

Workshop – June 15, 2007 – 10:10 AM



**Section**

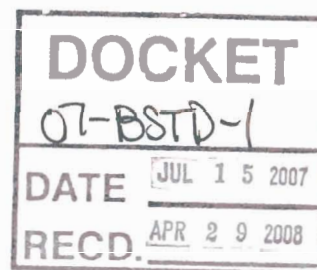
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# Revisions to the Residential Software Manual (ACM)



# Water Heating Distribution Multipliers (DSMs)



- Revise ACM Distribution System Multipliers
- Parallel pipe system and demand controlled recirculation system multipliers have been revised.
- New multipliers are proposed for pipe systems buried in soil and pipe systems buried in soil and insulated.
- Modifications have been made to several eligibility requirements to add new knowledge or correct the previous standards wording.

- ▶ **Measure Evaluation Report:**  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-05-18\\_workshop/2006-05-11\\_ACM\\_RG2.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-05-18_workshop/2006-05-11_ACM_RG2.PDF)
- ▶ **Res, Water Heating, Water Heating Distribution Multipliers (DSMs), DEG, May 06**

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# Tankless Water heaters



- Degrades performance of tankless water heaters by an adjustment factor of 8.8% to reflect actual operation
  - ▶ **Measure Evaluation Report:**  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-05-18\\_workshop/2006-05-11\\_GAS\\_WATER.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-05-18_workshop/2006-05-11_GAS_WATER.PDF)
  - ▶ Res, Water Heating, Tankless Water heaters, DEG, May 06

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# Refrigerant Charge / TXV (covered 6/13)



- Replaces requirement for visual verification of a TXV with testing of refrigerant charge and TXV. Provides a Charge Indicator Display as a compliance option.
- Changes the minimum level of evaporator airflow for charge testing to 300 cfm per ton and the level of evaporator airflow for adequate airflow credit to 350 cfm per ton.
  - ▶ **Measure Evaluation Report:**  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12\\_workshop/AIR\\_CONDITIONER\\_REFRIGERANT\\_TXVS\\_OVERVIEW.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12_workshop/AIR_CONDITIONER_REFRIGERANT_TXVS_OVERVIEW.PDF)
  - ▶ [http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12\\_workshop/RESIDENTIAL\\_AIRFLOW\\_APPENDIX\\_RD.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12_workshop/RESIDENTIAL_AIRFLOW_APPENDIX_RD.PDF)
  - ▶ [http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12\\_workshop/REFRIGERANT\\_CHARGE\\_AIR\\_FLOW\\_APPENDIX\\_B2.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12_workshop/REFRIGERANT_CHARGE_AIR_FLOW_APPENDIX_B2.PDF)
  - ▶ [http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12\\_workshop/APPENDIX\\_RJ\\_CHARGE\\_INDICATOR\\_LIGHT.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12_workshop/APPENDIX_RJ_CHARGE_INDICATOR_LIGHT.PDF)
  - ▶ Res, HVAC, Refrigerant Charge / TXV, Wilcox,

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# Fan Watt Draw and Airflow (covered 6/13)



- Extends detailed modeling of fan Watts from cooling to heating
- The 2005 RACM specifies that furnace fan electric energy in Btu be counted as a fixed 0.5% of furnace heating output in Btu regardless of any other characteristic of the furnace or fan.

- ▶ **Measure Evaluation Report:**  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-03-28\\_workshop/2006-03-27\\_FURNACE\\_FAN.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-03-28_workshop/2006-03-27_FURNACE_FAN.PDF)

- ▶ **Res, HVAC, Fan Watt Draw and Airflow, Wilcox, Mar 06**

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# Res IAQ Ventilation (covered 6/13)



## ● Adopts relevant provisions of ASHRAE Standard 62.2-2004

- ▶ **Measure Evaluation Report:**  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12\\_workshop/RESIDENTIAL\\_VENTILATION\\_STUDY.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12_workshop/RESIDENTIAL_VENTILATION_STUDY.PDF)
- ▶ [http://www.energy.ca.gov/title24/2008standards/documents/2006-03-28\\_workshop/2006-03-27\\_AIR\\_VENTILATION.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-03-28_workshop/2006-03-27_AIR_VENTILATION.PDF)
- ▶ Res, HVAC, Res IAQ Ventilation, Wilcox, Sherman, Jul 06

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# Evaporative cooled condensing units



- Adds rules for optional modeling capabilities for evaporatively-cooled condensing units

- ▶ **Measure Evaluation Report: Evaporatively Cooled Condensing Units, Compliance Application, Doc No. CEC400-2005-052**
- ▶ **Res, HVAC , Evaporative cooled condensing units, CEC,**

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# Thermal Energy Storage



## ● Thermal energy storage / DXAC systems

- ▶ ***Measure Evaluation Report:***
- ▶ **Res, HVAC , Thermal Energy Storage, CEC,**

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# Unconditioned Zone Model (covered 6/13)



- New model to simulate thermal performance of an unconditioned attic containing ducts delivering conditioned air to the space.

