at setpoint minus 200 PPM and to 100% at setpoint.
   (c) Loop is disabled and output set to zero when the zone is not in Occupied Mode.

CO_2 DCV is not yet well defined for Standard 62.1. RP-1747 is under way and should provide a detailed procedure. In the meantime, sequences have been included at the zone level, matching California's DCV approach as a first step. Because outdoor air rates at the AHU level dynamically calculate outdoor air rates using the Standard 62.1 multiple-spaces procedure, compliance with the standard is assured. Doing no DCV at all is not an option, because it is required by Standard 90.1-2016.

   (d) For cooling-only VAV terminal units, reheat VAV terminal units, constant-volume series fan-powered terminal units, dual-duct VAV terminal units with mixing control and inlet airflow sensors, dual-duct VAV terminal units with mixing control and a discharge airflow sensor, or dual-duct VAV terminal units with cold-duct minimum control:

      (1) The CO2 control loop output shall reset both the occupied minimum airflow setpoint (Vmin*) and the population component of the required breathing zone outdoor airflow (Vbz-P*) in parallel. Vmin* shall be reset from the zone minimum airflow setpoint Vmin at 0% loop output up to maximum cooling

airflow setpoint Vcool-max at 100% loop output. Vbz-P* shall be reset from 0 L/s (0 cfm) at 0% loop output up to the Vbz-P at 100% loop output. See Figure 5.2.1.3-1.

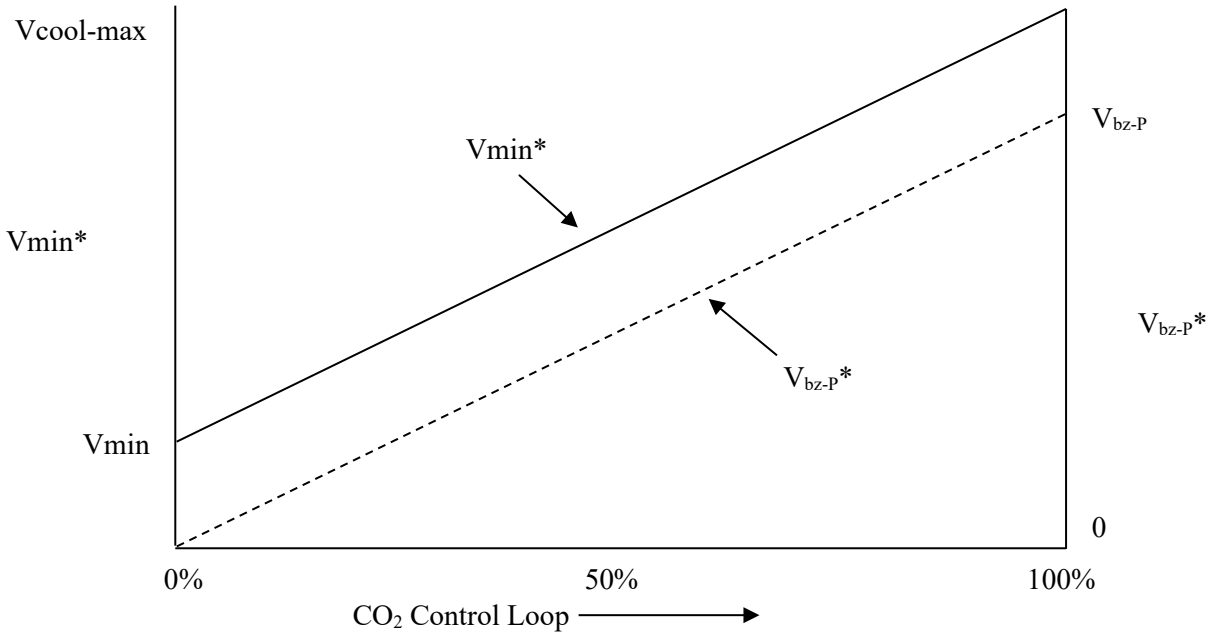

Figure 5.2.1.3-1 Vmin* and Vbz-P* reset with CO2 loop.

