STANDARD

ANSI/ASHRAE/IES Addendum u to
ANSI/ASHRAE/IES Standard 90.1-2022

Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings

Approved by ASHRAE and the American National Standards Institute on December 31, 2024, and by the Illuminating Engineering Society on December 19, 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 (https://www.ashrae.org/continuous-maintenance).

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FOREWORD

Addendum u addresses issues that have been reported with the minimum 50% turndown airflow defined in Section 6.5.3.2(b), which states the following:

> ***6.5.3.2(b)*** *All other units, including DX cooling units and chilled-water units that control the space temperature by modulating the airflow to the space, shall have modulating fan control. Minimum speed shall not exceed 50% of full speed. At minimum speed, the fan system shall draw no more than 30% of the power at full fan speed. Low or minimum speed shall be used during periods of low cooling load and ventilation-only operation.*

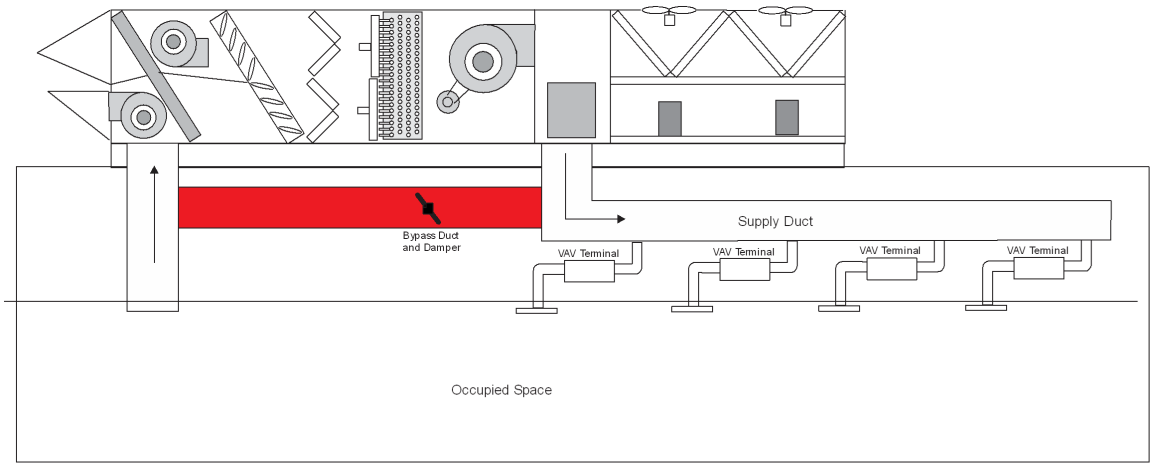
With the addition of occupied standby control as defined in Section 6.5.3.9, issues have been reported with variable-air-volume (VAV) systems that control space temperature by modulating airflow to the space (multizone VAV). The current minimum airflow requirements defined in Section 6.5.3.2 require a minimum turndown fan speed of 50%. Fifty percent is not acceptable for periods where the building occupancy is low and the ventilation airflow and required building airflow are significantly lower than the 50% minimum requirement. Fifty percent is well above the minimum design ventilation rates for typical buildings that use multizone VAV, and with occupied standby, the ventilation rates can be even lower when operating in ventilation-only mode. The "Minimum ANSI/ASHRAE Standard 62.1 Design Ventilation Rates" table shows minimum design ventilation rates for typical multizone VAV building applications.

Minimum ANSI/ASHRAE Standard 62.1 Design Ventilation Rates

Building Type	Average Design Ventilation Rate
Small Office	11.7%
Medium Office	19.2%
Large Office	19.9%
Outpatient	24.8%
Hospital	23.2%
Primary School	50.7%
Secondary School	54.4%

*Values based on ANSI/ASHRAE/IES Standard 90.1 reference building models

Systems with only a minimum 50% airflow turndown rate can result in cycling of equipment and poor control of the building VAV system and, in some cases, tripping of unit's safety devices. To solve this problem, some applications have been forced to add a bypass duct (see the figure below) to allow air to recirculate and to keep the unit from tripping on safeties; however, this increases annualized fan power and product installation costs.