- ▶ **Measure Evaluation Report:**  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-03-28\\_workshop/2006-03-27\\_UZM\\_MODEL.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-03-28_workshop/2006-03-27_UZM_MODEL.PDF)
- ▶ [http://www.energy.ca.gov/title24/2008standards/documents/2006-03-28\\_workshop/2006-03-27\\_UNCONDITIONED\\_ZONE\\_MODEL.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-03-28_workshop/2006-03-27_UNCONDITIONED_ZONE_MODEL.PDF)
- ▶ Res, HVAC, Unconditioned Zone Model (UZM), Wilcox, Mar 06

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# Multi-Zone Airflow (covered 6/13)



- Requires that all operating modes of multi-zone air conditioning systems provide at least 350 cfm per ton in order to obtain credit for adequate airflow. Specifies that the 350 cfm per ton must be accomplished without bypassing air from the supply ductwork into the return ductwork.
- Change the credit for multi-zone A/C systems to only be available if they meet the specifications for adequate airflow and air handler fan watt draw.

- ▶ **Measure Evaluation Report:**  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12\\_workshop/MULTI-ZONE\\_AIRFLOW\\_OVERVIEW.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12_workshop/MULTI-ZONE_AIRFLOW_OVERVIEW.PDF)
- ▶ [http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12\\_workshop/RESIDENTIAL\\_MULTI-ZONE\\_AIRFLOW\\_ACM.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12_workshop/RESIDENTIAL_MULTI-ZONE_AIRFLOW_ACM.PDF)
- ▶ Res, HVAC, Multi-Zone Airflow, Wilcox, July 06

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# Revisions to the Nonresidential Software Manual (ACM)

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# Accuracy Tests



- **Results must be within 15% of the reference method**
- **Custom weighting factors are clearly specified**

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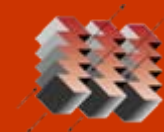
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# Modeling Rules for Demising Walls



- **Currently modeled as adiabatic surface**
- **With the changes wall will be modeled either as**
  - Shaded exterior partition
  - Explicit modeling of adjacent unconditioned space
- **Mandatory measures require R-13**

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# Lighting Controls



- Provides alternative lighting schedules for lighting controls that qualify for power adjustment factors.
- Sets daylight modeling rules for skylights
  - ▶ ***Measure Evaluation Report: Draft Report TDV (Time Dependent Valuation) Lighting Controls Schedules***
  - ▶ **Nonres, Lighting, Lighting Controls, HMG, Mar 2006**

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# FDD for RTUs (covered 6/13)



- Modifies Standard design to assume imperfect operation of rooftop DX air conditioners if FDD is not present. Provides a compliance credit if FDD is installed.
- Degrades equipment efficiency (EER) by 10% if FDD is not present; by 5% if FDD is present
- Degrades economizer effectiveness by setting MAX\_OA\_FRACTION less than 1 if FDD is not present
  - ▶ **Measure Evaluation Report:**  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23\\_workshop/templates/FAULT-DETEC-ROOF-AC\\_ENERGYSOFT\\_2006-02-04.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23_workshop/templates/FAULT-DETEC-ROOF-AC_ENERGYSOFT_2006-02-04.PDF)
  - ▶ Nonres, HVAC, FDD for RTUs, Dodd, Feb 06

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# FDD for AHU and VAV Boxes (covered 6/13)



- Modifies standard design to assume “broken” operation of central AHU and VAV boxes by default. Provides a compliance credit if FDD is installed and meets acceptance test requirements of NA7.
- MAX\_OA\_FRACTION is set to less than 1 to reflect imperfect economizer operation if FDD is not present
- Minimum VAV box setting is increased by 10% over design minimum to reflect imperfect operation if FDD is not present
- Capability is an addition to energy management systems that analyzes trend data

- ▶ **Measure Evaluation Report:**  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23\\_workshop/templates/FAULT-DETEC-AHU\\_VAV\\_ENERGYSOFT\\_2006-02-06.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23_workshop/templates/FAULT-DETEC-AHU_VAV_ENERGYSOFT_2006-02-06.PDF)
- ▶ Nonres, HVAC, FDD for AHU and VAV Boxes, Dodd, Feb 06

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# Underfloor Air Distribution (UFAD)



- UFAD: Provides updated modeling rules to account for heat gain to supply plenum and to provide conservative estimates of stratification
- 40% of heat load is transferred to supply plenum
- 85% of remaining load remains in the space
  - ▶ **Measure Evaluation Report:**  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23\\_workshop/templates/UNDERFLOOR-AIR-DISTR\\_ENERGYSOFT\\_2006-02-02.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23_workshop/templates/UNDERFLOOR-AIR-DISTR_ENERGYSOFT_2006-02-02.PDF)
  - ▶ (updates by Fred Bauman and Tom Webster of CBE)
  - ▶ Nonres, HVAC, Underfloor Air Distribution (UFAD), Dodd, Feb 06