The CO_2 control loop graph in Figure 5.2.1.3-1 is provided as a visual representation of the reset logic and is not representative of magnitude of Vbz-P in relation to Vbz-A or Vmin*.*

(e) For parallel fan-powered terminal units:

(1) Determine VCO2-max as follows:
(2) When the Zone State is cooling, VCO2-max is equal to the maximum cooling airflow setpoint Vcool-max.
(3) When the Zone State is heating or deadband, VCO2-max is equal to Vcool-max minus the parallel fan airflow

This logic prevents the total supply airflow from exceeding Vcool-max, which could create diffuser noise problems.

(4) The CO2 control loop output shall reset both the occupied minimum airflow setpoint Vmin* and the population component of the required breathing zone outdoor airflow Vbz-P* in parallel. Vmin* shall be reset from the zone minimum airflow setpoint Vmin at 0% loop output up to maximum cooling airflow setpoint VCO2-max at 100% loop output. Vbz-P* shall be reset from 0 L/s (0 cfm) at 0% loop output up to the Vbz-P at 100% loop output. See Figure 5.2.1.3-2.

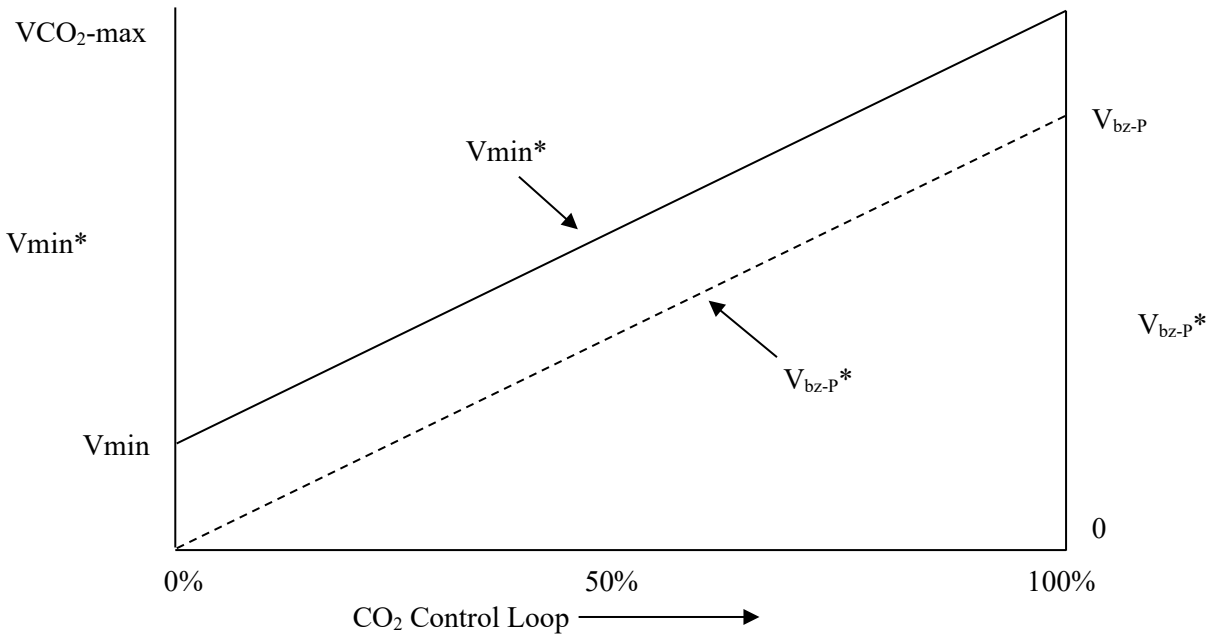

Figure 5.2.1.3-2 Vmin* and Vbz-P* reset with CO2 loop (parallel fan-powered).

The CO_2 control loop graph in Figure 5.1.2.1.3-2 is provided as a visual representation of the reset logic and is not representative of magnitude of Vbz-P in relation to Vbz-A or Vmin*.*

c. Single-Zone VAV Air-Handlers

1. Determine zone air distribution effectiveness Ez.

   i. If the SAT at the air handling unit is less than or equal to zone space temperature, Ez shall be equal to EzC (default to 1.0 if no value is scheduled).

   ii. If the SAT at the air handling unit is greater than zone space temperature, Ez shall be equal to EzH (default to 0.8 if no value is scheduled).