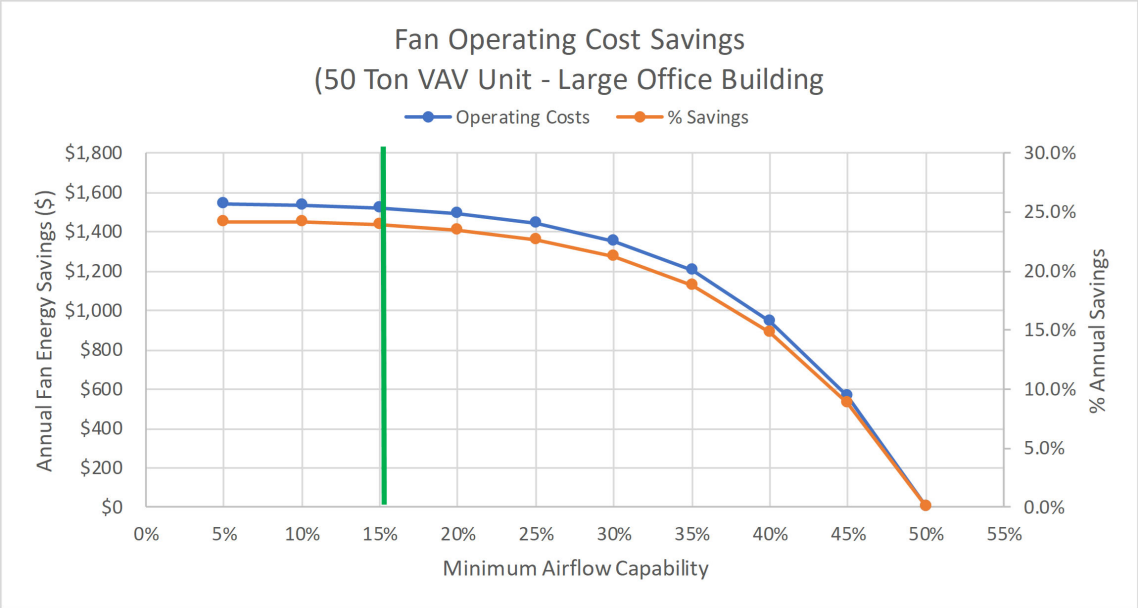


Multizone VAV systems today are equipped with inverter fan speed control and are capable of much lower speeds and turndown than the required minimum 50%. Addendum u reduces the minimum airflow for multizone VAV systems where the space temperature is controlled by modulating airflow from 50% to 15%. In addition, the current power reduction requirement of 30% at 50% airflow is much higher than what is delivered by variable speed inverter driver fan systems. Based on this, the fan system power requirements will be changed from 30% at 50% airflow to 16% at 15% airflow.

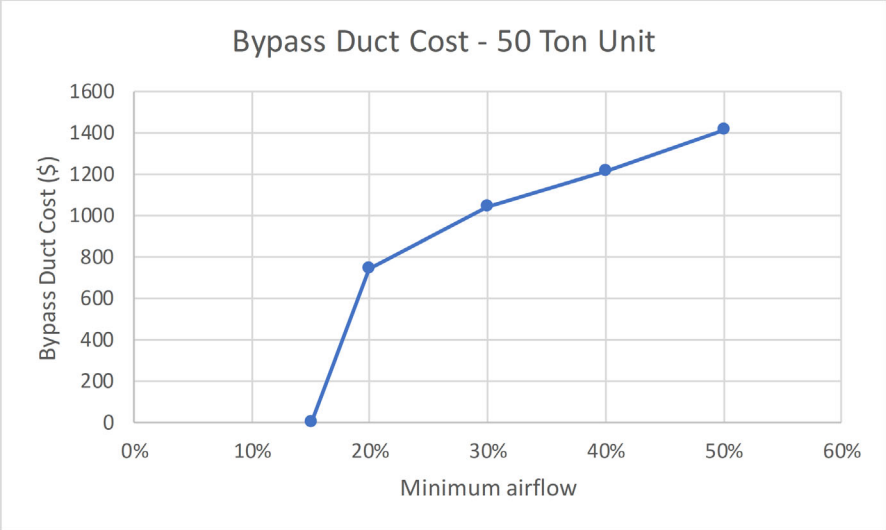
Note that this change only applies to multizone VAV systems and does not apply to single-zone VAV systems that control that control the capacity of the mechanical cooling directly based on space temperature.

