Proposal Summary

Reducing Maximum Airflow During Deadband Operation for Variable Air Volume HVAC Systems

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Measure Description

This proposed code change would modify prescriptive requirements for multi-zone variable air volume (VAV) HVAC systems in Section 140.4(c), such that the central air handler is required to be capable of turning down as much as the terminal units in individual zones during deadband and economizer operation to avoid wasting fan energy.

Multi-zone VAV systems control space temperature by modulating airflow to the space. The systems also provide a minimum flow of outdoor air to the space based on the outdoor airflow requirements in Section 120.1(c)3. Section 140.4(d)(2)(ii) currently requires terminal units in the individual zones for these systems to be capable of turning down airflow to no greater than the design outdoor airflow during deadband operation, where there is no demand for heating or cooling. In many applications, this would be 15 percent or less of the air handler's design airflow. However, there is no requirement that the central air handler be able to turn down flow to any level.

Some direct expansion (DX) air conditioners do not turn down below 50 percent airflow. Designers have two ways to handle the mismatch: (1) they can set the minimum zone airflow to match the higher airflow if they use a modeling compliance path or (2) they can specify a bypass duct that returns the excess airflow directly to the unit. In either case, the central air handler's fan uses more energy than necessary.

With the proposed change, while in deadband or economizer operation, the maximum airflow rate through an air handler would not exceed the greater of 15 percent of the design airflow or the sum of the design primary airflow of the associated terminal units. For new construction, per Section 140.4(d)(2)(ii), the design primary airflow is not to exceed the values in Section 120.1(c)(3) minimum requirements in Section 120.1(c)(3).

A higher airflow would be permitted if more than the minimum is required for cooling during economizer operation.

This proposed code change would apply to new construction, to additions where the addition is served by a new DX or hydronic unit, and to alterations where a new DX or hydronic air handler unit is installed. Note that this proposal only applies to multi-zone VAV systems and does not apply to single-zone VAV systems that control the capacity of mechanical cooling directly based on space temperature. The proposed code change will apply to all climate zones, and to all building and space types that have multi-zone VAV systems.

The compliance software already allows entry of the minimum airflow; the CBECC baseline will be updated as needed to reflect the code change. This proposed code change will require modification of the current acceptance test.

Table 1 summarizes the scope of the proposed code change.

Table 1: Scope of Proposed Code Change

An “X” indicates the proposed code change is relevant.

Building Type(s)		single family	**Construction Type(s)**	X	new construction
		multifamily		X	additions
	X	nonresidential		X	alterations
Type of Change		mandatory	**Updates to Compliance Software**		no updates
	X	prescriptive		X	update existing feature
		performance			add new feature
Third Party Verification		no changes to third party verification			
		update existing verification requirements			
	X	add new verification requirements			

Justification for Proposed Change

This measure is inspired by Addendum u to ASHRAE 90.1-2022, which ASHRAE and ANSI approved on December 31, 2024 (ASHRAE 90.1-2022, Addendum u). This new ASHRAE measure was brought as a candidate to Title 24 because of its energy savings and relative simplicity.

Section 140.4(d)(2)(ii) requires that the terminal units in the individual zones turn down airflow to no greater than the design outdoor airflow during deadband operation when there is no demand for heating or cooling. In many applications, this would be equivalent to 15 percent or less of the air handler's design airflow. However, there is no requirement that the central air handler be able to turn down flow to any level.

The preliminary energy savings analysis offers significant potential in the proposed measure resulting in annual Electricity Savings of approximately 0.08 kWh/ft^2 for medium offices, large schools, and laboratories. The modeling assumptions will be updated and could yield different savings estimates.

Data Needs / Information Requests

The Statewide CASE Team is seeking the following information to inform the code change proposal. Data may be provided anonymously. To participate or provide information, please email johnbade@2050partners.com directly and copy info@title24stakeholders.com.

