

AHRI Zone Control System Technology Section Q&A on California 2013 Title 24 Requirements for Zoning Systems and Bypass Ducts

The following Q&As are intended to provide sources of information on and help clarify some of the requirements and restrictions of *California's 2013 Building Energy Efficiency Standards for Residential and Nonresidential Buildings – Revised*, published by the California Energy Commission (CEC). These are the interpretations of the members of AHRI's Zone Control System Technology Product Section; however, only the CEC can provide official interpretations of the California requirements. The information below is not AHRI legal or other guidance or advice, but is intended to provide assistance and sources of further information on the questions listed below.

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Q: Are zoning systems with bypass dampers and ducts allowed under 2013 California Title 24?

A: Yes, the Performance Compliance Approach allows zoning systems with bypass dampers. The CEC has approved select compliance software packages to help properly design and submit zoning systems with bypass dampers. Permit applications for designs utilizing bypass dampers should be accompanied by the appropriate Certificate of Compliance.

For more information, see the following sections of the Standards:

[California Building Standards Website](#)

[2013 Approved Computer Compliance Programs](#)

[2013 California Title 24 Building Standards](#): Sections 110.2(c), 150.0(m)15, 150.1(b)4, 150.1(c)13

[2013 Residential ACM Reference Manual](#): Section 2.4.6.8

[2013 Residential Appendices](#): Appendices RA3.1.4.1, RA3.1.4.6, RA3.3

[2013 Residential Compliance Manual \(Building HVAC Requirements\)](#) – Sections 4.3.3B, 4.4.1, 4.5.1, 4.5.2

See also the various “Nonsubstantial Errata” notices on the CEC’s

<http://www.energy.ca.gov/title24/2013standards/>.

Q: Are there airflow and fan efficacy requirements associated zoning systems?

A: Yes. There may be different system airflow requirements when zoning systems are used, versus systems without zoning. See the latest Standards for more information, including Section 4.4.1R and Table 4-13 of the [2013 Residential Compliance Manual \(Building HVAC Requirements\)](#).

For more information, see the following sections of the Standards:

[2013 California Title 24 Building Standards](#): Sections 150.0(m)15, 150.1(b)4, 150.1(c)13

[2013 Residential ACM Reference Manual](#): Section 2.4.6.8

[2013 Residential Appendices](#): Appendices RA3.1.4.1, RA3.1.4.6, RA3.3

[2013 Residential Compliance Manual \(Building HVAC Requirements\)](#) – Sections 4.3.3B, 4.4.1R, 4.5.1, 4.5.2

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Q: Are there benefits of using multi-stage cooling equipment with zoning systems?

A: Yes, zoning systems with multi-stage cooling equipment may have fewer restrictions on system airflow than systems utilizing single-stage equipment. See Section 4.4.1R and Table 4-13 of the [2013 Residential Compliance Manual \(Building HVAC Requirements\)](#).

For more information, see the following sections of the Standards:

[2013 California Title 24 Building Standards](#) – Section 150.0(m)15 (Exception)

[2013 Residential Compliance Manual \(Building HVAC Requirements\)](#) – Sections 4.4.1R, 4.5.2; Table 4-13

Q: Is there an energy design credit allowed for zoning systems?

A: Yes, if the system meets the requirements of a Zonal Control system, as found in Section 4.5.2 within the 2013 Title 24 [Residential Compliance Manual](#). See excerpt on **Residential Compliance Manual Guidance on 150.0(m)15** in the Background section of this document.

