

Decoding Attics and Walls

Let's Talk High Performance Requirements

Host:
Gina Rodda
Gabel Associates, LLC

Guest Speaker:
John Morton
ConSol












This program is funded by California utility customers under the auspices of the California Public Utilities Commission and in support of the California Energy Commission.



Recording For Future Use

This session is being recorded.

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- ⊕  *Decoding* * Forms™
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- ⊕  *Decoding* * 2016 Title 24, Part 6™





Welcome



HELPING YOU PLAY YOUR CARDS RIGHT



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California Statewide Codes & Standards



EnergyCode AceTM
Helping you play your cards right



This program is funded by California utility customers under the auspices of the California Public Utilities Commission and in support of the California Energy Commission.



Who Are We?



Gabel Associates, LLC
gina@gabelenergy.com

Host: Gina Rodda

Gina Rodda, our host for the Decoding Talk series, is a Certified Energy Analyst (CEA), and LEED Accredited Professional (AP).

She is involved in providing residential and non-residential energy calculations for a variety of building types throughout California; an instructor of full day trainings; and host of various webinars specific to Title 24 (Part 6) Building Energy Efficiency Standards.

Gina has been in the energy modeling field since 1991, through the course of *eight* California building energy code cycles.



GABEL ASSOCIATES, LLC
BUILDING ENERGY ANALYSIS & ENERGY CODE COMPLIANCE



Who Are We?



Guest Speaker: John Morton

John Morton is a Senior Project Manager at ConSol and has worked in the residential new construction industry since 2001. Prior to joining ConSol, he worked for a homebuilder managing all aspects of the homebuilding process from design development through construction. Most recently he ran the award winning residential new construction programs for Southern California Edison.

ConSol
jmorton@ConSol.ws



His is considered a leader in the field of residential energy efficiency including extensive work in zero net energy construction. He is on the Board of Trustees at the California Homebuilding Foundation and Board of Directors for the Building Industry Association of Orange County.

John received his Bachelor of Science in Business from Devry University after being honorably discharged from the United States Marine Corps.



Our Goal Today

Review the 2016 residential requirements:



- ✦ What is a high performance attic and wall;
- ✦ How will that affect what we see for energy compliance;
- ✦ What resources are available for builders, building departments, architects and energy consultants to help understand and implement these measures.



We would like to know
about *you*.





Why?



HELPING YOU PLAY YOUR CARDS RIGHT



Why? Intent Behind the Code



**2020 – Net Zero
“New” Residential
Homes**

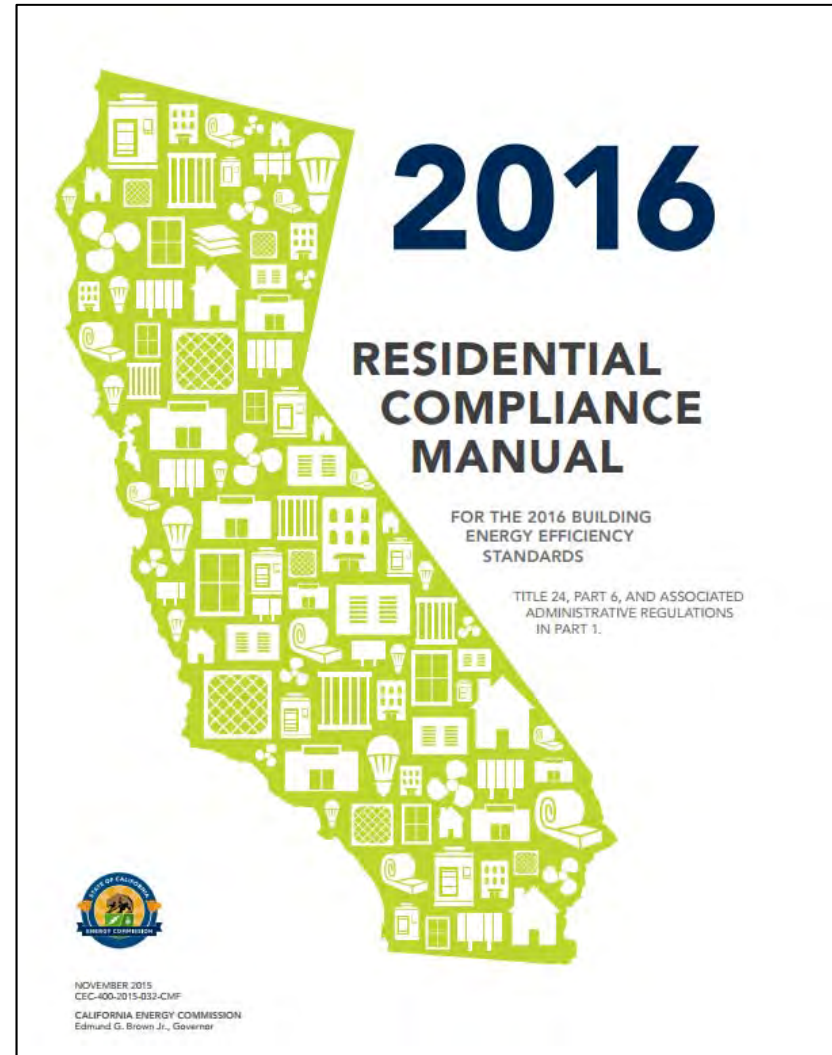
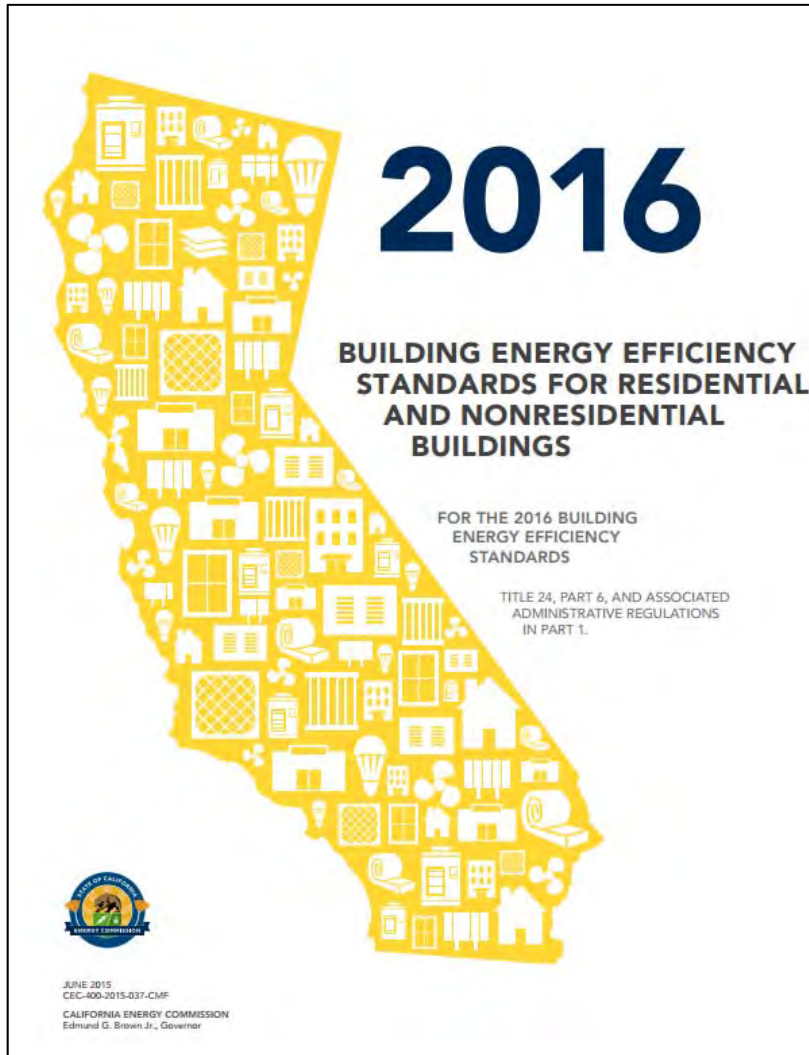
**2030 – Net Zero
“New”
Nonresidential
buildings**

History of 2016 Code Cycle

- ★ **1978:** Title 24, Part 6, *California State Building Energy Efficiency Standards* established; updates every 3 years
- ★ **2003:** *California Energy Action Plan* adopted; efficiency 1st choice in meeting future energy needs
- ★ **2006:** AB32, *Global Warming Solutions Act*, adopted to reduce greenhouse gas emissions
- ★ **2008:** “*Big Bold Strategies*” adopted – California Energy Efficiency Strategic Plan (CEESP)