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# Thermal Energy Storage DXAC



- TES using chillers and ice storage or chilled water storage
- DXAC: new optional modeling procedure for thermal energy storage – off-peak cooling, modeled by a separate DOE-2 function
  - ▶ ***Measure Evaluation Report: Thermal Energy Storage Compliance Option, Draft Report, CEC Doc. No. CEC-400-2006-010-SD, Dec 2006***
  - ▶ **Nonres, HVAC, Thermal Energy Storage DXAC, Ice Energy, Dec 06**

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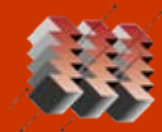
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# Fan Power Credit



- Modifies the Standard Design for System 3 (PVAV) and System 4 (built-up VAV) to cap the FPI at a minimum 0.8 W/cfm for the standard design.
- Provides some compliance credit for natural ventilation, subject to some restrictions.
  - ▶ **Measure Evaluation Report: Dodd, Natural Ventilation for Cooling**  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23\\_workshop/templates/NATURAL\\_VENTILATION\\_2006-02-16.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23_workshop/templates/NATURAL_VENTILATION_2006-02-16.PDF), [http://www.energy.ca.gov/reports/2003-11-20\\_500-03-097F-A09.PDF](http://www.energy.ca.gov/reports/2003-11-20_500-03-097F-A09.PDF)

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# Revisions to the Reference Appendices

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- **JA-1 – Glossary**
- **JA-2 – Reference Weather/Climate Data**
- **JA-3 – Time Dependent Valuation**
- **JA-4 – U-factor, C-factor, and Thermal Mass Data**
- **JA-5 – Specifications for Programmable Communicating Thermostats**
- **JA-6 – Charge Indicator Light**
- **JA-7 – Insulation Quality for SPF (Spray Polyurethane Foam)**
- **JA-8 – Specifications for Light Emitting Diodes (LEDs)**

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- **Terms added as required by other changes and by additions to the definitions section of the standard**

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# Climate Data for Design Calculations



## ● Edits made for completeness

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JA2

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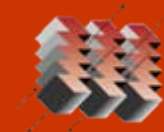
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# Time Dependent Valued (TDV) Energy



- **Graphs and summary tables made consistent with the 2008 data.**
- **Summary data added for green house gas emissions**

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**JA3**

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# U-factor Tables



- Roofs: added both rigid board polyiso insulation and spray-foam insulation to wood-framed roofs tables
- Walls:
  - **Added new table for foamed-in-place, insulated metal panels consisting of liquid polyurethane or polyisocyanurate injected between metal skins in individual molds or on fully automated production lines.**
  - **Updated spandrel panel / curtain wall table**
  - **Added insulation options to the metal building walls table**
  - **Added new table for foamed-in-place, insulated metal panel walls**
  - **Standardized R-value to use for all wood-based sheathing (R-0.96/in, R-0.48 for 1/2")**
    - ▶ *Measure Evaluation Report: N/A*

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- The requirements for PCTs are specified in §112
- This joint appendix lays out the specifications for controls that quality.
- *Measure Evaluation Report: Demand Responsive Control of Air Conditioning via Programmable Communicating Thermostats (PCTs),*  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23\\_workshop/2006-02-15\\_PROGRAMBLE\\_COMM.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23_workshop/2006-02-15_PROGRAMBLE_COMM.PDF)
  - ▶ Both, HVAC , CEC PCT, CEC, Feb 2006

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✓ Both

Envelope

Lighting

✓ HVAC

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# Charge Indicator Display



- Provides specifications for a charge indicator light, which is an alternate means of compliance for refrigerant charge testing.
- *Measure Evaluation Report:*  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12\\_workshop/APPENDIX\\_RJ\\_CHARGE\\_INDICATOR\\_LIGHT.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12_workshop/APPENDIX_RJ_CHARGE_INDICATOR_LIGHT.PDF)

► Both, HVAC, Charge Indicator Display, Wilcox, Jul 06

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# Spray-Foam Insulation Installation



- Quality Insulation Installation Procedures for Medium-Density, Closed-Cell Spray Polyurethane Foam (SPF)
- A compliance credit is offered when this procedure is followed for SPF application in low rise-residential buildings and verified by a qualified HERS rater.
- The procedure and credit applies to wood or metal framed construction with wall stud cavities, ceilings, and/or roof assemblies insulated with SPF insulation.
- High-rise residential, Hotel/Motel, and Nonresidential Buildings are required to follow the same procedures if SPF Insulation is installed however no compliance credit is available.
- *Measure Evaluation Report:* None
  - ▶ Both, Envelope, Spray-Foam Insulation Installation, CEC , None