- Minimum turndown for various models of multi-zone VAV packaged equipment.
- Prevalence of the use of bypass ducts in the absence of turndown.
- Costs of bypass ducts used in absence of turndown.
- Approaches used by designers to meet the current requirements to reduce zone airflow to the minimum flow required.
- Additional cost for multi-zone DX and hydronic equipment that can turn down to 15 percent airflow.
- Additional maintenance costs for VAV systems that can turn down to 15% airflow.
- Additional commissioning cost imposed by this ~~a~~ requirement for systems to turn down to 15% airflow
- Percentage of offices, schools, and laboratories that have multi-zone VAV DX HVAC systems.
- Are there other types of buildings that often use multi-zone VAV DX HVAC systems?
- Any known issues with providing DX equipment that can turn down to 15 percent of the design airflow
- Prevalence of Multizone VAV systems that turn down to 15%
- Variation by building type of turndown of multi-zone VAV systems

Draft Code Language

1.1 Guide to Marked Up Language

The proposed changes to the Standards and Reference Appendices are provided below. Changes to the 2025 documents are marked with blue underlining (new language) and ~~strikethroughs~~ (deletions).

1.2 Title 24, Part 1

There are no proposed changes to Title 24, Part 1.

1.3 Title 24, Part 6

140.4 (c) **Fan Systems.** Each fan system moving air into, out of or between conditioned spaces or circulating air for the purpose of conditioning air within a space shall meet the requirements of Items 1, 2 and 3 below.

…

2. **Multi-zone Variable air volume (VAV) systems.**

A. Static pressure sensor location. Static pressure sensors used to control multi-zone variable air volume fans shall be placed in a position such that the controller set point is no greater than one-third the total design fan static pressure, except for systems with zone reset control complying with Section 140.4(c)2B. If this results in the sensor being located downstream of any major duct split, multiple sensors shall be installed in each major branch with fan capacity controlled to satisfy the sensor furthest below its setpoint; and

B. Setpoint reset. For systems with direct digital control of individual zone boxes reporting to the central control panel:

i. Static pressure setpoints shall be reset based on the zone requiring the most pressure

ii. Control sequences of operation for static pressure setpoint reset shall be in accordance with ASHRAE Guideline 36.

C. Minimum fan turndown. Central fans for multi-zone VAV systems shall be capable of and configured to turn down to the larger of the following during deadband or compressor off economizer operation:

i. 15 percent of the design airflow.

ii. The sum of the design primary airflow of the associated terminal units.

1.4 Reference Appendices

NA7.5.6 Supply Fan Variable Flow Controls

NA7.5.6.1 Construction Inspection

Prior to Functional Testing, verify and document the following:

(a) Supply fan includes device(s) for modulating airflow, such as variable speed drive or electrically commutated motor.

(b) For multiple zone systems:

1. Discharge static pressure sensors are either factory calibrated or field calibrated.
2. The static pressure location, setpoint, and reset control meets the requirements of §140.4(c)2A and §140.4(c)2B.
3. The central fan(s) are capable of and configured to meet the requirements of §140.4(c)2C.

NA7.5.6.2 Functional Testing

Step 1: Simulate demand for full design airflow. Verify and document the following:

(a) Supply fan controls modulate to increase capacity.

(b) For multiple zone systems, supply fan maintains discharge static pressure within +/-10 percent of the current operating setpoint.

(c) Supply fan controls stabilize within a 5 minute period.

Step 2: For multiple zone systems, simulate demand for ~~reduced or~~ minimum airflow where there is no demand for heating or cooling, and all zone terminals are at their design primary airflows. Verify and document the following:

(d) Supply fan controls modulate to decrease ~~capacity~~ airflow to the greater of the sum of the zone terminal primary airflows for the system or 15 percent of the design airflow of the system.

(e) Current operating setpoint has decreased (for systems with DDC to the zone

level).

(f) ~~For multiple zone systems, s~~Supply fan maintains discharge static pressure within +/-10 percent of the current operating setpoint.

(g) Supply fan controls stabilize within a 5 minute period.

Step 3: Restore system to correct operating conditions.