2. Vbz-P* is the population component of the required breathing zone outdoor airflow. The normal value of Vbz-P* shall be Vbz-P. Vbz-A* is the area component of the required breathing zone outdoor airflow. The normal value of Vbz-A* shall be Vbz-A.

3. The minimum outdoor air setpoint MinOAsp shall be equal to Voz.

4. The required zone outdoor airflow Voz shall be calculated as Voz = (Vbz-A* + Vbz-P*)/Ez, where the normal values of Vbz-A* and Vbz-P* are modified if any of the following conditions are met, in order from higher to lower priority:

   i. If the zone is in any mode other than Occupied Mode, and for zones that have window switches and the window is open: Vbz-P* = 0 and Vbz-A* = 0.

   ii. If the zone has an occupancy sensor, is unpopulated, and occupied-standby mode is permitted per Section 3.1.1.2.a.5: Vbz-P* = 0 and Vbz-A* = 0.

   iii. Else, if the zone has an occupancy sensor, is unpopulated, but occupied-standby mode is not permitted per Section 3.1.1.2.a.5: Vbz-P* = 0.

Occupied-standby mode applies to individual zones, is considered a zonal subset of Occupied Mode, and is not considered a zone-group operating mode.

iv. If the zone has a CO_2 sensor:

(a) See Section 3.1.1.3 for CO_2 setpoints.
(b) During Occupied Mode, a P-only loop shall maintain CO_2 concentration at setpoint; reset from 0% at setpoint minus 200 PPM and to 100% at setpoint.
(c) Loop is disabled and output set to zero when the zone is not in Occupied Mode.

CO_2 DCV is not yet well defined for Standard 62.1. RP-1747 is under way and should provide a detailed procedure. In the meantime, sequences have been included at the zone level, matching California's DCV approach as a first step. Because outdoor air rates at the AHU level dynamically calculate outdoor air rates using the Standard 62.1 multiple-spaces procedure, compliance with the standard is assured. Doing no DCV at all is not an option because it is required by Standard 90.1-2016.

~~v. For SZVAV AHUs:~~

(d) The minimum outdoor air setpoint MinOAsp is equal to Voz. The CO2 control loop output shall reset the population component of the required breathing zone outdoor airflow Vbz-P* from 0 L/s (0 cfm) at 0% loop output up to Vbz-P at 100% loop output. See Figure 5.2.1.3-3.

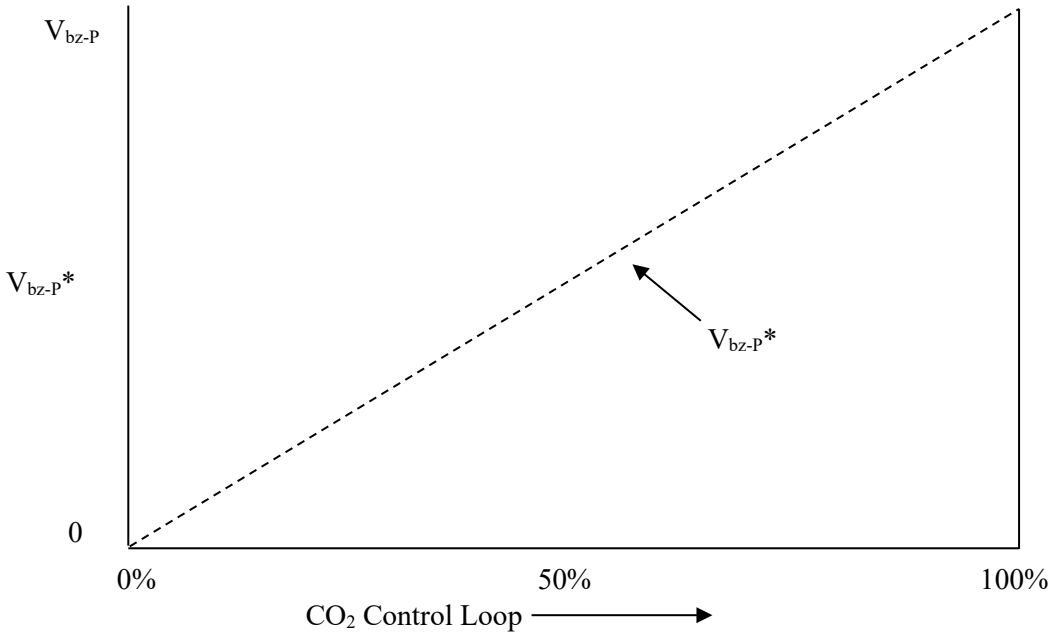

Figure 5.2.1.3-3 Vbz-P* reset with CO2 loop (SZVAV).