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# LED Lighting Systems



- Provides test methods to determine wattage and efficacy for all light emitting diode (LED) lighting systems, also known as solid state lighting (SSL).
- *Measure Evaluation Report*: N/A
  - ▶ Both, Lighting, LED Lighting Systems, CEC,

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JA8

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- **NA-1 – Home Energy Rating Systems (HERS) Required Field Verification And Diagnostic Testing**
- **NA-2 – Illuminance Categories and Luminaire Power**
- **NA-3 – Fan Motor Efficiencies**
- **NA-4 – Compliance Procedures for Relocatable Public School Buildings**
- **NA-5 – Standard Procedure for Determining the Energy Efficiencies of Single-Zone Nonresidential Air Distribution Systems in Buffer Spaces or Outdoors**
- **NA-6 – Alternate Default Fenestration Thermal Properties**
- **NA-7 – Acceptance Requirements for Nonresidential Buildings**

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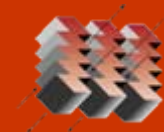
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# Fenestration Defaults



- **Applies to site-built fenestration less than 10,000 ft<sup>2</sup> and to skylights**
- **Equation for fenestration product U-factor based on center-of-glass U-factor.**
- **Equation for fenestration product SHGC based on center-of-glass SHGC.**

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# Acceptance Requirements Indoor Lighting



## ● Automatic Daylighting Controls

- **Construction Inspection**
- **Sampling**
- **Continuous Dimming Functional Testing**
- **Stepped Control Functional Testing**

## ● Occupancy Sensor Controls

- **Construction Inspection**
- **Sampling**
- **Functional Testing**

## ● Manual Daylighting Controls

- **Construction Inspection**
- **Functional Testing**

## ● Automatic Time Switch Control

- **Construction Inspection**
- **Functional Testing**

► Nonres, All, Acceptance Requirements Indoor Lighting, , None

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# Acceptance Test Requirements



- Formerly ACM-NJ
- Added acceptance test requirements for FDD compliance credit option
- Added acceptance test requirements for Thermal Energy Storage / DXAC systems
- *Measure Evaluation Report:*  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23\\_workshop/templates/FAULT-DETEC-ROOF-AC\\_ENERGYSOFT\\_2006-02-04.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23_workshop/templates/FAULT-DETEC-ROOF-AC_ENERGYSOFT_2006-02-04.PDF)

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- **RA-1 – HVAC Sizing**
- **RA-2 – Home Energy Rating Systems (HERS) Required Field Verification And Diagnostic Testing**
- **RA-3 – Interior Mass Capacity**
- **RA-4 – Procedures for Field Verification and Diagnostic Testing of Air Distribution Systems**
- **RA-5 – Procedures for Determining Refrigerant Charge for Split System Space Cooling Systems**
- **RA-6 – Field Verification and Diagnostic Testing of Forced Air System Fan Flow and Air Handler**
- **RA-7 – Procedures for Verifying the Presence of a Thermostatic Expansion Valve or High Energy Efficiency Air Conditioner**
- **RA-8 – High Quality Insulation Installation Procedures**
- **RA-9– Field Verification and Diagnostic Testing of Photovoltaic Systems**
- **RA-10 – Eligibility Criteria for Energy Efficiency Measures**
- **RA-11 – IAQ Ventilation**

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# HERS Verification Procedures



- Formerly Chapter 7 of the ACM Manual
- Updated HERS verification procedures to reflect new acceptance test requirements and new compliance credits
  - ▶ ***Measure Evaluation Report: N/A***

Section

RA2

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# Acceptance Requirements Indoor Lighting

(covered 6/13)



## ● Automatic Daylighting Controls

- **Construction Inspection**
- **Sampling**
- **Continuous Dimming Functional Testing**
- **Stepped Control Functional Testing**

## ● Occupancy Sensor Controls

- **Construction Inspection**
- **Sampling**
- **Functional Testing**

## ● Manual Daylighting Controls

- **Construction Inspection**
- **Functional Testing**

## ● Automatic Time Switch Control

- **Construction Inspection**
- **Functional Testing**

► Nonres, All, Acceptance Requirements Indoor Lighting, , None

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NA7

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✓ Nonresidential

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✓ Lighting

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# Acceptance Requirements Outdoor Lighting

(covered 6/13)



## ● Motion Sensor Controls

- **Construction Inspection**
- **Functional Testing**

## ● Shutoff Controls

- **Construction Inspection**
- **Photocell Functional Testing**
- **Astronomical Timeclock Functional Testing**
- **Timeclock Functional Testing**

▶ **Nonres, All, Acceptance Requirements Outdoor Lighting, , None**

Section

**NA7**

Residential

✓ Nonresidential

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Envelope

✓ Lighting

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# Nonresidential Lighting Acceptance Requirements

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# Lighting Controls



- Provides alternative lighting schedules for lighting controls that qualify for power adjustment factors.
- Sets daylight modeling rules for skylights
- *Measure Evaluation Report*. Draft Report
- TDV (Time Dependent Valuation)
- Lighting Controls Schedules
  - ▶ Nonres, Lighting, Lighting Controls, HMG, Mar 2006