Important Links:

[California Building Standards Website](#)

[2013 Building Energy Efficiency Standards for Residential and Nonresidential Buildings - Revised \("Title 24;" includes Section 150\)](#)

[2013 Approved Computer Compliance Programs](#)

[2013 Reference Appendices Revised \(includes Appendix RA3\)](#)

[2013 Residential Alternative Calculation Method \(ACM\) Approval Manual](#)

[2013 Residential Alternative Calculation Method \(ACM\) Reference Manual](#)

[2013 Residential Compliance Manual & Forms Page \(webpage with links to all sections and forms\)](#)

[2013 Residential Compliance Manual \(Building HVAC Requirements\)](#)

[2013 Residential Compliance Manual \(Additions, Alterations and Repairs\)](#)

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Background Information

Note: The following are excerpts from the various California Energy Commission (CEC) documents relating to the requirements of California 2013 Title 24, and are provided as a convenience only. The material taken from the Standard is the property of the CEC, and may not represent the most current versions of the various documents. Please refer to the documents available directly from the CEC for the most recent versions, and for authoritative information. A listing of the links to the CEC website and the various CEC documents is included above. Also refer to the [CEC published changes](#).

Summary of What's New for the 2013 Standards (According to Residential Compliance Manual)

The following is a summary of the new HVAC measures for the 2013 Standards, including new compliance options that provide greater flexibility in complying with the Standards when using the performance method. See individual sections of this Manual for more detail.

Mandatory Features and Devices - Section 150.0

- There are some new mandatory requirements for space cooling systems that utilize automatic zonal control to meet airflow and fan watt draw requirements. [150.0(m)15]

Prescriptive and Performance Compliance Approaches - Section 150.1

- When homes utilizing the prescriptive approach have automatic zonal control, they are prohibited from using bypass ducts that divert supply air directly back to the return air stream. Using the performance approach, there is an energy penalty for systems choosing to utilize bypass ducts for zonal control. [150.1(c)13]

Mandatory Language within Title 24

Any newly constructed low-rise residential building shall meet the following requirement:

Section 150.0m(15) of Title 24 Standard (Mandatory Language)

Zonally Controlled Central Forced Air Systems. Zonally controlled central forced air cooling systems shall be capable of simultaneously delivering, in every zonal control mode, an airflow from the dwelling, through the air handler fan and delivered to the dwelling, of greater than or equal to 350 CFM per ton of nominal cooling capacity, and operating at an air-handling unit fan efficacy of less than or equal to 0.58 W/CFM as confirmed by field verification and diagnostic testing in accordance with the applicable procedures specified in Reference Residential Appendix RA3.3.

EXCEPTION to Section 150.0(m)15: Multispeed compressor systems or variable speed compressor systems, or single speed compressor systems that utilize the performance compliance approach set forth in Section 150.1(b) shall demonstrate compliance for airflow (cfm/ton) and fan efficacy (Watt/cfm) by operating the system at maximum compressor capacity and maximum system fan speed and with all zones calling for conditioning.

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See also the requirements and exceptions in Section 4.4.1R and Table 4-13 in [2013 Residential Compliance Manual \(Building HVAC Requirements\)](#).

RA3.3 Field Verification and Diagnostic Testing of Forced Air System Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy

RA3.3 contains procedures for:

- (a) Verification of improved system airflow rate (cfm) in ducted split system and packaged space conditioning systems serving low-rise residential buildings.
- (b) Verification of reduced fan power (Watt) draw achieved through improved air distribution system design, including more efficient motors and ducts that have less resistance to airflow.
- (c) Determination of fan efficacy (Watt/cfm) utilizing simultaneous measurement of system Watt draw and airflow rate.

Residential Compliance Manual Guidance on 150.0(m)15:

Note that “zonally controlled” systems allow for energy compliance credits under Title 24, but the requirements are stringent in order to provide the energy benefits. A zoning system using duct dampers, and/or bypass ducts, may be allowed under a Performance Approach, but may not qualify for the “zonally controlled” credits. This would not mean that the zoning system itself would be non-compliant.

Zonally Controlled Central Forced Air Cooling Systems

The primary purpose of zoning ducted air conditioners, heat pumps, and furnaces is to improve comfort. Increased comfort is attained by having the capacity of the HVAC system (cooling or heating delivered) follow the shift in load as it changes across the house. For example, it is common for two-story homes to be too hot on the second floor in both summer and winter. Zoning has the capability of diverting more of the HVAC capacity to the area with the increased load. Another common example is a home with a significant area of west-facing and east-facing windows. In the summer, the east rooms overheat in the morning and the west rooms overheat in the afternoon.