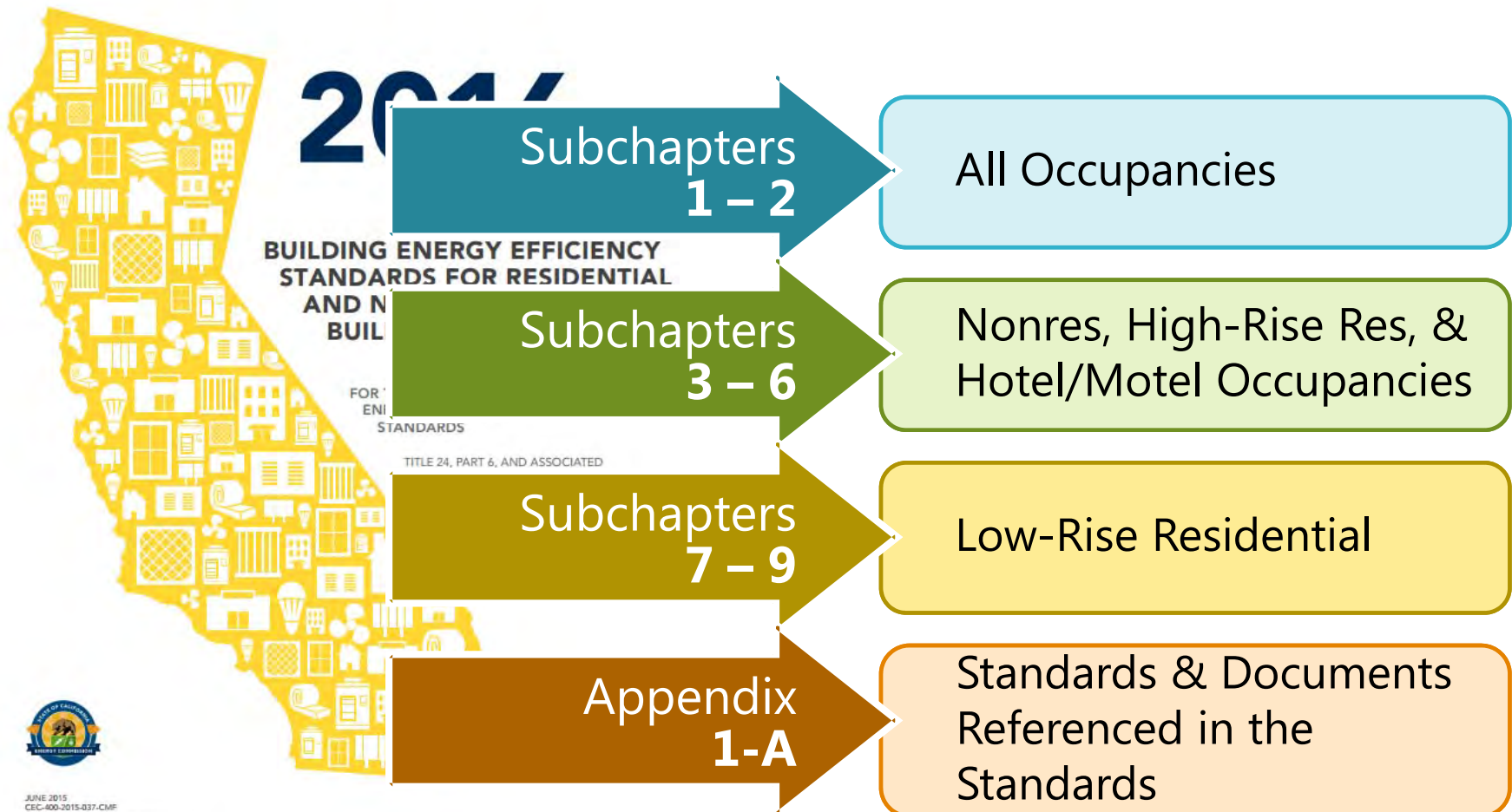
What? Title 24 Part 6: Energy Code



<http://www.energy.ca.gov/title24/2016standards/index.html>



Structure/Organization of the Standards



JUNE 2015
CEC-400-2015-037-CMP
CALIFORNIA ENERGY COMMISSION
Edmund G. Brown Jr., Governor

TABLE 100.0-A APPLICATION OF STANDARDS

Occupancies	Application	Mandatory	Prescriptive	Performance	Additions Alterations
General Provisions for All Buildings		100.0, 100.1, 100.2, 110.0			
Nonresidential, High-Rise Residential, And Hotels/Motels	General	120.0	140.0, 140.2	140.0, 140.1	141.0
	Envelope (conditioned)	110.6, 110.7, 110.8, 120.7	140.3		
	Envelope (unconditioned process spaces)	N.A.	140.3(c)		
	HVAC (conditioned)	110.2, 110.5, 120.1, 120.2, 120.3, 120.4, 120.5, 120.8	140.4		
	Water Heating	110.3, 120.3, 120.8, 120.9	140.5		
	Indoor Lighting (conditioned, process spaces)	110.9, 120.8, 130.0, 130.1, 130.4	140.3(c), 140.6		
	Indoor Lighting (unconditioned and parking garages)	110.9, 120.8, 130.0, 130.1, 130.4	140.3(c), 140.6		
	Outdoor Lighting	110.9, 130.0, 130.2, 130.4	140.7		
	Electrical Power Distribution	110.11, 130.5	N.A.		
	Pool and Spa Systems	110.4, 110.5, 150.0(p)	N.A.		
	Solar Ready Buildings	110.10	N.A.		
Covered Processes¹	Envelope, Ventilation, Process Loads	110.2, 120.6	140.9	140.1	120.6, 140.9
Signs	Indoor and Outdoor	130.0, 130.3	140.8	N.A.	141.0, 141.0(b)2H
Low-Rise Residential	General	150.0	150.1(a, c)	150.1(a), 150.1(b)	150.2(a), 150.2(b)
	Envelope (conditioned)	110.6, 110.7, 110.8, 150(a), 150.0(b), 150.0(c), 150.0(d), 150.0(e), 150.0(g)			
	HVAC (conditioned)	110.2, 110.5, 150.0(h), 150.0(i), 150.0(j), 150.0(m), 150.0(o)			
	Water Heating	110.3, 150.0(j, n)			
	Indoor Lighting (conditioned, unconditioned and parking garages)	110.9, 130.0, 150.0(k)			
	Outdoor Lighting	110.9, 130.0, 150.0(k)			
	Pool and Spa Systems	110.4, 150.0(p)			
Solar Ready Buildings	110.10	N. A.	N.A.	N.A.	

¹ Nonresidential, high-rise and hotel/motel buildings that contain covered processes may conform to the applicable requirements of both occupancy types listed in this table.



Energy Code Ace

www.energycodeace.com

2016 ENERGY CODE

Fact Sheet

Residential

What's New with 2016 Code?

Overview

The 2016 update to the Residential Building Energy Efficiency Standards (Energy Standards) requires new and altered homes to become more efficient in several ways to create energy and environmental savings for Californians. See Figure 1 below for building systems that include updates under the new 2016 Energy Standards. The 2016 Energy Standards have been adopted, and once approved, will be implemented for projects permitted on or after January 1, 2017. For more detailed information, see the related California Energy Commission (Energy Commission) FAQ sheet.

Figure 1: Title 24, Part 6 2016 Update Infographic by Energy Commission

Statewide Savings

The incremental changes to California's energy code mean big savings across the state for ratepayers. Per the Energy Commission, new residential requirements for the 2016 code cycle mean real savings for homeowners—around \$7,400 over a 30 year mortgage. A single family home that meets the 2016 standards could see 26% more energy savings in regulated loads than those built under the 2013 Energy Standards. See the Adoption Vetting Presentation for more 2016 Energy Standards energy impacts.

California's Energy Goals

California's Energy Efficiency Strategic Plan describes energy efficiency as the "least cost, most reliable, and most environmentally sensitive resource, and minimizes our contribution to climate change." The Strategic Plan goes on to outline four "Big Bold Strategies" to guide the market transformation necessary to meet the State's energy goals. A short description of the "Big Bold Strategies" and overview of the Strategic Plan is included in a summary Fact Sheet. Energy codes and standards is one of six themes identified in the Energy Efficiency Strategic Plan to achieve the Big Bold Strategy related to residential construction. The Strategic Plan describes the role of codes and standards as:

"Adopt aggressive and progressive minimum energy codes and standards for buildings and plug loads, effective code compliance and enforcement, and parallel, tiered voluntary energy efficiency standards that pull the market along and set a higher bar for subsequent standards."

Envelope Highlights

Mandatory Measures \$150.0

There are several new thresholds for mandatory envelope requirements including:

- Ceiling/Floor insulation maximum = 0.043 U-factor (R-22 wood framing)
- Non-framed (mass) wall maximum = 0.102 U-factor — Equivalency to R-13 wood framing
- Maximum fenestration U-factor = 0.58 (same as 2013)
 - New exception allows for 30 sqft for dual glazed greenhouse windows
- Doors (including pet doors) must meet maximum 0.3 cfm/ft² air leakage

Prescriptive High Performance Walls \$150.1

In Climate Zones 1-5 & 8-16, above grade framed wall assemblies must not exceed a maximum U-factor of 0.051:

- 2x6 @ 16" OC framing—R19 cavity + R5 continuous
- 2x4 @ 16" OC framing—R15 cavity + R5 continuous
- In Climate Zones 6 & 7, the maximum U-Factor is 0.065.

Prescriptive High Performance Attics \$150.1

There are three options that may be used to comply:

- **Option A:** Ducts and air handler may be located in the attic
 - Install attic radiant barrier (Zones 2-15)
 - Install R-38 insulation at ceiling (R-30 in Zones 3 & 5-7)
 - Install continuous roof deck insulation (Zones 4 & 8-16)
 - R-6 with air space above insulation/ R-8 with no space
- **Option B:** Ducts and air handler may be located in the attic
 - Install attic radiant barrier (Zones 2,3 & 5-7)
 - Install R-38 insulation at ceiling (R-30 in Zones 3 & 5-7)
 - Install below roof deck insulation (at rafter) (Zones 4 & 8-16)
 - R-13 with air space above insulation/ R-16 with no space
- **Option C:** Ducts and air handler must be located in conditioned space
 - Install attic radiant barrier (Zones 2-15)
 - Install R-38 insulation at ceiling (R-30 in Zones 3 & 5-7)

Prescriptive Additions \$150.2

There are several options that allow for extensions of existing wood-framed walls to retain the same dimensions.

- Install R-16 in 2x4 framing
- Install R-19 in 2x6 framing

Title 24, Part 6 - Residential What's New with 2016 Code

Page 1 of 2

2016-05-03

Mechanical Highlights

Updates were made to both mandatory and prescriptive HVAC requirements under the 2016 Standards:

Mandatory Measures \$150.0(m)

- All ducts in conditioned spaces must include R-4.2 insulation.
- Duct leakage requirement has been reduced to 5% maximum for single family homes.

Prescriptive Measures \$150.1

- High performance attics with ducts in attic (options A and B)
 - R-8 duct insulation in Zones 1-2, 4, 8-16
 - R-6 duct insulation in Zones 3, and 5-7
- High performance attics with ducts in conditioned space (option C)
 - R-6 in all zones
- Whole house fans must supply 1.5 cfm/sf (reduced from 2 cfm/sf) Attic vent area also reduced to 1 sf/ 750 cfm of airflow.

Domestic Hot Water Highlights

Increased Prescriptive Efficiency for Water Heaters (3 options) \$150.1(c)B

1. Tankless (gas or propane) minimum energy factor of 0.82
2. Tank ≤ 55 gal (gas or propane) minimum energy factor of 0.60. Additional HERS verification: HERS verified Quality Insulation Installation (QII) and either HERS verified compact hot water distribution system or HERS verified DHW pipe insulation required.
3. Tank ≥ 55 gal (gas or propane) minimum energy factor of 0.76. Additional HERS verification: HERS verified compact hot water distribution system or HERS verified DHW pipe insulation required.

Mandatory Isolation Valves \$110.3(c)7

- Instantaneous water heaters with an input rating of 6.8kBTU/hr (2 kW) or greater need an isolation valve on cold water supply and hot water leaving water heater.
- Each valve needs a hose bibb or other fitting allowing for flushing the water heater when the valves are closed.

Mandatory Water Heater Pipe Insulation \$150.2(b)1G

- For water heater replacements, install piping insulation per mandatory measures and insulate all existing accessible piping.