Section

NACM

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✓ Nonresidential

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✓ Lighting

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# LED Lighting Systems



- Provides test methods to determine wattage and efficacy for all light emitting diode (LED) lighting systems, also known as solid state lighting (SSL).
- *Measure Evaluation Report*: N/A
  - ▶ Both, Lighting, LED Lighting Systems, CEC,

Section

JA8

Residential

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✓ Both

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✓ Lighting

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# Nonresidential Fault Detection and Diagnostics

- Air Handling Units
- VAV Boxes
- Rooftop Air Conditioners

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# FDD for RTUs



- Modifies Standard design to assume imperfect operation of rooftop DX air conditioners if FDD is not present. Provides a compliance credit if FDD is installed.
- Degrades equipment efficiency (EER) by 10% if FDD is not present; by 5% if FDD is present
- Degrades economizer effectiveness by setting MAX\_OA\_FRACTION less than 1 if FDD is not present
  - ▶ **Measure Evaluation Report:**  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23\\_workshop/templates/FAULT-DETEC-ROOF-AC\\_ENERGYSOFT\\_2006-02-04.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23_workshop/templates/FAULT-DETEC-ROOF-AC_ENERGYSOFT_2006-02-04.PDF)
  - ▶ Nonres, HVAC, FDD for RTUs, Dodd, Feb 06

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# FDD for AHU and VAV Boxes



- Modifies standard design to assume “broken” operation of central AHU and VAV boxes by default. Provides a compliance credit if FDD is installed and meets acceptance test requirements of NA7.
- MAX\_OA\_FRACTION is set to less than 1 to reflect imperfect economizer operation if FDD is not present
- Minimum VAV box setting is increased by 10% over design minimum to reflect imperfect operation if FDD is not present
- Capability is an addition to energy management systems that analyzes trend data
  - ▶ **Measure Evaluation Report:**  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23\\_workshop/templates/FAULT-DETEC-AHU\\_VAV\\_ENERGYSOFT\\_2006-02-06.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23_workshop/templates/FAULT-DETEC-AHU_VAV_ENERGYSOFT_2006-02-06.PDF)
  - ▶ Nonres, HVAC, FDD for AHU and VAV Boxes, Dodd, Feb 06

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# Underfloor Air Distribution (UFAD)



- UFAD: Provides updated modeling rules to account for heat gain to supply plenum and to provide conservative estimates of stratification
- 40% of heat load is transferred to supply plenum
- 85% of remaining load remains in the space
- TES/DXAC: new optional modeling procedure for thermal energy storage – off-peak cooling, modeled by a separate DOE-2 function
  - ▶ **Measure Evaluation Report:**  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23\\_workshop/templates/UNDERFLOOR-AIR-DISTR\\_ENERGYSOFT\\_2006-02-02.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23_workshop/templates/UNDERFLOOR-AIR-DISTR_ENERGYSOFT_2006-02-02.PDF)
  - ▶ (updates by Fred Bauman and Tom Webster of CBE)
  - ▶ Nonres, HVAC, Underfloor Air Distribution (UFAD), Dodd, Feb 06

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# Thermal Energy Storage DXAC



- TES/DXAC: new optional modeling procedure for thermal energy storage – off-peak cooling, modeled by a separate DOE-2 function
- *Measure Evaluation Report*: Thermal Energy Storage Compliance Option, Draft Report, CEC Doc. No. CEC-400-2006-010-SD, Dec 2006
  - ▶ **Nonres, HVAC, Thermal Energy Storage DXAC, Ice Energy, Dec 06**

Section  
NACM

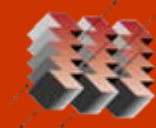
✓ Residential  
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# Nonresidential Overall Envelope Tradeoffs and Insulation Requirements

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# Insulation Requirements



- Provides prescriptive insulation requirements
- Determines cost-effective insulation levels for each climate zone, occupancy type, and construction type, using TDV as the basis
- Updates to tables 143-A, 143-B and 143-C of the Standard
- Increases stringency for some constructions (metal framed walls) and climate zones
- Sets standard design for performance method in Table N2-1 of the Nonresidential ACM Manual

- ▶ ***Measure Evaluation Report: Insulation CASE Report, March 20, 2007***
- ▶ **Nonres, Envelope, Insulation Requirements, AEC, May 2006**

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143(a)

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# Envelope Tradeoff



- Provides updated overall envelope tradeoff procedure for Section 143, based on TDV energy. Combines heat gain and heat loss effects into a single equation
- Provides separate weighting coefficients to account for effects of conduction heat gain through each envelope component, solar heat gain, and effects of roof reflectance and emittance
- Spreadsheet available.
  - ▶ **Measure Evaluation Report: CASE Report on Envelope Tradeoff Procedure, January 18, 2007**
  - ▶ **Nonres, Envelope, Envelope Tradeoff, AEC, May 2006**