Providing the most agreeable temperature to all the zones is comfortable, but it carries with it the distinct possibility of increased energy consumption. Since the most common home is single zoned and has only one thermostat placed near the center of the house, temperatures in the rooms distant from that thermostat will vary, sometimes significantly. If zoning is added, the more distant rooms may be conditioned to a more comfortable temperature. This increased conditioning requires more energy.

It is common for zonally controlled central forced air cooling systems to produce lower airflow through the returns thus lowering the sensible efficiency of the heating or cooling equipment. There are two primary methods by which the common multi-zoned dampered system lowers airflow: additional restriction of zoning dampers and recirculation through the air conditioner from a bypass duct. To avoid this efficiency problem,

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zonally controlled central forced air cooling systems utilizing a single speed air conditioner must simultaneously meet the following criteria;

1. In every zonal control mode, the system shall provide airflow through the return grilles that is equal to or greater than 350 CFM per ton of nominal cooling capacity.
2. In every zonal control mode, the fan watt draw must be less than or equal to 0.58 Watts per CFM.

The airflow and fan watt draw must be HERS verified. See Reference Residential Appendix RA3.3 for the HERS verification procedures.

Zonally controlled central forced air cooling systems with multi-speed or variable speed compressors only need to be verified to meet the above 350 CFM per nominal ton and 0.58 Watts per CFM criteria with the compressor on high speed and all zones calling for cooling.

Zoned Systems and Airflow and Fan Efficacy Requirements

Recent studies have shown that zoned systems (multiple zones served by a single air handler with motorized zone dampers), with or without bypass dampers, usually do not meet the AF/FE requirements when less than all zones are calling. The energy penalty that results from this is greater than the benefit of having zonal control, therefore zonal control is no longer simply assumed to be a “better than minimum” condition and there are special compliance requirements for them. Note that zonal control accomplished by using multiple single-zone systems is not subject to these requirements.

There are two choices for modeling zoned systems. One is for air conditioning condensers that have single speed compressors and the other is for condensers that have “multi-speed” compressors. Two Speed and Variable Speed Compressors are considered multi-speed. Multi-speed compressors alleviate the detrimental effects of not meeting the AF/FE when less than all zones are calling and are given special consideration when used in zoned systems. They are assumed to offset the negative impacts of zoned systems and airflow and fan efficacy testing is only required to be performed in the highest speed with all zones calling, while zoned systems with single speed compressors must be tested and pass in all operating modes.

Because zoned systems, with or without bypass dampers, are less likely to meet the AF/FE requirements when less than all zones are calling, a way is provided in the performance compliance option to take this penalty and still allow use of zone dampers. Other energy features must offset the penalty. In the performance compliance software, if the system is modeled as a zoned system with a single speed compressor, the default airflow drops to 150 CFM/ton. Note that the standard house is assumed to have an airflow of 350 CFM/ton, so there is definitely a penalty unless the user specifies a value of 350 or higher. Entering a value between 150 and 350 can lessen the penalty.

It is extremely important that the energy consultant model airflow and fan efficacy values that are reasonable and obtainable, otherwise they will fail in the field and will need to be remodeled at actual values. Energy consultants should coordinate with the HVAC designer prior to registering the Certificate of Compliance.

Note: Bypass dampers may only be installed if the Certificate of Compliance specifically states that the system was modeled as having a bypass damper.

Example:

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1. A home is to be built with a zoned system (2-zones) with a single speed compressor and bypass ducts. From experience, the HVAC contractor knows that it will not be possible to meet the 350 CFM/ton requirement, but 275 CFM/ton is likely.
2. The energy consultant models the system in the proposed house with 275 CFM/ton (better than default) and 0.58 W/CFM (default). Because the standard house assumes 350 CFM/ton there is an energy penalty that must be made up with other better-than-standard features, but it is not nearly as bad as it would be at the default of 150 CFM/ton.
3. Because 275 CFM/ton is better than the default of 150, it must be tested in all zonal control modes. Because the modeled fan efficacy is the default value, it needs only to be tested with all zones calling. If a better than default value was modeled for fan efficacy it would need to be tested in all zonal control modes.
4. The home is built and the system is verified by a rater and passes at 287 CFM/ton with one zone calling, 298 CFM/ton with the other zone calling, and 372 CFM/ton with both zones calling. Note that it must still meet the mandatory requirements of 350 cfm/ton with all zones calling.
5. If this same home was to be built with a multi-speed compressor, it would only have to be tested with both zones calling whether or not it has a bypass damper, but the target airflow would be no less than 350 CFM/ton. Compliance credit can be achieved by modeling airflows greater than 350 CFM/ton and/or fan efficacies less than 0.58 watts/CFM.