The engineer must select between ventilation logic options:

If the project is to comply with ASHRAE Standard 62.1 ventilation requirements, use Section 5.2.1.3 and delete Section 5.2.1.4.

If the project is to comply with California Title 24 ventilation requirements, use Section 5.2.1.4 and delete Section 5.2.1.3.

5.2.1.4. For compliance with California Title 24, outdoor air setpoints shall be calculated as follows:

a. See Section 3.1.1.2 for zone ventilation setpoints.

b. VAV Terminal Units

1. Determine the zone minimum outdoor air setpoints Zone-Abs-OA-min and Zone-Des-OA-min.

Zone-Abs-OA-min is used in terminal-unit sequences and air-handler sequences. Zone-Des-OA-min is used in air-handler sequences only.

i. Zone-Abs-OA-min shall be reset based on the following conditions in order from highest to lowest priority:

(a) Zero if the zone has a window switch and the window is open.
(b) Zero if the zone has an occupancy sensor and is unpopulated and is permitted to be in occupied-standby mode per Section 3.1.1.2.b.3.

The term "populated" is used instead of "occupied" to mean that a zone occupancy sensor senses the presence of people, because the term "occupied" is used elsewhere to mean "scheduled to be occupied."

(c) Varea-min if the zone has a CO_2 sensor.
(d) Zone-Des-OA-min otherwise.

ii. Zone-Des-OA-min is equal to the following, in order from highest to lowest priority:

(a) Zero if the zone has a window switch and the window is open.
(b) Zero if the zone has an occupancy sensor, is unpopulated, and is permitted to be in occupied-standby mode per Section 3.1.1.2.b.3.
(c) The larger of Varea-min and Vocc-min otherwise.

2. Vmin

i. Shall be equal to Zone-Abs-OA-min if Vmin in Section 3.1.2 is "AUTO";

ii. Else shall be equal to Vmin as entered in Section 3.1.2.

3. The occupied minimum airflow Vmin* shall be equal to Vmin except as noted below, in order from highest to lowest priority:

i. If the zone has an occupancy sensor and is permitted to be in occupied-standby mode per Section 3.1.1.2.b.3, Vmin* shall be equal to zero when the room is unpopulated.

ii. If the zone has a window switch, Vmin* shall be zero when the window is open.

iii. If the zone has a CO_2 sensor:

(a) See Section 3.1.1.3~~3.1.1.2.b.3~~ for CO_2 setpoints.
(b) During Occupied Mode, a P-only loop shall maintain CO_2 concentration at setpoint; reset from 0% at setpoint minus 200 PPM and to 100% at setpoint.
(c) Loop is disabled and output set to zero when the zone is not in Occupied Mode.
(d) For cooling-only VAV terminal units, reheat VAV terminal units, constant-volume series fan-powered terminal units, dual-duct VAV terminal units with mixing control and inlet airflow sensors, dual-duct VAV terminal units with mixing control and a

discharge airflow sensor, or dual-duct VAV terminal units with cold-duct minimum control:

(1) The CO2 control loop output shall reset the occupied minimum airflow setpoint Vmin* from the zone minimum airflow setpoint Vmin at 0% up to maximum cooling airflow setpoint Vcool-max at 50%, as shown in Figure 5.2.1.4-1. The loop output from 50% to 100% will be used at the system level to reset outdoor air minimum; see AHU controls.