Section

143(b), NA8

Residential

✓ Nonresidential

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# Skylight Prescriptive Requirements



- Modifies skylight U-factor and SHGC requirements to be consistent with default fenestration assumptions in Tables 116-A and 116-B
- (Modifies default skylight assembly to assume a thermal break – glass thermal break costs are well below assumed value of \$1.50/ft<sup>2</sup> used in 2000 LCC analysis)
  - ▶ **Measure Evaluation Report: None**
  - ▶ **Nonres, Envelope, Skylight Prescriptive Requirements, HMG, Jul 06**

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143

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# Insulation Requirements for Alternations



- R-8 to R-14 of continuous insulation required (depending on CZ) on re-roofing unless existing insulation of R-19 or greater is present

- ▶ ***Measure Evaluation Report: Insulation CASE Report and subsequent analysis.***
- ▶ **Nonres, Envelope, Insulation Requirements for Alternations, AEC, May 2006**

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✓ Envelope

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# ASHRAE 90.1 Building Envelope Measures



- Loading Dock Weather Seals - for CZ1 and 16, introduces a mandatory requirement for cargo doors and loading dock doors adjacent to conditioned spaces to be equipped with weather seals to restrict infiltration when vehicles are parked in the doorway.
- Vestibules - introduce a requirement for vestibules or revolving doors in buildings with four or more stories for all California climate zones.
- Opaque Doors - introduces a prescriptive requirement for opaque doors to have a U-factor not greater than 0.70 for swinging doors and 1.45 for non-swinging doors in California climate zones 2 through 15. The requirement for climate zones 1 and 16 would be the same for swinging doors, but more stringent for non-swinging doors, with an allowable U-factor not to exceed 0.50.
- Loose-fill Insulation - introduces a limitation prohibiting open-blown or poured loose-fill insulation in attic roof spaces when the slope of the ceiling is more than three in twelve.

- ▶ *Measure Evaluation Report: Building Envelope and HVAC*, [http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12\\_workshop/DRAFT\\_BUILDING\\_ENVELOPE\\_HVAC.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12_workshop/DRAFT_BUILDING_ENVELOPE_HVAC.PDF)
- ▶ Nonres, Envelope, HVAC, ASHRAE 90.1 Building Envelope Measures, AEC, July 2006

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# Spray-Foam Insulation Installation



- Quality Insulation Installation Procedures for Medium-Density, Closed-Cell Spray Polyurethane Foam (SPF)
- A compliance credit is offered when this procedure is followed for SPF application in low rise-residential buildings and verified by a qualified HERS rater.
- The procedure and credit applies to wood or metal framed construction with wall stud cavities, ceilings, and/or roof assemblies insulated with SPF insulation.
- High-rise residential, Hotel/Motel, and Nonresidential Buildings are required to follow the same procedures if SPF Insulation is installed however no compliance credit is available.
- *Measure Evaluation Report:* None
  - ▶ Both, Envelope, Spray-Foam Insulation Installation, CEC , None

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JA7

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✓ Both

✓ Envelope

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# Nonresidential Cool Roof Requirements

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# Steep-sloped cool roofs



- For CZ 2-15, sets aged reflectance to 0.55, emittance to 0.75, or aged SRI of 55
- For high-rise residential, low-sloped roofs in CZ 10, 11, 13, 14 15, sets a minimum aged reflectance of 0.55, emittance of 0.75
- Adds new requirement for steep-slope roofs: minimum aged reflectance of 0.25, emittance of 0.75, or alternatively, an SRI of 25
- *Measure Evaluation Report:*  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-05-18\\_workshop/2006-05-19\\_NONRESIDENTIAL\\_STEEP-SLOPED\\_COOL\\_ROOFS.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-05-18_workshop/2006-05-19_NONRESIDENTIAL_STEEP-SLOPED_COOL_ROOFS.PDF)
  - ▶ Nonres, Envelope, Steep-sloped cool roofs, Akbari, May 2006

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## ● Low-Slope

- For low-rise residential with low-slope, in CZ 13 and 15, requires an aged reflectance of 0.55 and an emittance of 0.75
- Requires for low-rise, low-slope alterations in CZ 13 and 15, requires aged reflectance of 0.55, emittance of 0.75; alternatively, alteration complies if (a) no ducts are in attic and (b) in zones 10,11, 13 and 14, R-3 or greater roof deck insulation above vented attic is present

## ● Steep-Slope

- For low-rise, steep slope residential buildings, in CZ11, 13 and 15, an aged reflectance of 0.25, emittance of 0.75, or SRI of 25
- For low-rise, steep slope alterations, in CZ 10-15, an aged reflectance of 0.20 and an emittance of 0.75
- Defines equivalent alterations (SRI>19, no ducts in attic, R-30 ceiling insulation, R-0.85 or greater above roof deck over ventilated attic, sealed and tested ducts, radiant barrier, or in CZ10, 12 and 13, 1 cfm attic ventilation per 150 ft<sup>2</sup> of attic (floor) area