Table 4-12 – Single Zone Ducted Central Forced Air Cooling Systems

Single-Zone Ducted Cooling Systems (Single Zone Off of a Single Air Handler)			
Compressor Type	Mandatory Requirements for Airflow and Fan Efficacy	Performance Compliance Option	
		Proposed House Defaults	Modeled Improved Airflow and/or Fan Efficacy
Single Speed and Two Speed or Variable Speed (Testing Performed on Highest Speed only)	Airflow \geq 350 CFM/ton, and Fan Efficacy \leq 0.58 W/CFM (Airflow and Fan Efficacy testing not required if Return System Sized to Tables 150.0- C or D, but verification of sizing is required)	350 CFM/ton and 0.58 W/CFM	Airflow \geq 350 CFM/ton and/or Fan Efficacy \leq 0.58 W/CFM

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Table 4-13 – Zonally Controlled Central Forced Air Cooling Systems

Zoned Ducted Cooling Systems (Multiple Zones Off of a Single Air Handler)			
Compressor Type	Mandatory Requirements for Airflow and Fan Efficacy ¹	Performance Compliance ²	
		Proposed House Defaults ³	Modeled Improved Airflow and/or Fan Efficacy
Single Speed	Airflow ≥ 350 CFM/ton and Fan Efficacy ≤ 0.58 W/ CFM (For Prescriptive Compliance Method, verification is mandatory in all zonal control modes. For Performance Compliance Method, verification is mandatory using highest capacity with all zones calling)	150 CFM/ton and 0.58 W/CFM	Airflow ≥ 150 CFM/ton and/or Fan Efficacy ≤ 0.58 W/CFM (Verification of better-than-default values required in all zonal control modes. Mandatory requirement of 350 CFM/ton and 0.58 W/CFM still applies for all zones calling)
Two Speed or Variable Speed	Airflow ≥ 350 CFM/ton and Fan Efficacy ≤ 0.58 W/ CFM (Verification Required Only on Highest Capacity and with All Zones Calling)	350 CFM/ton and 0.58 W/CFM	Airflow ≥ 350 CFM/ton and/or Fan Efficacy ≤ 0.58 W/CFM (Verification of modeled improved values required only on Highest Capacity and with All Zones Calling)

¹ For the Prescriptive Compliance Method, all Mandatory Requirements for airflow and fan efficacy must be met, and use of a bypass duct is not allowed.
² For the Performance Compliance Method, all Mandatory Requirements for airflow and fan efficacy must be met, and use of a bypass duct may be specified in the compliance software input for the zoned system type.
³ The Standard House Defaults for all cases are 350 CFM/ton and 0.58 W/CFM.

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Prescriptive Language within Title 24

Performance and Prescriptive Compliance Approaches for Newly Constructed Residential Buildings (Section 150.1(c)13 of Title 24 Standard)

Basic requirements: New low-rise residential buildings shall meet: a). Requirements of Sections 110.0 through 110.10 are applicable to new residential buildings; b). Requirements of Section 150.0 (mandatory features); and c). Either the performance standards or the prescriptive standards set forth for a given Climate Zone.

For the prescriptive standards/component package approach, installed components shall meet the following:

HVAC System Bypass Ducts. Unless otherwise specified on the Certificate of Compliance, bypass ducts that deliver conditioned supply air directly to the space conditioning system return duct airflow shall not be used. All zonally controlled forced air systems shall be verified by a HERS Rater utilizing the procedure in Reference Residential Appendix Section RA3.1.4.6 to confirm compliance with 150.1(c)13.

