ADDENDA

ASHRAE Addendum a to
ASHRAE Guideline 36-2018

High-Performance Sequences of Operation for HVAC Systems

Approved by ASHRAE on August 16, 2019.

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FOREWORD

Guideline 36 includes Section 5.1.16, "VAV Box Controllable Minimum," under Section 5, "Sequences of Operation." This addendum addresses the following issues:

a. The section is not actually a control sequence—it would not be programmed into a controller. Rather it contains instructions for how to calculate the controllable minimum.

b. The section includes two options for the controllable minimum. The first option includes this caveat:

VAV box controllers that stop moving the damper when they are unable to read an airflow signal may avoid the need to determine a minimum. When given a setpoint below controllable minimum, the controller will control as low as it can, which is the desired behavior. This assumes that duct static pressure will not decrease after this damper stop occurs, so this Option is not always a reliable approach to maintaining minimum airflow. Option 2 is more fool-proof and recommended for most applications.

It acknowledges this is not a reliable way to maintain minimum airflow.

c. The second option requires the following information:

1. The lowest controllable velocity pressure signal of the controller

2. The amplification factor of the VAV box flow probe

This information is not generally known to the designer, in part because the manufacturer of the controller and VAV box are often determined during the construction phase, well after the design phase, and because the controllable minimum velocity pressure is not always published.

To address these issues, this addendum proposes the following:

a. Move this section out of Section 5 to a new section under Section 3 and assign the task of determining the controllable minimums to the control contractor who is best equipped to know the required information needed to determine the controllable minimum.

b. Delete Option 1 because it is not reliable.

c. Improve the explanation of how to determine the minimum controllable velocity pressure using multiple sources, including an informative reference to ASHRAE Standard 195, which is a method of test for this value. (Standard 195 is currently under revision so that it better aligns with the controllable minimum equations in Guideline 36, but the standard is still useful in its current form.)

d. The calculation of inlet VAV box area is deleted because it assumed a round inlet, and not all VAV box inlets are round. The area data can be readily calculated by standard formulas.

Note: In this addendum, changes to the current standard 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 a to Guideline 36-2018

Create a new Section 3.3 and move Section 5.1.16 to this new section with edits shown.

3.3 Information Determined by Control Contractor

3.3.1~~5.1.16~~ VAV Box Controllable Minimum

~~5.1.16.1~~ This section is used to determine the lowest possible VAV box airflow setpoint (other than zero) allowed by the controls (Vm) used in VAV box control sequences. The minimums shall be stored as software points.

~~**5.1.16.2 Option 1.** If the VAV box controls simply stop moving the damper when the airflow reading becomes too low to register and then re-enables the damper when the airflow reading rises above that threshold, Vm shall be equal to zero.~~

~~*VAV box controllers that stop moving the damper when they are unable to read an airflow signal may avoid the need to determine a minimum. When given a setpoint below controllable minimum, the controller will control as low as it can, which is the desired behavior. This assumes that duct static pressure will not decrease after this damper stop occurs, so this Option is not always a reliable approach to maintaining minimum airflow. Option 2 is more fool-proof and recommended for most applications.*~~

~~**5.1.16.3 Option 2.** The minimum setpoint Vm shall be determined as follows:~~

a. First, d~~D~~etermine the velocity pressure sensor reading VPm in Pa (in. of water) that will give a reliable flow indication using product literature from the manufacturer of the VAV box controller. If this information is not ~~provided by~~available from the ~~sensor~~ controller manufacturer, ~~determine the velocity pressure that will result in a digital reading from the transducer and A/D converter of 12 bits or counts (assuming a 10-bit A/D converter). This is considered sufficient resolution for stable control~~assume 1% of the velocity pressure sensor's differential pressure range.

See also ASHRAE Standard 195, Method of Test for Rating Air Terminal Unit Control*, for guidance on determining the lowest controllable minimum velocity pressure.*

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b. Next, determine minimum setpoint Vm using either of the following:

1. **Option 1.** Determine the minimum velocity vm for each VAV box size and model. If the VAV box manufacturer provides an amplification factor F for the flow pickup, calculate the minimum velocity vm as

$$vm = 1.28\sqrt{\frac{VPm}{F}} \quad \text{(SI)}$$

$$vm = 4005\sqrt{\frac{VPm}{F}} \quad \text{(I-P)}$$

Where F is not known, in I-P units it can be calculated from the measured airflow at 1 in. of water signal from the VP sensor

$$F = \left(\frac{4005A}{CFM_{@1\text{ in. of water}}}\right)^2$$

where A is the nominal inlet duct area (ft^2), ~~equal to~~

$$A = \pi\left(\frac{D}{24}\right)^2$$

~~where D is the nominal duct diameter (in.).~~

Calculate the minimum airflow setpoint allowed by the controls (Vm) for each VAV box size as

$$Vm = vmA$$

c. **Option 2.** Use airflow vs. signal pressure data published by the manufacturer of the VAV box velocity pressure probe. Select a pair of values of airflow and velocity pressure signal as the rated operating point for the calculation, Vrated and VPrated. Use these values and the minimum controllable signal pressure to calculate the minimum controllable flow as follows:

$$Vm = Vrated\sqrt{\frac{VPm}{VPrated}}$$

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