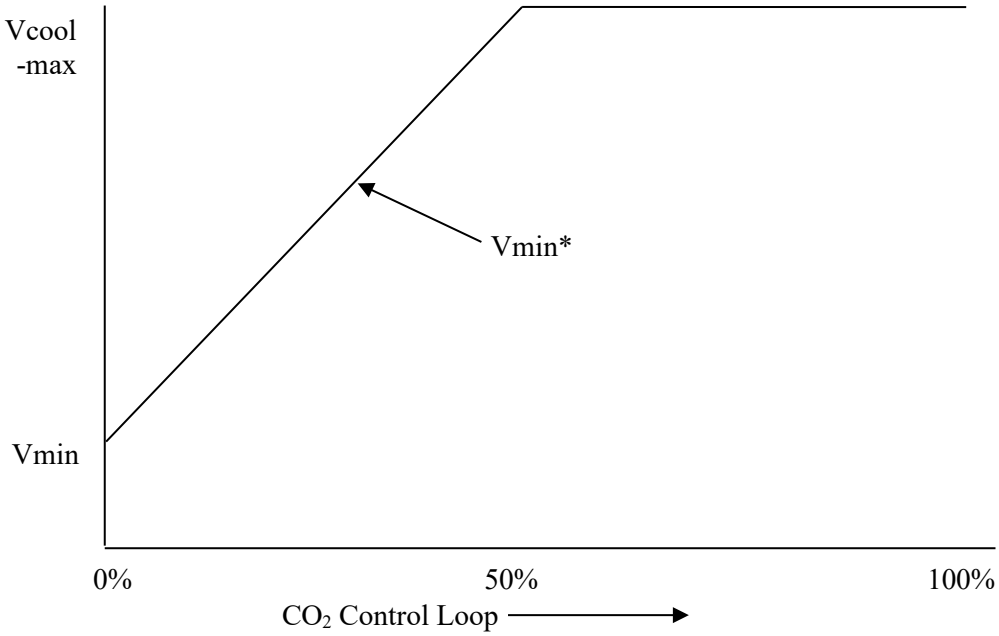

Figure 5.2.1.4-1 Vmin* reset with CO2 loop.

(e) For parallel fan-powered terminal units:

(1) Determine VCO2-max as follows:
(2) When the Zone State is cooling, VCO2-max is equal to the maximum cooling airflow setpoint Vcool-max.
(3) When the Zone State is heating or deadband, VCO2-max is equal to Vcool-max minus the parallel fan airflow

This logic prevents the total supply airflow from exceeding Vcool-max, which could create diffuser noise problems.

(4) The CO2 control loop output shall reset the occupied minimum airflow setpoint Vmin* from the zone minimum airflow setpoint Vmin at 0% up to maximum cooling airflow setpoint VCO2-max at 50%, as shown in Figure 5.2.1.4-2. The loop output from 50% to 100% will be used at the system level to reset outdoor air minimum; see AHU controls.

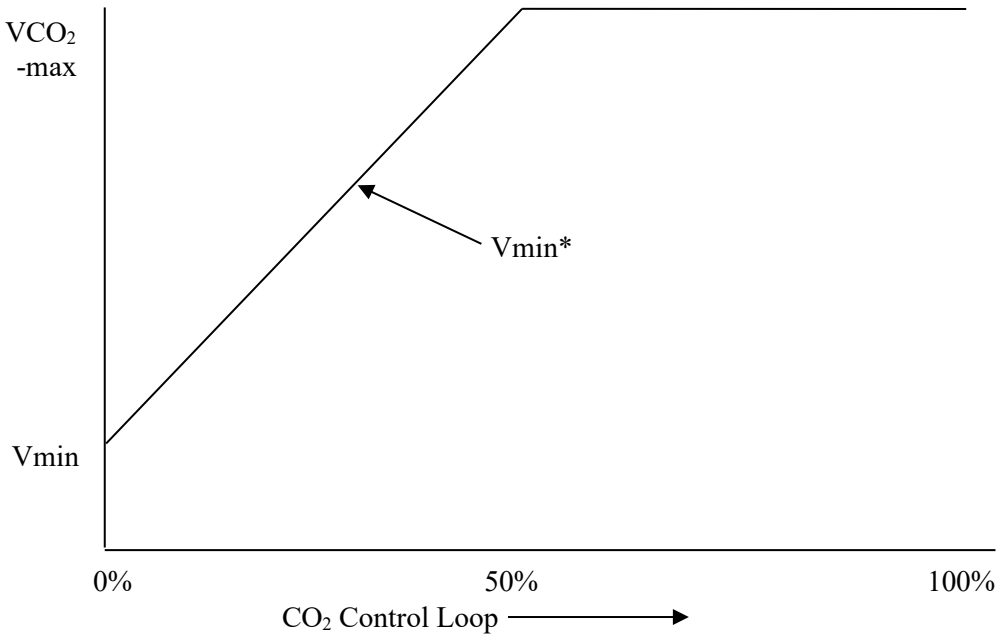

Figure 5.2.1.4-2 Vmin* reset with CO2 loop (parallel fan-powered).