A check of capabilities of variable speed drives and ECM motors was performed, and it was confirmed that the 15% minimum turndown is not a problem and can be done. Some qualification may be required for minimum airflow sensors to ensure compressor capacity control function. Note that this condition occurs at lower loads and ambient, and often the unit is operating in integrated or economizer-only operation or just ventilations. Compressor cycle will likely occur, but units should be checked for operation without tripping. The units should also be using supply air temperature reset control per Section 6.5.3.5 and VAV setpoint reset per Section 6.5.3.2.3, which can help with building turndown requirements.

Most multizone VAV units sold today are capable of much lower turndown rates. Lower turndown rates will result in significant fan saving versus a unit that uses a bypass duct to meet the required minimum building airflow delivery rates. The figure below shows the annual fan energy savings relative to a unit that only turns down to 50% airflow for a typical 50-ton multizone VAV unit applied to the large office building. The curve is the average of a detailed study of all 19 climate zones. The fan energy is reduced 24% relative to the current required minimum turndown of 50%.



It is likely that there will not be any cost impact on a properly designed true multizone system, but some are taking single-zone VAV systems and trying to apply full VAV using hot gas bypass and limited airflow modulation that a true multizone VAV system requires and are forced in the field to use bypass ducts. Considering the cost of increases for use of the bypass duct, elimination of the bypass duct to allow for proper system operation can actually result in a cost reduction at the system level. The figure below shows an estimate of the cost for the bypass duct and controls for the a 50-ton unit as a function of the minimum turndown.



For limited VAV turndown, there is significant energy savings for fan systems that can turndown below the current 50% requirement.

Some added cost may be needed for units that have very limited capacity control meeting the minimum requirements of Table 6.5.1.3, but this should easily be covered by the significant fan energy savings and elimination of the bypass duct.

Considering the significant energy savings and the potential elimination of the bypass duct, this change essentially has less than a zero payback period; even if some units have to add some cost for fan turndown, that proposed change is easily cost justified.

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 u to Standard 90.1-2022

Modify Section 6.5.3.2.1, "Supply Fan Airflow Control," as shown below. (I-P and SI)

6.5.3.2 Fan Control

6.5.3.2.1 Supply Fan Airflow Control. Each cooling *system* listed in Table 6.5.3.2.1 shall be designed to vary the supply fan airflow as a function of load and shall comply with the following requirements:

a. Single-zone *VAV* DX and chilled-water cooling units that *control* the capacity of the *mechanical cooling* directly based on *space* temperature shall have a minimum of two stages of fan control. Low or minimum ~~speed~~ airflow shall not exceed 66% of ~~full speed~~ design airflow. At low or minimum ~~speed~~ airflow, the fan *system* shall draw no more than 40% of the fan power at ~~full fan speed~~ design airflow. Low or minimum ~~speed~~ airflow shall be used during periods of low cooling load and *ventilation*-only operation.

b. All other units, including multiple-zone *VAV* DX cooling units and chilled-water units that *control* the *space* temperature by modulating the airflow to the *space*, shall have modulating fan control. Minimum ~~speed~~ supply fan airflow shall not exceed ~~50%~~ the greater of 15% of design airflow or the *design minimum outdoor air rate* ~~full speed. At minimum speed, the fan system shall draw no more than 30% of the power at full fan speed.~~ Low or minimum ~~speed~~ airflow shall be used during periods of low cooling load

and *ventilation*-only operation. *Mechanical cooling*, economizer, and *ventilation* shall not limit the unit from operating at minimum supply fan airflow.

c. Units that include an air economizer to meet the requirements of Section 6.5.1 shall have a minimum of two speeds of fan control during economizer operation.

Exceptions to 6.5.3.2.1:

1. Modulating fan control is not required for chilled-water and evaporative cooling units with <1 hp (0.75 kW) fan motors if the units are not used to provide ventilation air and if the indoor fan cycles with the load.
2. If the volume of *outdoor air* required to meet the *ventilation* requirements of Standard 62.1 at low ~~speed~~ airflow exceeds the air that would be delivered at the ~~speed~~ airflow defined in Section 6.5.3.2.1(a) or 6.5.3.2.1(b) then the minimum ~~speed~~ airflow shall be selected to provide the required *ventilation* air.

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

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

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.

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