Onsite Renewable Systems Highlights

The compliance credit for installing PV systems is only available if the project meets the following conditions:

- The Performance Approach is used
- The project is in Climate Zones 1-5, 8-16
- The system is ≥ 2 kWdc* for Single Family
- The system is ≥ 1 kWdc* for Multifamily
- The amount of credit will depend upon the Climate Zone and the Conditioned Floor Area of the dwelling.

Note: Taking the PV system credit does not require HERS verification unless getting a rebate from the New Solar Homes Partnership (NSHP).

Lighting Highlights

Mandatory High Efficacy Lighting \$150.0(k)

High efficacy lighting is essential to reducing energy load in homes and dwelling units, and the 2016 Standards makes it mandatory that all residential lighting be high efficacy. The Standards do not allow trade-offs

between lighting and other features when using the Performance Method. These mandatory requirements apply to permanently installed light fixtures, including screw-based which must contain JAB compliant lamps. Table 150.0-A summarized below, lists light source technologies qualified as high efficacy.

Table 150.0-A: High Efficacy Light Sources
Pin-based linear or compact fluorescent lamps light sources using electronic ballasts
Pulse-start metal halide lamps
High pressure sodium lamps
GU-24 sockets containing light sources other than LEDs
Inseparable SSL luminaires that are installed outdoors
Inseparable SSL luminaires containing colored light sources that are installed to provide decorative lighting

Light sources not listed in Table 150.0-A above may be certified to the Energy Commission as high efficacy in accordance with Joint Appendix 8 (JAB). JAB compliant light sources must be marked as "JAB-2016" or "JAB-2016-E." "JAB-2016-E" designates light sources that have passed the Elevated Temperature Life Test and are deemed appropriate for use in enclosed luminaires.

JAB compliant light sources shown in the table below must be controlled by vacancy sensors or dimmers (exceptions for closets <70 SF and hallways, \$150.0(k)2K).

Table 150.0-A & JAB: High Efficacy Light Sources
Light sources in ceiling recessed downlight luminaires
LED luminaires with integral sources
Pin-based LED lamps (MR-16, AR-111, etc.)
GU-24 based LED light source

Screw Based Luminaires \$150.0(k)G

- Screw based luminaires must contain JAB compliant light sources
- Recessed downlight luminaires in ceilings must not contain screw-based sockets.
- Incandescent sources are prohibited from having a GU-24 base (per Title 20 Section 1605.3K).

Blank Electrical Boxes \$150.0(k)B

- The number of blank electrical boxes more than 5 feet above the finished floor shall not be greater than the number of bedrooms.
- Additionally, these electrical boxes must be served by a dimmer, vacancy sensor, or fan speed control.

Bathrooms, Garages, Laundry Rooms, and Utility Rooms \$150.0(k)2J

- At least one fixture must be controlled by a vacancy sensor.

Under Cabinet Lighting \$150.0(k)2L

- Any under cabinet lighting (including kitchen) must be switched separately from other lighting systems.

Outdoor Lighting \$150.0(k)3

- Must be high efficacy like indoor lighting
- Must include manual on/off switch and one of the following:
 - Photocontrol and motion sensor
 - Photocontrol and automatic time switch control
 - Astronomical time switch control
 - Energy Management Control System

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Title 24, Part 6 - Residential What's New with 2016 Code

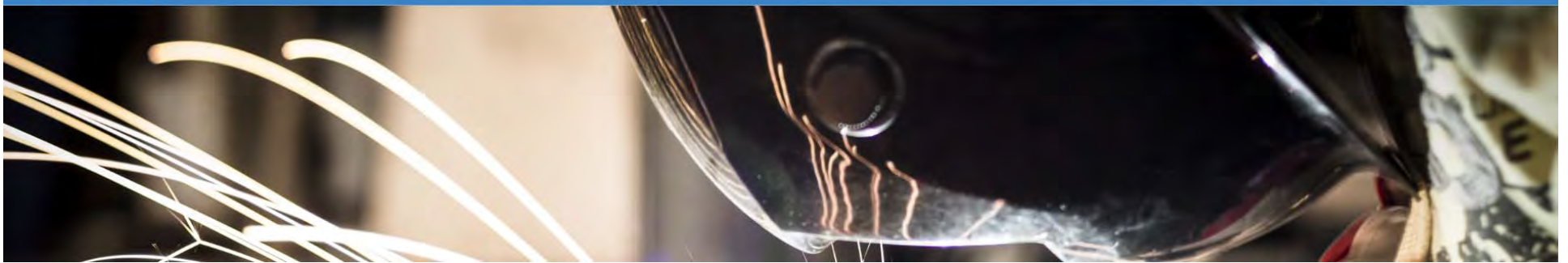


WISE

www.wisewarehouse.org



[CODE REQUIREMENTS](#) [PRODUCTS/SOLUTIONS](#) [CASE STUDIES](#) [RESOURCES](#) [EVENTS & FORUMS](#) [ABOUT US](#)



Workforce Instruction for Standards and Efficiency (WISE) is a training and education program designed to support the transition of California new residential building toward High Performance Attic (HPA) and High Performance Wall (HPW) construction practices.

WISE is designed to help accelerate learning and implementation of high performance building by training workers and providing a platform for the exchange of best practices and solutions from industry experts.

This web portal is designed as a central point for sharing information related to the program, including reports, technical briefings, case studies and event coordination.



Master Builder through CAHP

<http://cahp-pge.com/masterbuilder/>

california advanced homes Toll Free (866) 352-7457
11211 Gold Country Blvd., Suite 103
Gold River, CA 95670

Home Program Incentives Training Resources Master Builder

NEW PROGRAM OFFERING
The **California Advanced Homes Program Master Builder** recognizes and aids early adoption of advanced design and building practices. Industry leaders participate in this 2016 code-readiness program through the installation of two key 2016 Code measures:
1. High performance attics (including ducts in conditioned space)
2. High performance walls

PARTICIPATION BENEFITS

- Additional incentives for advanced design and construction options: (A) \$30,000 for high performance attic and high performance walls builders; (B) \$20,000 for high performance attic
- Increased CAHP incentives of \$1,000 to \$4,000 for each participating lot
- Exclusive consulting services from dedicated subject matter experts to guide projects from design to construction, including coordination of design meetings
- On-site training for your design team and subcontractors, and installation guidance from product manufacturers
- Potential product discounts from participating manufacturers

View the **program factsheet** for eligibility requirements.

HOW TO PARTICIPATE

1. Contact Melissa Buckley via email or phone at (916) 844-0081
2. Submit a CAHP Master Builder enrollment agreement and required documents
3. Design and install agreed-upon high performance attics and/or walls
4. Complete post-construction verification, monitoring, and promotion

HIGH PERFORMANCE ATTICS
High performance attics minimize the temperature difference between the attic space and the conditioned air that travels through the attic ductwork. This reduced temperature difference lowers energy use for cooling and heating. High performance attics can increase CAHP incentives by \$100 to \$2,000 per lot.

PGE CAHP RESOURCES

- 2014-15 Application
- 2014-15 Adjustment App
- Incentive Request Checklist
- 2010-12 Adjustment App
- 2013 Adjustment App

Contact Our Staff

Scott Blunk
Program Manager

Carol Waterbury
Program Application Coordinator

Lori McAdams
Incentive Coordinator

- ✦ Master Builder is a limited design support program for early adoption of 2016 High Performance Attics & High Performance Walls
- ✦ Operating in all 4 IOU territories
- ✦ Cash incentives and subject matter expert support with design, permitting and initial construction
- ✦ Best practices to be shared with the public via case studies
- ✦ Contact Melissa Buckley (mbuckley@trcsolutions.com) for more information.



CEC: Blueprint

<http://www.energy.ca.gov/efficiency/listservers.html>

Issue 115 March – April 2016

BLUEPRINT

California Energy Commission
Efficiency Division



In This Issue

- ▶ New Mechanical Acceptance Test Technician Certification Provider
- ▶ Small Duct High Velocity Space Conditioning Systems
- ▶ Demand Responsive Controls for Additions and Alterations
- ▶ Residential Water Heating Options
- ▶ EnergyPro Version 7.0
- ▶ Alternative Path for Complying with Lighting Alteration Requirements
- ▶ Lighting Standards to Save Californians More Than \$4 Billion in Electricity Costs
- ▶ Q&A
 - Illuminated Areas
 - Track Lighting Alterations
 - Compliance Documents
 - Townhouses and Duplexes
 - Commissioning
- ▶ Energy Code Ace Training Schedule

New Mechanical Acceptance Test Technician Certification Provider

On January 13, 2016, the California Energy Commission (Energy Commission) approved the National Environmental Balancing Bureau (NEBB), as a mechanical Acceptance Test Technician Certification Provider (ATTCP).

This gives NEBB the authority to train, certify, and oversee acceptance test technicians (ATTs) and their employers. NEBB will train and certify ATTs to perform all 17 mechanical acceptance tests required in the 2013 *Building Energy Efficiency Standards* (Energy Standards).

The Conditions of Approval are available for review in the **Executive Director's recommendation**.

For more information, please visit: <http://energy.ca.gov/title24/attcp/>.

Small Duct High Velocity Space Conditioning Systems

Small duct high velocity (SDHV) systems may be used to comply with the Energy Standards. The following is a list of requirements with direction on how SDHV systems can comply with the low-rise residential requirements of the Energy Standards.

Mandatory Requirements

United States Department of Energy Standards:

SDHV systems manufactured on or after January 23, 2006, and before January 1, 2015, must have a minimum Seasonal Energy Efficiency Ratio (SEER) of 11, and a minimum Heating Seasonal Performance Factor (HSPF) of 6.8.

SDHV systems manufactured on or after January 1, 2015, must have a minimum SEER of 12, and a minimum HSPF of 7.2.

Energy Standards:

Section 150.0(m)13B - Single zone systems that use forced air ducts to supply cooled air to an occupiable space must either meet minimum airflow and fan efficacy requirements, or meet the return duct and grille sizing requirements of TABLES 150.0-C or 150.0-D.

Section 150.0(m)15 - Specific to systems with multiple thermostatically controlled zones, this section requires the same mandatory airflow and fan efficacy requirements as Section 150.0(m)13B. However, it does not have the same duct and grille sizing alternative. If such systems cannot satisfy the airflow and fan efficacy requirements of this section, compliance must be demonstrated via the performance approach.

The duct leakage and insulation requirements apply as with any other system.

Prescriptive Requirements

The refrigerant charge and duct insulation requirements apply as with any other system.

✦ Building Standards and Blueprint listserv (automatic email list)

✦ Best way to stay up with latest information from CEC

✦ Software update approvals

✦ ATT status updates

✦ Code interpretations

✦ And so much MORE!