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# Residential Requirements

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- The requirements for PCTs are specified in §112
- This joint appendix lays out the specifications for controls that quality.
- *Measure Evaluation Report: Demand Responsive Control of Air Conditioning via Programmable Communicating Thermostats (PCTs),*  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23\\_workshop/2006-02-15\\_PROGRAMBLE\\_COMM.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-02-22+23_workshop/2006-02-15_PROGRAMBLE_COMM.PDF)
  - ▶ Both, HVAC , CEC PCT, CEC, Feb 2006

Section

JA5

Residential

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✓ Both

Envelope

Lighting

✓ HVAC

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# Charge Indicator Display



- Provides specifications for a charge indicator light, which is an alternate means of compliance for refrigerant charge testing.
- *Measure Evaluation Report:*  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12\\_workshop/APPENDIX\\_RJ\\_CHARGE\\_INDICATOR\\_LIGHT.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12_workshop/APPENDIX_RJ_CHARGE_INDICATOR_LIGHT.PDF)

► Both, HVAC, Charge Indicator Display, Wilcox, Jul 06

Section

JA6

Residential

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✓ Both

Envelope

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✓ HVAC

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# New Solar Home Partnership



- Specifies efficiency requirements for Tier I and Tier II alternate compliance options:
- Tier I – combined energy use (space heating and cooling, lighting, water heating) 15 percent less than the standard
- Tier II – combined energy use 35 percent less than the Standard and air-conditioning energy use 40 percent less than the Standard
- *Measure Evaluation Report*: None
  - ▶ Res, NSHP, New Solar Home Partnership, CEC, None

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✓ Residential  
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✓ Envelope  
✓ Lighting  
✓ HVAC  
✓ Water Heating

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# Water Heating Distribution Multipliers (DSMs)



- Revise ACM Distribution System Multipliers
- Parallel pipe system and demand controlled recirculation system multipliers have been revised.
- New multipliers are proposed for pipe systems buried in soil and pipe systems buried in soil and insulated.
- Modifications have been made to several eligibility requirements to add new knowledge or correct the previous standards wording.
- *Measure Evaluation Report:*  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-05-18\\_workshop/2006-05-11\\_ACM\\_RG2.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-05-18_workshop/2006-05-11_ACM_RG2.PDF)
  - ▶ Res, Water Heating, Water Heating Distribution Multipliers (DSMs), DEG, May 06

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✓ Residential  
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✓ Water Heating

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# Tankless Water heaters



- Degrades performance of tankless water heaters by an adjustment factor of 8.8% to reflect actual operation
- *Measure Evaluation Report:*  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-05-18\\_workshop/2006-05-11\\_GAS\\_WATER.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-05-18_workshop/2006-05-11_GAS_WATER.PDF)
- Res, Water Heating, Tankless Water heaters, DEG, May 06

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✓ Water Heating

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# Furnace Fan Modeling



- This change replaces the existing compliance options for adequate airflow, air handler watt draw, and duct design with new prescriptive standards for air flow and fan Watt draw in for forced air central systems used in cooling and Watt draw for systems used in Air Distribution System modes.
- The unconditioned zone model handles
  - - Duct sealing
  - - Duct insulation (including buried ducts)
  - - Duct location (including conditioned space)
  - - Roof solar absorptivity and emissivity
  - - Tile roofs
  - - Radiant barriers mounted on the roof deck
  - - Attic ventilation

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# Refrigerant Charge / TXV



- (4 documents)
- Replaces requirement for visual verification of a TXV with testing of refrigerant charge and TXV. Provides a Charge Indicator Display as a compliance option. This is a modification of an existing prescriptive requirement.
- Changes the minimum level of evaporator airflow for charge testing to 300 cfm per ton and the level of evaporator airflow for adequate airflow credit to 350 cfm per ton.
- Basis: Field data have shown that TXVs are not performing to their assumed potential with respect to maintaining proper refrigerant metering and overcoming improper refrigerant charge. A review of 4384 field tests of TXVs that had subcooling within proper range (indicating proper refrigerant charge) showed that 8.7% of the units had a superheat of less than 4 °F and 13.8% of the units had superheat greater than 25 °F (both indicating improper refrigerant control). When refrigerant control is not proper the unit will not

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# Fan Watt Draw and Airflow



- Extends detailed modeling of fan Watts from cooling to heating
- The 2005 RACM specifies that furnace fan electric energy in Btu be counted as a fixed 0.5% of furnace heating output in Btu regardless of any other characteristic of the furnace or fan. For the 2005 Standards the furnace fan BTU is converted to electric Wh and then converted to TDV energy.
- The new proposed design modeling rules are:
  - 1. The Standard Design and the default for the Proposed Design shall assume furnace fan Watts per Cubic Feet per Minute (W/CFM) in heating mode is a function of the cooling mode W/CFM:
$$\text{W/CFM Heat} = 0.88 * \text{W/CFM Cool}$$
  - 2. The Standard Design and the default for the Proposed Design shall assume furnace fan heating air flow in Cubic Feet per Minute (CFM) is a function of the cooling air flow for