RA3.1.4.6 Verification of Prescriptive Bypass Duct Requirements for Zonally Controlled

Forced Air Systems

When a zonally controlled forced air system is installed, the following shall be verified to determine compliance as required by Standards Section 150.1(c)13:

- (a) A visual inspection shall confirm that bypass ducts that deliver conditioned supply air directly to the space conditioning system return duct airflow are not used; or
- (b) If the Certificate of Compliance indicates an allowance for use of a bypass duct, the system with the bypass duct shall conform to the specifications given on the Certificate of Compliance.

If the zonally controlled system meets one of these criteria, the system complies. Otherwise the system does not comply.

Language within Residential Compliance Manual for Zonal Control

4.5.2 Zonal Control

An energy compliance credit is provided for zoned heating systems, which save energy by providing selective conditioning for only the occupied areas of a house. A house having at least two zones (living and sleeping) may qualify for this compliance credit. The equipment may consist of one heating system for the living areas and another system for sleeping areas or a single system with zoning capabilities, set to turn off the sleeping areas in the daytime and the living area unit at night (see Figure 4-20).

There are unique eligibility and installation requirements for zonal control to qualify under the Standards. The following steps must be taken for the building to show compliance with the Standards under this exceptional method:

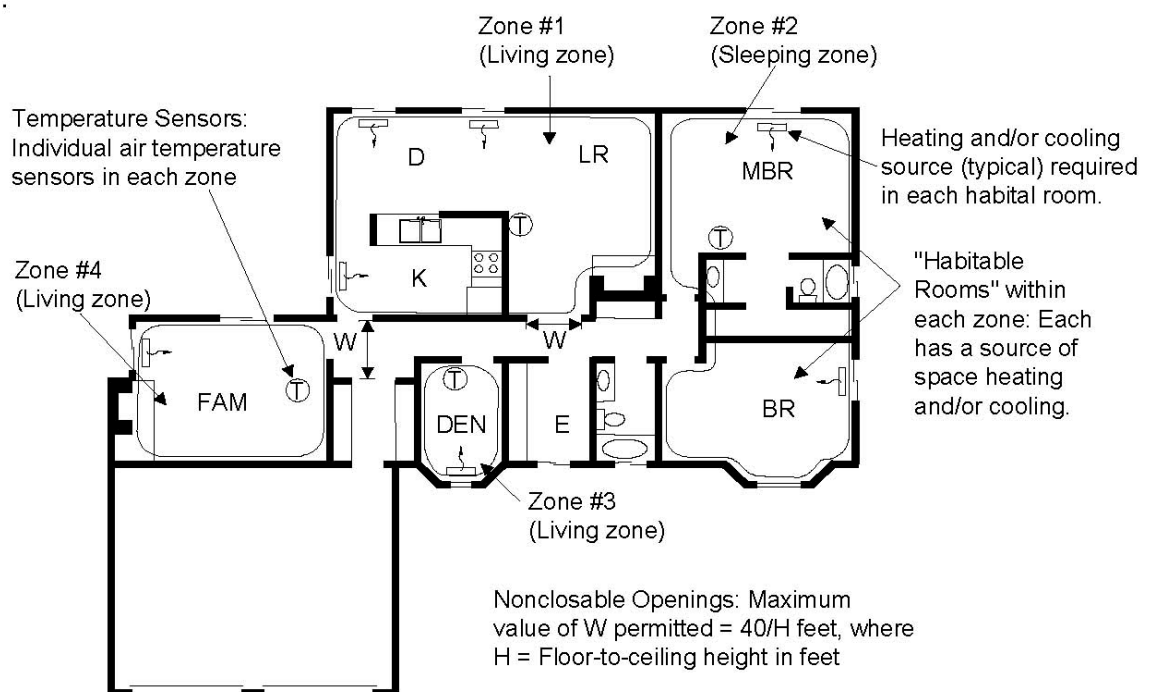
1. **Temperature Sensors.** Each thermal zone, including a living zone and a sleeping zone, must have individual air temperature sensors that provide accurate temperature readings of the typical condition in that zone.
2. **Habitable Rooms.** For systems using central forced air or hydronic heating each habitable room in each zone must have a source of space heating such as forced air supply registers, radiant tubing or a

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radiator. For systems using a combination of a central system and a gas vented fireplace or other individual conditioning units, the zone served by the individual conditioning unit can be limited to a single room. Bathrooms, laundry, halls and/or dressing rooms are not habitable rooms.