CEC: Future Code

<http://www.energy.ca.gov/title24/2019standards/>



Have a voice!

2019 STANDARDS UPDATE SCHEDULE	
DATE	MILESTONES
February 2016-July 2016	Measures Identified and approval
August 2016 to June 2017	Stakeholder meeting/workshop & final staff workshop
June 1, 2017	CASE Reports submitted to the CEC
December 1, 2017	45-day Language Hearings
March 1, 2018	Adoption of 2019 Standards at Business Meeting
June 1, 2018 to November 2018	Staff work on Software, Compliance Manuals, Electronic Documents Available to Industry
November 1, 2018	Approval of the Manuals
January 1, 2019	Software, Compliance Manuals, Electronic Documents Available to Industry
January 1, 2020	Effective Date



Let's Talk



HELPING YOU PLAY YOUR CARDS RIGHT



Our Question To You

As we are progressing toward California's ZNE's goals, why has the CEC focused on improvements to residential attic and walls for the 2016 standards?

most opportunity to reduce energy use in residential construction - not as dependent on occupant behavior as equipment, lighting, etc - technology available now

Because they are running out of components to squeeze.

To expand the number of dwellings without building new energy sources needed.

Cooling demand and duct location are critical.

To keep attics cooler to minimize the effects of heat on ducts and HVAC systems in order to extend the units life expectancy and save energy

CALIFORNIA'S 2016 — RESIDENTIAL BUILDING ENERGY EFFICIENCY STANDARDS

CALIFORNIA ENERGY COMMISSION

The state's energy efficiency standards for new buildings and appliances have saved consumers billions in reduced electricity and natural gas bills. The building standards include better windows, insulation, lighting, air conditioning systems and other features that reduce energy consumption in homes and businesses. Since 1978 these standards have helped protect the environment by reducing more than 250 million metric tons of greenhouse gas emissions (or the equivalent of removing 37 million cars off California roads).

\$7,400 SAVINGS OVER A 30 YR. MORTGAGE | INITIAL COST \$2,700

28% more stringent



HIGH EFFICACY LIGHTING

All lighting in new homes must be efficient. Installation of high quality lighting with controls that nearly halve the energy required for lights in new homes.



HIGH PERFORMANCE WALLS

Increased wall insulation keeps the sun's heat out of your home during hot summer months and warm air in during winter months, improving comfort and reducing energy consumption.



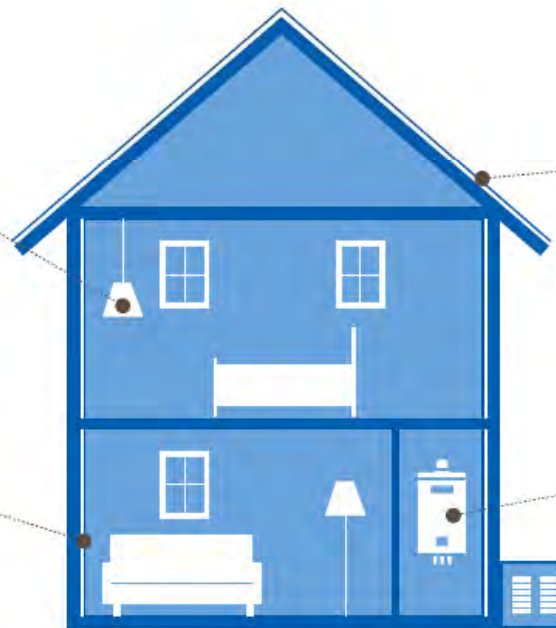
HIGH PERFORMANCE ATTICS

Attics with additional insulation at the roof deck keep attic temperatures closer to ambient, improving the home's heating and cooling performance. Extra insulation at the roof deck, in addition to the ceiling insulation, will reduce the attic temperature by 35 degrees or more during hot summer days.



IMPROVED WATER HEATING SYSTEM EFFICIENCY

Installing tankless water heating technology and better distribution systems reduces the energy needed to provide hot water to the home by about 35 percent.



These are cost effective measures that home builders may consider to achieve new levels of efficiency. They can be traded for other efficient technologies such as higher efficiency HVAC units, higher efficiency water heaters, etc.



Challenges



- ✦ Challenge A:
 - ✦ Climate Zone Matters



- ✦ Challenge B:
 - ✦ High Performance Attic (HPA)



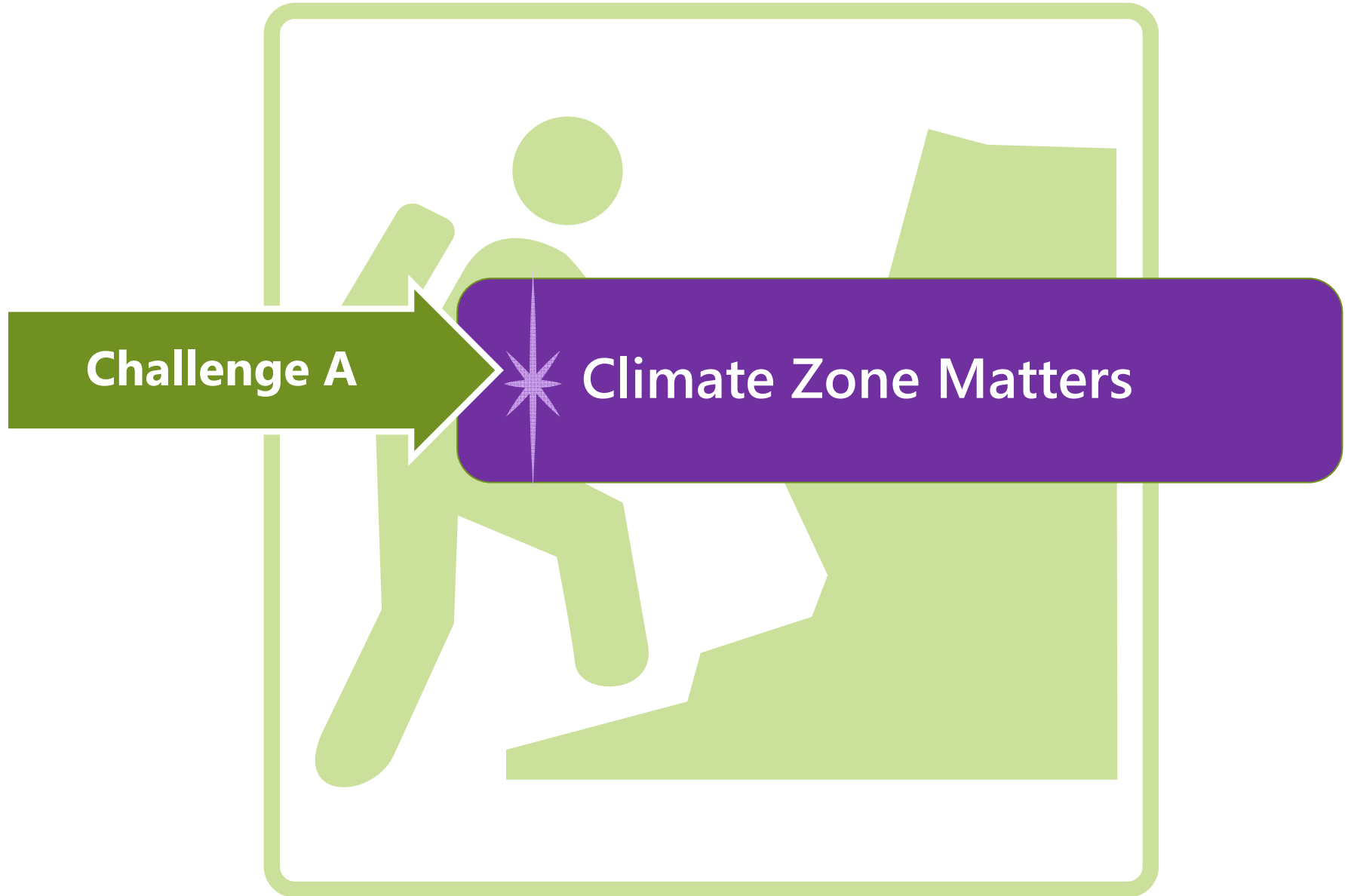
- ✦ Challenge C:
 - ✦ High Performance Walls



- ✦ Challenge D:
 - ✦ Performance Options



Challenge A





Why?

Intent Behind the Code



http://www.energy.ca.gov/title24/2016standards/rulemaking/documents/2015-06-10_hearing/2015-06-10_Adoption_Hearing_Presentation.pdf

- ✦ The Warren-Alquist Act, requires the Energy Commission to develop and maintain energy efficiency standards that are
 - ✧ "... cost effective, when taken in their entirety, and when amortized over the economic life of the structure when compared with historic practice".
- ✦ Time Dependent Valuation (TDV)
 - ✧ Gives greater weight to energy saved during peak periods – or periods when the generation capacity is at its limit and when the distribution system is near capacity.



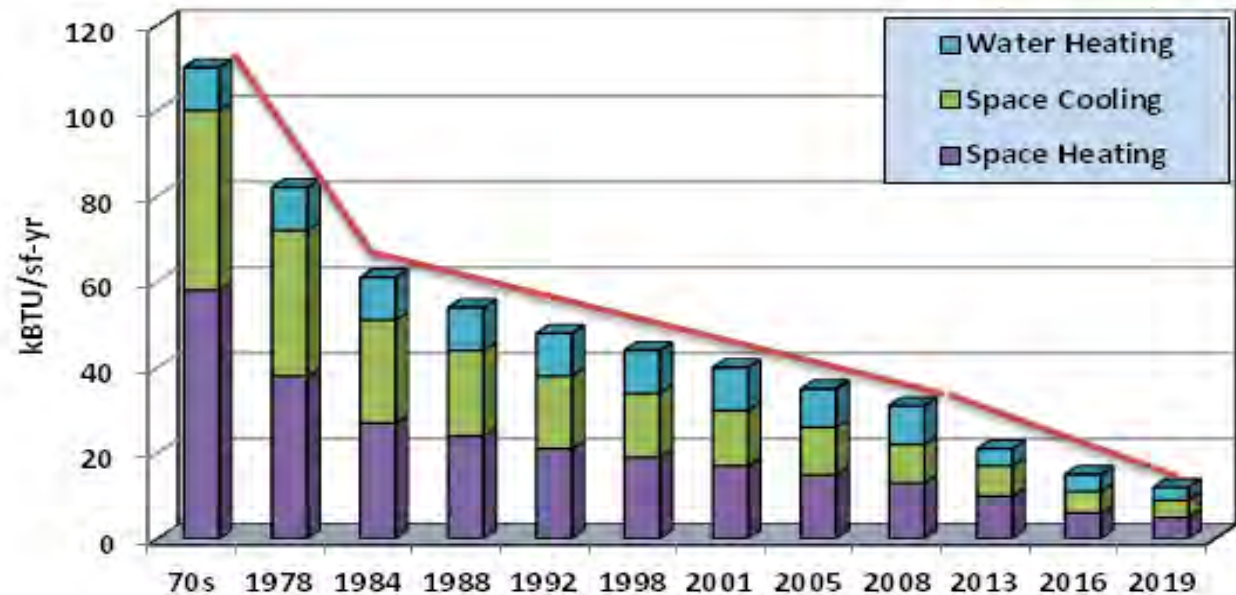
Why?