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# Res IAQ Ventilation



- This proposal includes the a new mandatory requirement to comply with
- ASHRAE Standard 62.2-2004 specifies:
  - 1. Mechanical ventilation is required. Window operation is not permitted as a means of meeting the required ventilation.
  - 2. Whole-house Mechanical exhaust, supply or balanced ventilation equal to 1 cfm/100 sq. ft. plus 7.5 cfm \*(number of bedrooms +1).
  - 3. If performance approach is not used, the total fan power used to meet this requirement shall not exceed 1.2 W/cfm of required ventilation air. If performance approach is used, total fan power in the standard design is equal to the proposed house but not greater than 1.2 W/cfm of required ventilation air.
  - 4. Control must be provided to allow occupant use and to

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# Distribution System Leakage



- Introduces two compliance credits that require HERS verification:
- 1. Introduce a new credit for low leakage air handlers. This credit may be taken when factory sealed air handlers are installed in conjunction with verified duct leakage. Factory sealed air handlers must be certified by the manufacturer to the Commission as meeting the reduced air handler leakage criteria and must be verified by a HERS rater. The credit is calculated by either reducing the duct air leakage rates from 8% to 6%, or by specifying and verifying the actual duct air leakage rates.
- Low-leakage air handler is an air handler that is factory-tested to have a leakage rate of no more than 2% of the design CFM when tested at 1" w.g. static pressure.
- 2. Introduce a new credit for low leakage ducts in conditioned space. This credit may be taken when ducts meet the existing criteria for verified ducts in conditioned

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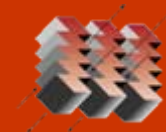
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# Slab Edge Heat Flow Modeling



- Revised calculation procedure for slab-edge modeling in residential buildings, to use a simplified model of the procedure used for nonresidential buildings.
- This method replaces the slab edge F-factors in 3.2.6 of the Residential ACM manual and accounts for weekly and monthly seasonal effects on ground temperatures at the perimeter and at the core of the slab.
- The model accepts slab area and perimeter as the primary user inputs and requires the R-value and depth of the slab edge insulation to be entered.
- *Measure Evaluation Report:*  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-03-28\\_workshop/2006-03-24\\_ACE.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-03-28_workshop/2006-03-24_ACE.PDF)
- Res, HVAC, Slab Edge Heat Flow Modeling, Wilcox, Mar 06

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# Evaporative cooled condensing units



- Adds rules for optional modeling capabilities for:
- evap-cooled condensing units (i.e., Freus)
- *Measure Evaluation Report*: Evaporatively Cooled Condensing Units, Compliance Application, Doc No. CEC400-2005-052
- Res, HVAC , Evaporative cooled condensing units, CEC,

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# Thermal Energy Storage



- Thermal energy storage / DXAC systems
- *Measure Evaluation Report.*
- Res, HVAC , Thermal Energy Storage, CEC,

Section

✓ Residential  
Nonresidential  
Both

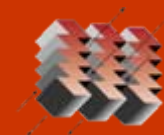
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✓ HVAC  
Water Heating

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# Unconditioned Zone Model (UZM)



- New model to simulate thermal performance of an unconditioned attic containing ducts delivering conditioned air to the space.
- *Measure Evaluation Report*:  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-03-28\\_workshop/2006-03-27\\_UZM\\_MODEL.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-03-28_workshop/2006-03-27_UZM_MODEL.PDF)
- [http://www.energy.ca.gov/title24/2008standards/documents/2006-03-28\\_workshop/2006-03-27\\_UNCONDITIONED\\_ZONE\\_MODEL.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-03-28_workshop/2006-03-27_UNCONDITIONED_ZONE_MODEL.PDF)
- Res, HVAC, Unconditioned Zone Model (UZM), Wilcox, Mar 06

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# Multi-Zone Airflow



- (2 documents) Requires that all operating modes of multi-zone air conditioning systems provide at least 350 cfm per ton in order to obtain credit for adequate airflow. Specifies that the 350 cfm per ton must be accomplished without bypassing air from the supply ductwork into the return ductwork.
- Change the credit for multi-zone A/C systems to only be available if they meet the specifications for adequate airflow and air handler fan watt draw.
- This would apply to Residential New Construction and A/C Replacements (Alterations) of split system air conditioners. The diagnostic test would determine whether the TXV controls the superheat to within acceptable range and whether the refrigerant charge is correct.
- *Measure Evaluation Report:*  
[http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12\\_workshop/MULTI-](http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12_workshop/MULTI-)

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