c. ~~For SZVAV AHUs:~~Single-Zone VAV Air-Handlers

1. Determine the zone minimum outdoor airflow setpoint, MinOAsp.

i. MinOAsp shall be reset based on the following conditions in order from highest to lowest priority:

(a) Zero if the zone is in any mode other than Occupied Mode.
(b) Zero for zones that have window switches and the window is open.
(c) Zero if the zone has an occupancy sensor, is unpopulated, and is permitted to be in occupied-standby mode per Section 3.1.1.2.b.3.

The term "populated" is used instead of "occupied" to mean that a zone occupancy sensor senses the presence of people, because the term "occupied" is used elsewhere to mean "scheduled to be occupied."

(d) If the zone has a CO2 sensor:

(1) See Section 3.1.1.3 for CO_2 setpoints.
(2) During Occupied Mode, a P-only loop shall maintain CO_2 concentration at setpoint; reset from 0% at setpoint minus 200 PPM and to 100% at setpoint.
(3) Loop is disabled and output set to zero when the zone is not in Occupied Mode.
(4) The minimum outdoor air setpoint MinOAsp shall be reset based on the zone CO2 control-loop signal from MinOA at 0% signal to DesOA at 100% signal. See Figure 5.2.1.4-3.

(e) DesOA otherwise.

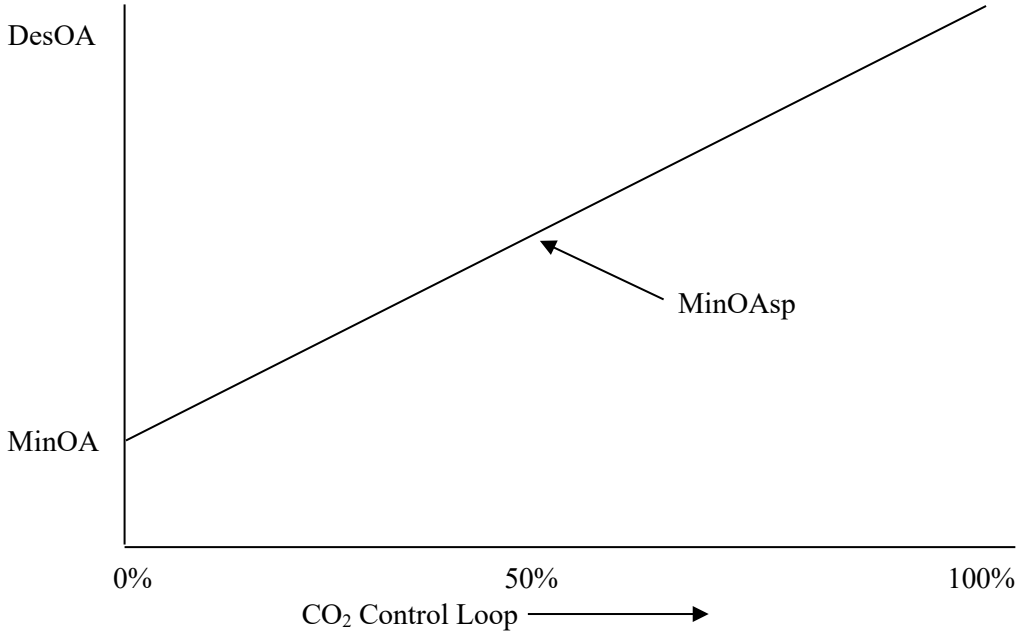

Figure 5.2.1.4-3 ~~Vmin*~~MinOAsp reset with CO2 loop (SZVAV).

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

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ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

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