Intent Behind the Code



http://www.energy.ca.gov/title24/2016_standards/prerulemaking/documents/2014-07-21_workshop/case_reports/2016_Title_24_Draft_CASE_Report-Residential_Ducts_in_Conditioned_Space-High_Performance_Attics.pdf

- ✦ High Performance Attics (HPA) is a package of measures that minimizes the temperature difference between the attic and the conditioned air in ducts.



Impacts of Building Standards on Home Energy Use

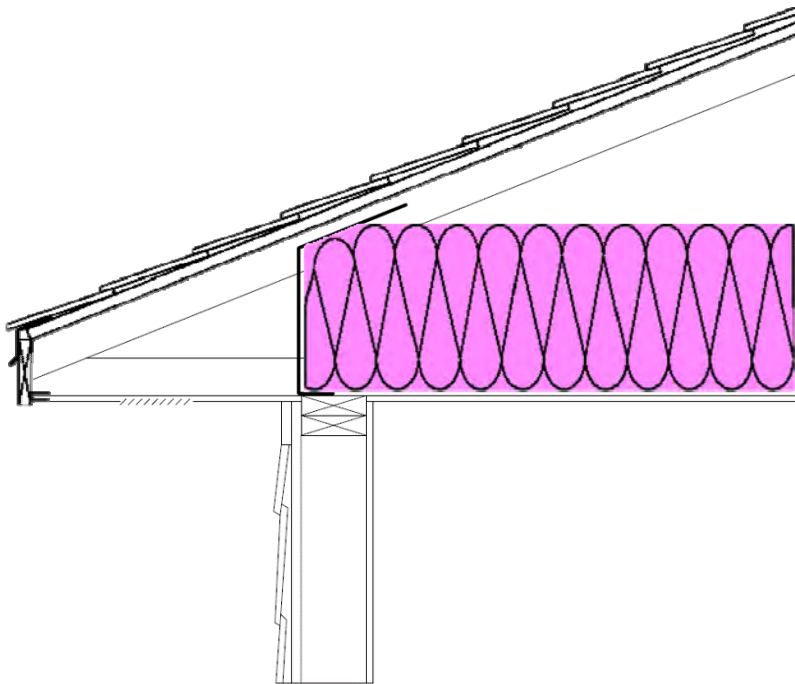


Roof: Mandatory Measures



Roof §150.0

- ◆ U-factor (wood framed attic): 0.043
- ◆ Example: R-22 (JA4.2.1-1A)



Reduced
from 2013
code which
was R-30

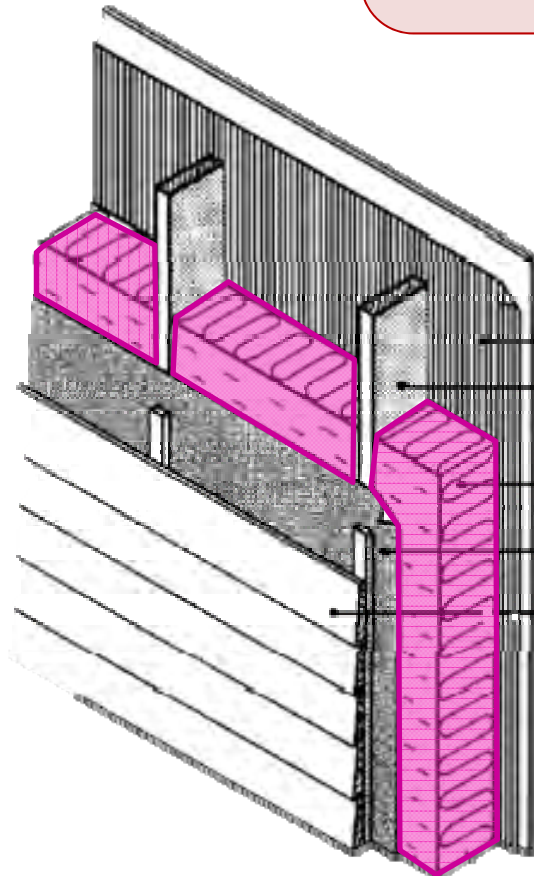


Walls: Mandatory Measures



Walls \$150.0

- ◆ U-factor (wood framed 2 x 4): 0.102
 - ◇ Example: R-13 (JA4.3.1-3A)
- ◆ U-factor (wood framed 2 x 6): 0.074
 - ◇ Example: R-19 (JA4.3.1-5A)



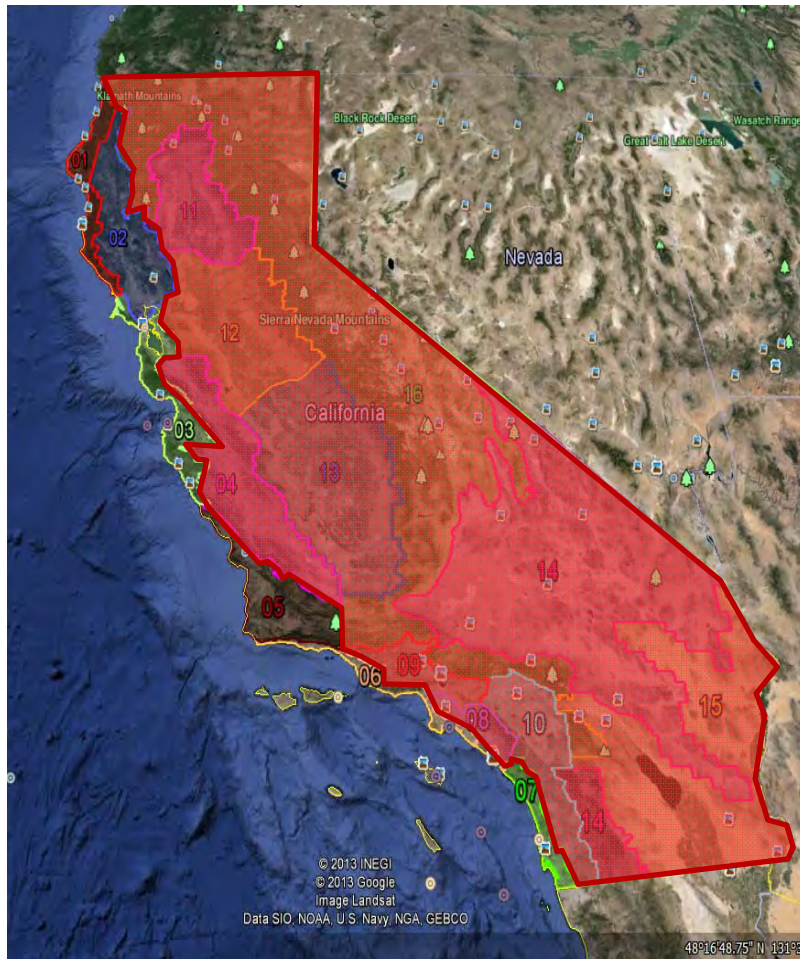
**No change
from 2013
standards.**



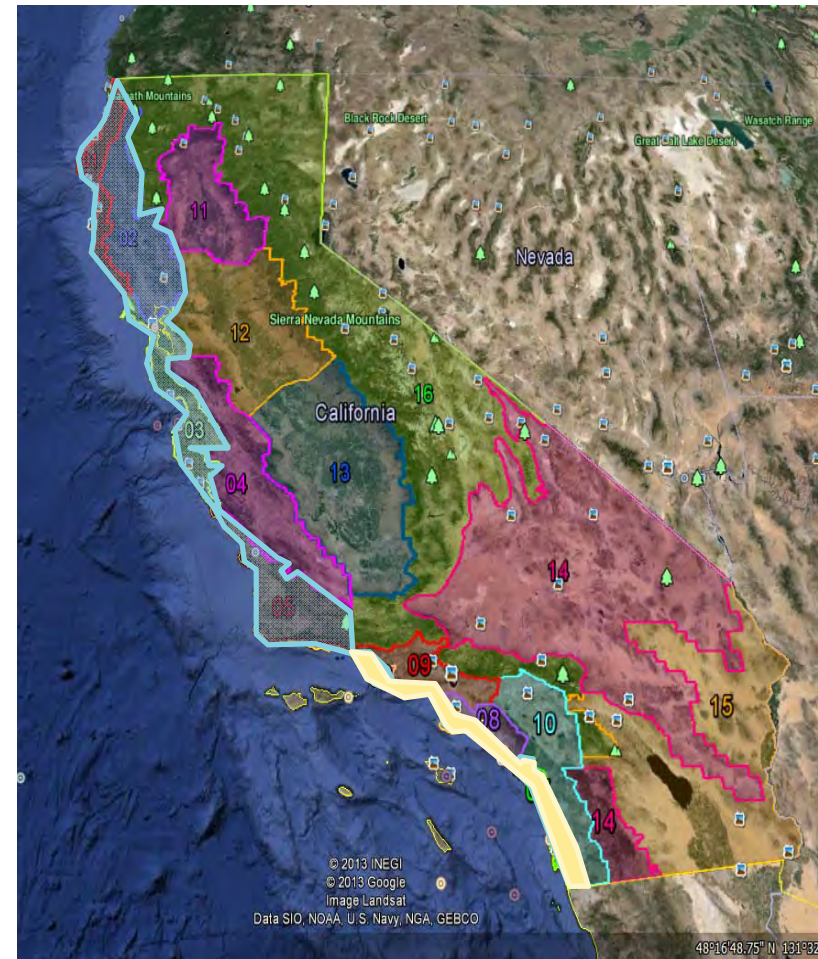
Prescriptive Package A: \$150.1



Hot/Cold Climate Zones



Mild Climate Zones





Challenge B





Our Question To You

What are your top 3 concerns regarding the residential high performance attics and walls?