3. Non-closeable Openings. The total non-closeable opening area (W) between adjacent living and sleeping thermal zones (i.e., halls, stairwells, and other openings) must be less than or equal to 40 ft². All remaining zonal boundary areas must be separated by permanent floor-to-ceiling walls and/or fully solid, operable doors capable of restricting free air movement when in the closed position.



4. Thermostats. Each zone must be controlled by a central automatic dual setback thermostat that can control the conditioning equipment and maintain preset temperatures for varying time periods in each zone independent of the other. Thermostats controlling vented gas fireplace heaters that are not permanently mounted to a wall are acceptable as long as they have the dual setback capabilities.

Other requirements specific to forced air ducted systems include the following:

1. Each zone must be served by a return air register located entirely within the zone. Return air dampers are not required.
2. Supply air dampers must be manufactured and installed so that when they are closed, there is no measurable airflow at the registers.
3. The system must be designed to operate within the equipment manufacturer's specifications.

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4. Air is to positively flow into, through, and out of a zone only when the zone is being conditioned. No measurable amount of supply air is to be discharged into unconditioned or unoccupied space in order to maintain proper airflow in the system.

Although multiple thermally distinct living and/or sleeping zones may exist in a residence, the correct way to model zonal control for credit requires only two zones: one living zone and one sleeping zone. All separate living zone components must be modeled as one single living zone; the same must be done for sleeping zones.

Example 4-2

Question

In defining the living and sleeping zones for a home with a zonally-controlled HVAC system, can laundry rooms and bathrooms (which are not habitable spaces) be included on whichever zone they are most suited to geographically (e.g., a bathroom located near bedrooms)?

Answer

Yes. For computer modeling purposes, include the square footage of any non-habitable or indirectly conditioned spaces, with the closest zone.

Example 4-3

Question

I have two HVAC systems and want to take zonal control credit. Can the return air grilles for both zones be located next to each other in the 5 ft wide by 9 ft high hallway (in the same zone)?

Answer

No. Because of the need to prevent mixing of air between the conditioned zone and the unconditioned zone, it is necessary to (1) have the return air for each zone within that zone, and (2) limit any non-closeable openings between the two zones to 40 ft² or less. Unless these criteria and the other criteria listed in this chapter can be met, credit for a zonally controlled system cannot be taken.

Example 4-5

Question

How do I model the energy efficiency of a gas vented fireplace for zonal control heating?

Answer

The efficiency of gas vented fireplaces is described as an Annual Fuel Utilization Efficiency (AFUE) and is calculated by the manufacturer per the ANSI Z21.88-2009 Standard. Gas vented fireplaces need to meet all of the other relevant requirements of zonal control.

Example 4-6

Question

Does a gas vented fireplace with a handheld remote thermostat meet the thermostat requirement for the two-zone modeling credit?

Answer

Yes, as long as the thermostat has manual on to start, automatic setback capability and temperature preset capability, it does not have to be permanently wall-mounted.

Language within 2013 Residential Alternative Calculation Method (ACM) Reference Manual

2.4.6.8 Bypass Duct

PROPOSED DESIGN

Software shall allow users to specify whether a bypass duct is or is not used for a zonally controlled forced air system.

STANDARD DESIGN

The standard design is based on a split system air conditioner meeting the requirements of §150.1(c) and Table 150.1-A. The system is not a zonally-controlled system.

VERIFICATION AND REPORTING

An HVAC system with zonal control, and whether the system is assumed to have a bypass duct or have no bypass duct, is reported in the HERS Required Verification listings on the CF1R.