1. Feasibility. Do installers know how to create these new attics/walls for the installers that are willing to try.
2. Resistance to change/ push back from installer.
3. Being able to meet code when (and it will be often) developers/designers do not want to use high performance attics and walls.

Education, adoption and deployment by the building industry.

Contractors understanding

"Walls: thickness of total assembly
Attic: relevance in microclimates
Both: added costs"

Detailing openings, especially waterproofing windows.
Condensation in unvented attics.
Losing usable floor space due to thick walls.



Table 150.1-A - ROOF

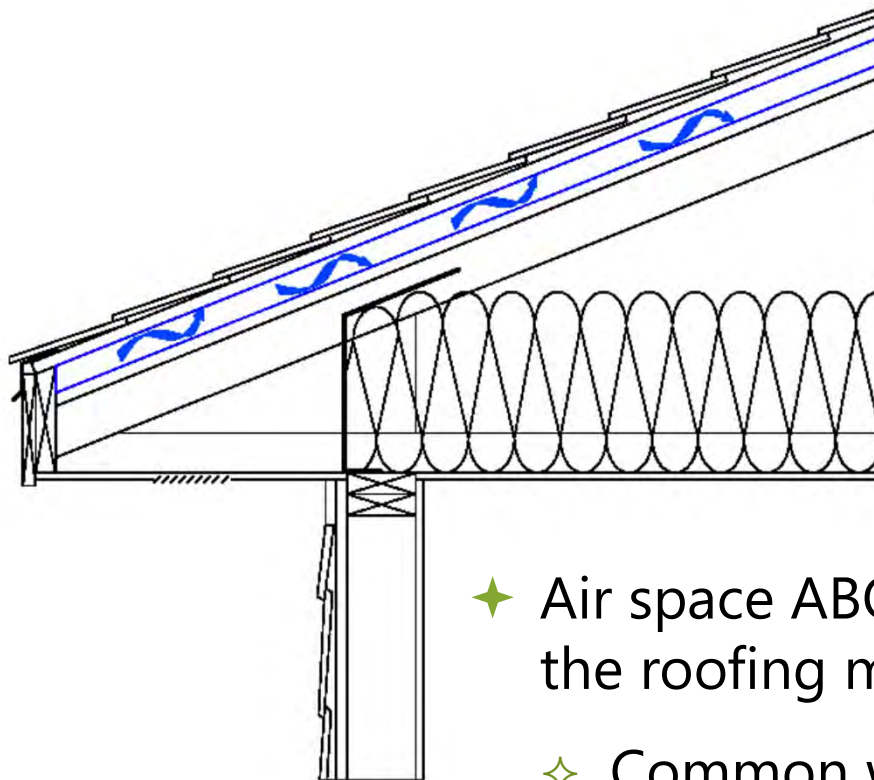
2016 TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN - ROOF																			
		Mandatory U-factor	Climate Zone																
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Envelope Insulation: Roofs/Ceilings	Option A §150.1(c)9A	Continuous Insulation Above Roof Rafter	Roofing Type	No Air Space	NR	NR	NR	R 8	NR	NR	NR	R 8	R 8	R 8	R 8	R 8	R 8	R 8	
			With Air Space	NR	NR	NR	R 6	NR	NR	NR	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6
		Ceiling Insulation		R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38
		Radiant Barrier		NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
	Option B §150.1(c)9A	Below Roof Deck	Roofing Type	No Air Space	NR	NR	NR	R 18	NR	NR	NR	R 18	R 18	R 18	R 18	R 18	R 18	R 18	R 18
			With Air Space	NR	NR	NR	R 13	NR	NR	NR	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13
		Ceiling Insulation		R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38
		Radiant Barrier		NR	REQ	REQ	NR	REQ	REQ	REQ	NR	NR	NR	NR	NR	NR	NR	NR	NR
	Option C §150.1(c)9B	Ceiling Insulation		R 38	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38
		Radiant Barrier		NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
	2013 Roofs /Ceilings		0.031 R-30	U 0.025 R 38	U 0.031 R 30								U 0.025 R 38						



Roof: Air Space Example



Roofs/Ceilings	Option A	Insulation Above Roof Rafter	Roofing Type	With Air Space	No Air Space															
	\$150.1(c)9A Continuous					0.043 (R-22)	NR	NR	NR	R 8	NR	NR	NR	R 8	R 8	R 8	R 8	R 8	R 8	R 8
							NR	NR	NR	R 6	NR	NR	NR	R 6	R 6	R 6	R 6	R 6	R 6	R 6



With Air Space?
No Air Space?

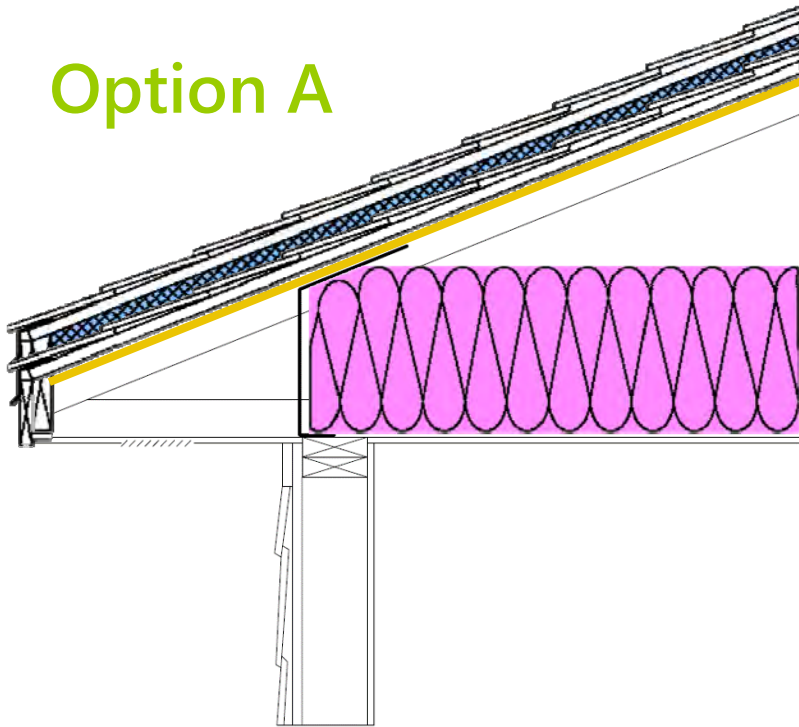
- ✦ Air space ABOVE the roof deck but BELOW the roofing material
- ✦ Common with tile roofing



Roof: Vented Attic



Option A



Ceiling insulation AND above roof deck insulation

- ✦ Above roof deck, which is typically in the purview of the roofer. R-value depends on with or without "airspace".
- ✦ Ceiling insulation must also be provided.
- ✦ Radiant Barrier dependent on CZ.
- ✦ Upper insulation dependent upon CZ.

2016 TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN - ROOF

		Mandatory U-factor	Climate Zone															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Roofs/Ceilings	Option A §150.1(c)9A	Continuous Insulation Above Roof Rafter Roofing Type No Air Space	NR	NR	NR	R 8	NR	NR	NR	R 8	R 8	R 8	R 8	R 8	R 8	R 8	R 8	R 8
		With Air Space	NR	NR	NR	R 6	NR	NR	NR	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6
	Ceiling Insulation	R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	
	Radiant Barrier	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	



HPA: Option A



✦ Basic design: Example CZ 12

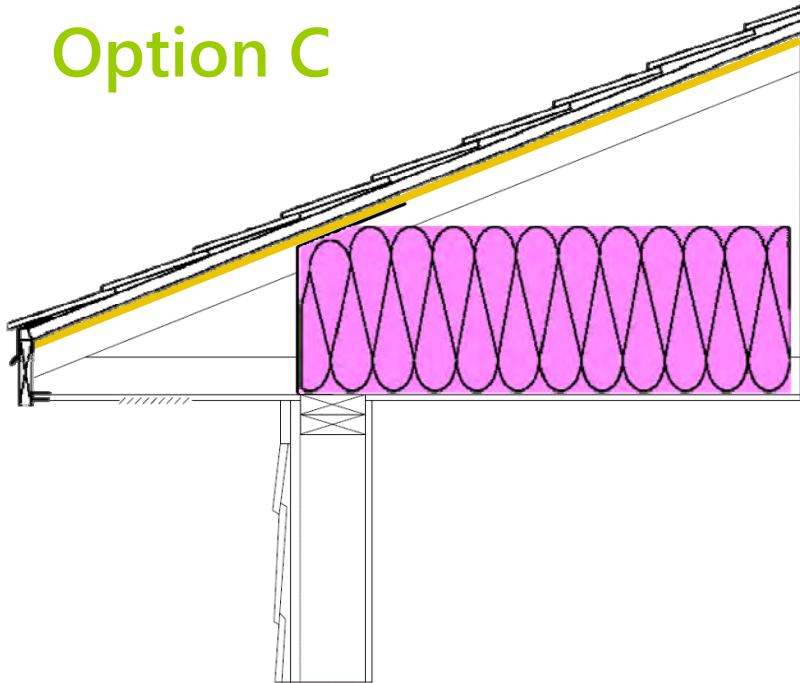
- ✦ Ducts and air handler remain in the attic
- ✦ Vented attic
- ✦ *Above deck rigid foam (R-6) + Radiant Barrier*
 - *Air space below roofing product*
- ✦ *Ceiling insulation (R-38)*
- ✦ R-8 duct insulation
- ✦ Control duct leakage to maximum 5% (HERS verified)
- ✦ Cool roof:
 - Aged solar reflectance = 0.20
 - Thermal emittance = 0.75



Roof: Vented Attic



Option C



Ducts and air handler in conditioned space

- ✦ Conditioned space = habitable space!
- ✦ Ceiling insulation only.
 - ✦ **Must be a vented attic**
- ✦ Radiant Barrier dependent on CZ.

2016 TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN - ROOF

		Mandatory U-factor	Climate Zone																
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
			Roofs/Ceilings	Option C §150.1(c)9B	Ceiling Insulation	R 38	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 38	R 38	R 38
		0.043 (R-22)	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR

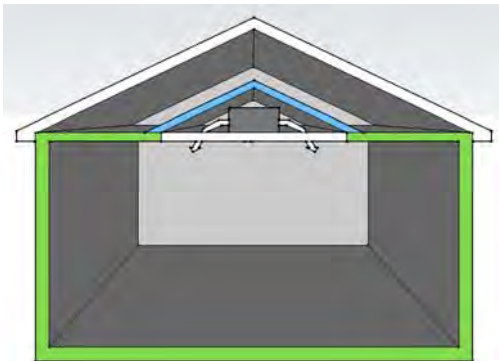
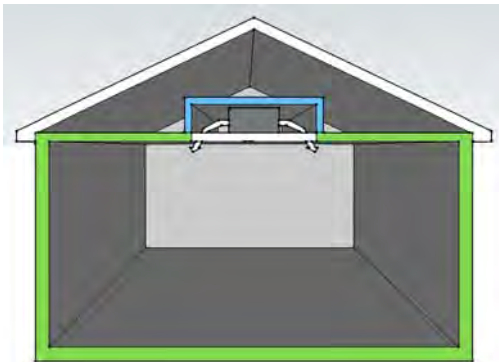


HPA: Option C



Basic Design: 3 Options

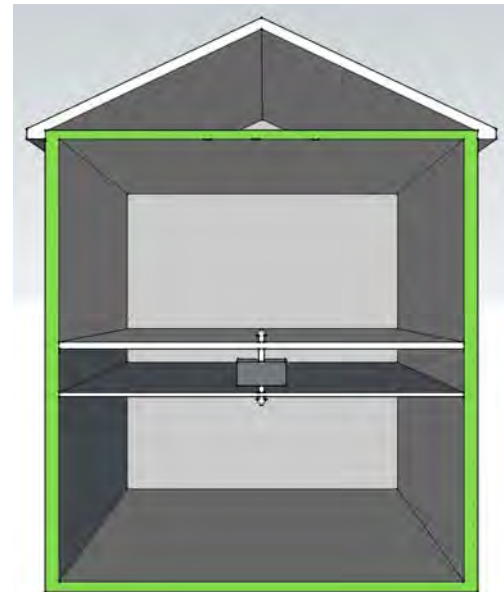
**In a plenum
(box or scissor truss)**



Dropped ceiling soffit



**Open-Web floor truss
in two story homes**





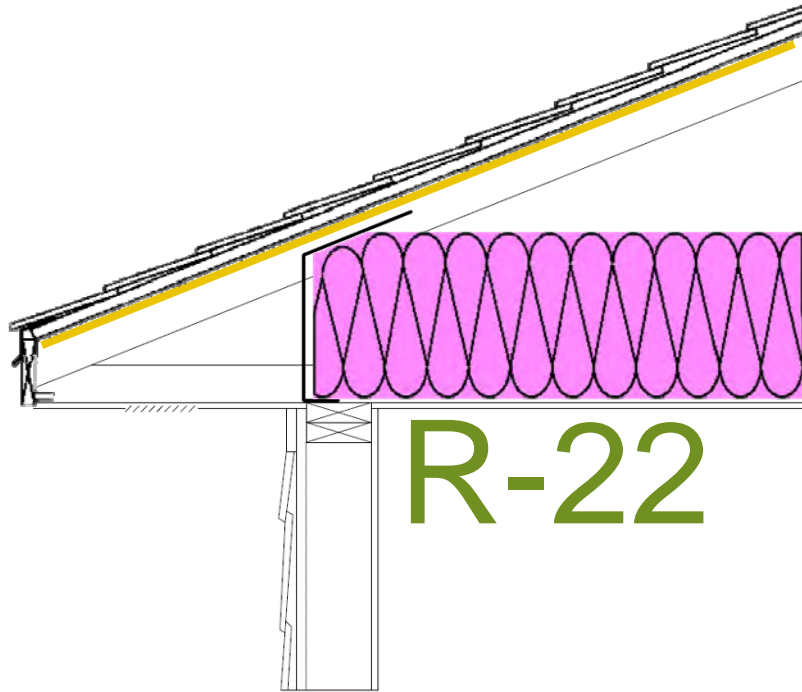
Additions/Alterations



HELPING YOU PLAY YOUR CARDS RIGHT



HPA: Additions



Additions 700 ft² or less

- ✦ Insulation:
 - ✦ Mandatory insulation requirements only
 - (U-factor = 0.043 / R-22)
- ✦ Radiant Barrier:
 - ✦ Package A (CZ 2-15) for vented attics

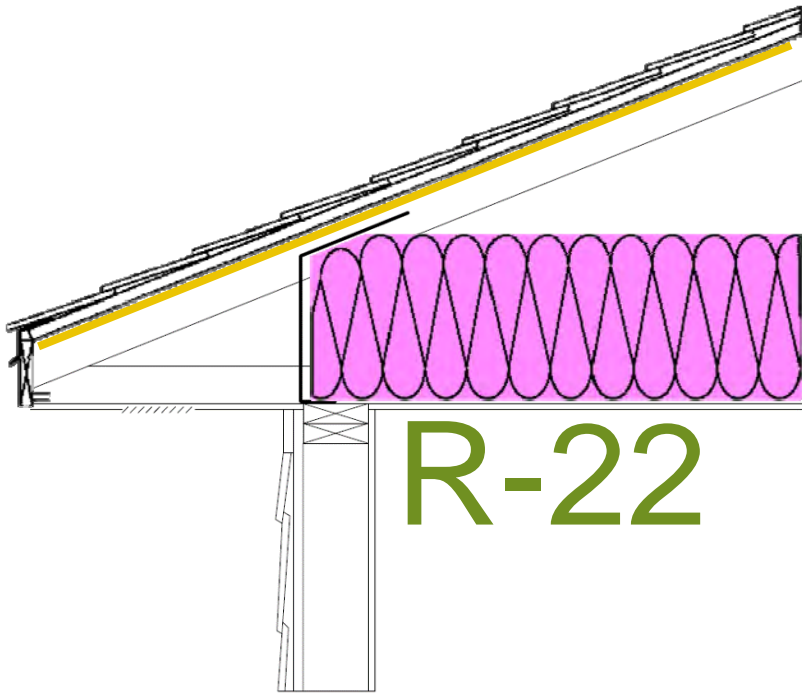
Additions over 700 ft²

- ✦ Package A: **Option B performance baseline**

2016 TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN - ROOF																				
				Mandatory U-factor	Climate Zone															
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Roofs/Ceilings	Option B §150.1(c)9A	Below Roof Deck	Roofing Type	No Air Space	NR	NR	NR	R 18	NR	NR	NR	R 18	R 18	R 18	R 18	R 18	R 18	R 18	R 18	
		With Air Space	NR	NR	NR	R 13	NR	NR	NR	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13	
		Ceiling Insulation		R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38
		Radiant Barrier		NR	REQ	REQ	NR	REQ	REQ	REQ	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR



HPA: Alterations



All Alterations

- ✦ Insulation:
 - ✧ Mandatory insulation requirements only
 - (U-factor = 0.043 / R-22)
- ✦ Radiant Barrier:
 - ✧ Package A (CZ 2-15) for vented attics



Forms

▶ **What might that look like on the Title 24 forms?**

- CF1R-PRF
- CF1R-NCB
- CF2R's



HELPING YOU PLAY YOUR CARDS RIGHT



Compliance Paperwork: CF1R-NCB-01



STATE OF CALIFORNIA

NEWLY CONSTRUCTED BUILDINGS

CEC-CF1R-NCB-01-E (Revised 03/16)

CALIFORNIA ENERGY COMMISSION



CERTIFICATE OF COMPLIANCE

CF1R-NCB-01-E

Prescriptive Newly Constructed Buildings

(Page 2 of 7)

Project Name:

Date Prepared:

D. Opaque Surface Details – Mass Walls (Section 150.1(c)1)

01	02	03	04	05	06		07		08	09	10		11	
Tag/ID	Walls Above Grade	Mass Type	Mass Thickness (inches)	Furring Strip Thickness (inches)	Proposed						Required			
					Interior Insulation		Exterior Insulation		Appendix JA4 Reference		Interior Insulation		Exterior Insulation	
					R-value	U-factor	R-value	U-factor	Table	Cell	R-value	U-factor	R-value	U-factor

E. Slab Insulation (Table 150.1-A)

01	02		03		04
Floor Type	Proposed		Required		Comments
	Insulation R-value	Insulation U-factor	Insulation R-value	Insulation U-factor	

Note:

- Heated slab floors require mandatory slab insulation (see Table 110.8-A).

F. Ceiling/Roof Insulation (Section 150.1(c)1A)

01	02	03	04	05	06	07
Option	Air Space (Yes/No)	Above Roof Deck R-value	Below Roof Deck R-value	Ceiling Insul. R-value	Radiant Barrier Required?	Vented Attic? (Yes/No)
<i>A</i>	<i>No</i>	<i>R8</i>	<i>N/A</i>	<i>R38</i>	<i>Yes</i>	<i>Yes</i>

Note:

- Where insulation is installed above the roofing membrane, or above the layer used to seal the roof from water penetration, the insulation shall have a maximum water absorption of 0.3 percent by volume when tested according to ASTM Standard C272.

Option A

Registration Number:

CA Building Energy Efficiency Standards - 2016 Residential Compliance

Registration Date/Time:

HERS Provider:

March 2016



Compliance Paperwork: CF1R-PRF-01



CERTIFICATE OF
Project Name: R
Calculation Desc

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Residential Example
Calculation Description: Title 24 Analysis

Calculation Date/Time: 18:12, Mon, Jul 18, 2016
Input File Name: Res Sample.ribd16x

CF1R-PRF-01
Page 5 of 8

ATTIC
01
Name
Attic __Gar
Attic 1st Flo
Attic 2nd Flo

WINDOWS
C
Na
Front V
Left W
Back W
Right W
Front W
Left W
Back W
Right W

DOORS

OPAQUE SURFACE CONSTRUCTIONS						
01	02	03	04	05	06	07
Construction Name	Surface Type	Construction Type	Framing	Total Cavity R-value	Winter Design U-value	Assembly Layers
Garage Ext Wall	Exterior Walls	Wood Framed Wall	2x4 @ 16 in. O.C.	none	0.361	<ul style="list-style-type: none"> Inside Finish: Gypsum Board Cavity / Frame: no insul. / 2x4 Exterior Finish: 3 Coat Stucco
R-30 Roof Attic	Ceilings (below attic)	Wood Framed Ceiling	2x4 @ 24 in. O.C.	R 30	0.032	<ul style="list-style-type: none"> Inside Finish: Gypsum Board Cavity / Frame: R-9.1 / 2x4 Over Ceiling Joists: R-20.9 insul.
Attic Garage Roof Cons	Attic Roofs	Wood Framed Ceiling	2x4 Top Chord of Roof Truss @ 24 in. O.C.	none	0.644	<ul style="list-style-type: none"> Cavity / Frame: no insul. / 2x4 Top Chrd Roof Deck: Wood Siding/sheathing/decking Roofing: Light Roof (Asphalt Shingle)
Attic Roof1st Floor Zone	Attic Roofs	Wood Framed Ceiling	2x4 Top Chord of Roof Truss @ 24 in. O.C.	none	0.103	<ul style="list-style-type: none"> Cavity / Frame: no insul. / 2x4 Top Chrd Roof Deck: Wood Siding/sheathing/decking Above Deck Insulation: R8 Sheathing Roofing: Light Roof (Asphalt Shingle)
R-38 Roof Attic	Ceilings (below attic)	Wood Framed Ceiling	2x4 @ 16 in. O.C.	R 38	0.025	<ul style="list-style-type: none"> Inside Finish: Gypsum Board Cavity / Frame: R-9.1 / 2x4 Over Ceiling Joists: R-28.9 insul.
R-19 Wall	Exterior Walls	Wood Framed Wall	2x6 @ 16 in. O.C.	R 19	0.050	<ul style="list-style-type: none"> Inside Finish: Gypsum board Cavity / Frame: R-19 / 2x6 Sheathing / Insulation: R5 Sheathing Exterior Finish: 3 Coat Stucco
R-13 Wall	Interior Walls	Wood Framed Wall	2x4 @ 16 in. O.C.	R 13	0.092	<ul style="list-style-type: none"> Inside Finish: Gypsum Board Cavity / Frame: R-13 / 2x4 Other Side Finish: Gypsum Board
Attic Roof2nd Floor Zone	Attic Roofs	Wood Framed Ceiling	2x4 Top Chord of Roof Truss @ 24 in. O.C.	none	0.103	<ul style="list-style-type: none"> Cavity / Frame: no insul. / 2x4 Top Chrd Roof Deck: Wood Siding/sheathing/decking Above Deck Insulation: R8 Sheathing Roofing: Light Roof (Asphalt Shingle)
R-0 Floor No Crawlspace	Interior Floors	Wood Framed Floor	2x12 @ 16 in. O.C.	none	0.196	<ul style="list-style-type: none"> Floor Surface: Carpeted Floor Deck: Wood Siding/sheathing/decking Cavity / Frame: no insul. / 2x12 Ceiling Below Finish: Gypsum Board
R-19 Floor No Crawlspace	Interior Floors	Wood Framed Floor	2x6 @ 16 in. O.C.	R 19	0.048	<ul style="list-style-type: none"> Floor Surface: Carpeted Floor Deck: Wood Siding/sheathing/decking Cavity / Frame: R-19 / 2x6 Ceiling Below Finish: Gypsum Board

Option A

Registration Num
CA Building Energy

Registration Number:
CA Building Energy Efficiency Standards - 2016 Residential Compliance

Registration Date/Time:
Report Version - CF1R-Invalid Version-572

HER Provider:
Report Generated at: 2016-07-18 18:11:18



Installation Compliance : CF2R-ENV-03-E

STATE OF CALIFORNIA
INSULATION INSTALLATION
 CEC-CF2R-ENV-03-E (Revised 01/16) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF INSTALLATION **CF2R-ENV-03-E**
 (Page 1 of 5)

Insulation Installation

Project Name: _____ Enforcement Agency: _____ Permit Number: _____
 Dwelling Address: _____ City: _____ Zip Code: _____

Medium and light density SPF manufacturers claim various R-values per inch. In California the maximum R-value that can be claimed for ccSPF is an R-value of 5.8 per inch, and for ocSPF is an R-value of 3.6 per inch, unless documentation is provided showing that the product and/or manufacturer has a current ICC Evaluation Service Report (ESR) that shows compliance with Acceptance Criteria for Spray-Applied Foam Plastic Insulation-AC377.

A. Roof/Ceiling Insulation

01	02	03	04	05	06	07	08	09	10
I.D.	Manufacturer & Brand	Framing Material	Framing Size & Spacing	Insulation Type	ESR Number	Cavity Insulation R-value	Insulation Depth (inches)	Above Deck Insulation R-value	Below Deck Insulation R-value
	Owens Corning	Wd	2x10 24"	Batt	234	38	10	8	N/A

C. Mass Insulation

01	02	03	04	05	06	07	08
I.D.	Manufacturer & Brand	Location	Mass Thickness (inches)	Furring Strip Type/ Depth (inches)	Insulation Type	Exterior Insulation R-value	Interior Insulation R-value

D. Raised Floor Insulation

01	02	03	04	05	06	07	08	09	10
I.D.	Manufacturer & Brand	Framing Material	Framing Size & Spacing	Insulation Type	ESR Number	Cavity Insulation R-value	Insulation Depth (inches)	Exterior Floor Insulation R-value	Interior Floor Insulation R-value

E. Slab Floor/Perimeter Insulation (See Section F. for Insulation Requirements for Heated Slabs)

01	02	03	04	05	06	07	08
I.D.	Manufacturer & Brand	Floor Type	Insulation Type	Insulation Depth (inches)	Insulation R-Value	Vertical Insulation Length (inches)	Horizontal Insulation Length (feet)

Registration Number: _____ Registration Date/Time: _____ HERS Provider: _____
 CA Building Energy Efficiency Standards - 2016 Residential Compliance January 2016

Option A



Installation Compliance : CF2R-ENV-04-E

STATE OF CALIFORNIA ROOFING-RADIANT BARRIER CEC-CF2R-ENV-04-E (Revised 01/16)	CALIFORNIA ENERGY COMMISSION CF2R-ENV-04-E (Page 1 of 3)
CERTIFICATE OF INSTALLATION Roofing-Radiant Barrier	

A. Radiant Barrier		
01	Brand Name and Product Number	<i>Shining Board #345</i>
02	Installation Type	<i>Sheathing board</i>
03	Total Attic Area (ft ²)	<i>1000 sq. ft.</i>

B. Schedule of Lower Vents			
The Net Free Area (NFA) of a manufactured product is stated on the packaging or on the manufacturer's specification data sheet. For non-manufactured products, assume that the net free area is one third of the total aperture area.			
01	02	03	04
Type of Vent (For instance, eyebrow vent, eave vent, round vent)	NFA Per Vent (in ²) (Manufacturer's Specification Sheet)	Number of Vents Installed	Total NFA Per Vent Type (in ²)
<i>Eave vents</i>	<i>100/1</i>	<i>5</i>	<i>10</i>

C. Schedule of Upper Vents			
The Net Free Area of a manufactured product is stated on the packaging or on the manufacturer's specification data sheet. For non-manufactured products, assume that the net free area is one third of the total aperture area.			
01	02	03	04
Type of Vent (For instance, eyebrow vent, eave vent, round vent)	NFA Per Vent (in ²) (Manufacturer's Specification Sheet)	Number of Vents Installed	Total NFA Per Vent Type (in ²)
<i>Eyebrow</i>	<i>100/1</i>	<i>5</i>	<i>10</i>

07	The NFA of upper vents must be within required NFA range of upper vents Note: per Exception to R806.2 of the CBC Title 24, Part2, Vol.2.5, if the net free ventilating area is less than 1:150, then the upper ventilation must be at least 40% and no more than 50%. Part 2 contains additional requirements that must be met if the area is less than 1:150.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	
Registration Number:	Registration Date/Time:
CA Building Energy Efficiency Standards - 2016 Residential Compliance	HERS Provider: January 2016

Option A



Challenge C

Challenge C

High Performance Walls

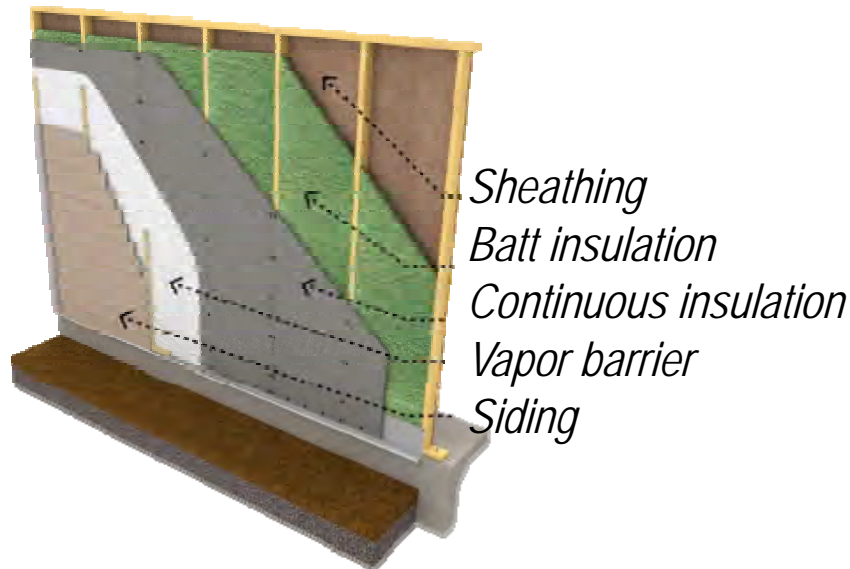


Table 150.1-A - Walls

2016 TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN																		
U-factors		Mandatory	Climate Zone															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2013 Above Grade Framed		0.102 (2x4) or 0.074 (2x6)	U 0.065: R 15+4 or R 13+5															
Envelope Insulation: Walls	Above Grade		Framed	0.051	0.051	0.051	0.051	0.051	0.065	0.065	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051
	Above Grade	Mass Wall Interior	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.059 R 17
	Above Grade	Mass Wall Exterior	0.125 R 8.0	0.125 R 8.0	0.125 R 8.0	0.125 R 8.0	0.125 R 8.0	0.125 R 8.0	0.125 R 8.0	0.125 R 8.0	0.125 R 8.0	0.125 R 8.0	0.125 R 8.0	0.125 R 8.0	0.125 R 8.0	0.125 R 8.0	0.125 R 8.0	0.125 R 8.0
Below Grade	Below Grade	Interior	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.070 R 13	0.066 R 15
	Below Grade	Grade	0.200 R 5.0	0.200 R 5.0	0.200 R 5.0	0.200 R 5.0	0.200 R 5.0	0.200 R 5.0	0.200 R 5.0	0.200 R 5.0	0.200 R 5.0	0.200 R 5.0	0.200 R 5.0	0.200 R 5.0	0.200 R 5.0	0.200 R 5.0	0.100 R 10	0.100 R 10



Wall: Above Grade - Framed



Source: BASF Corporation

U-factor = 0.051

✦ 2 x 6 R-19 + R-5 continuous

✦ Or....??

U-factor = 0.065

✦ 2 x 4 R-13 + R-5 continuous

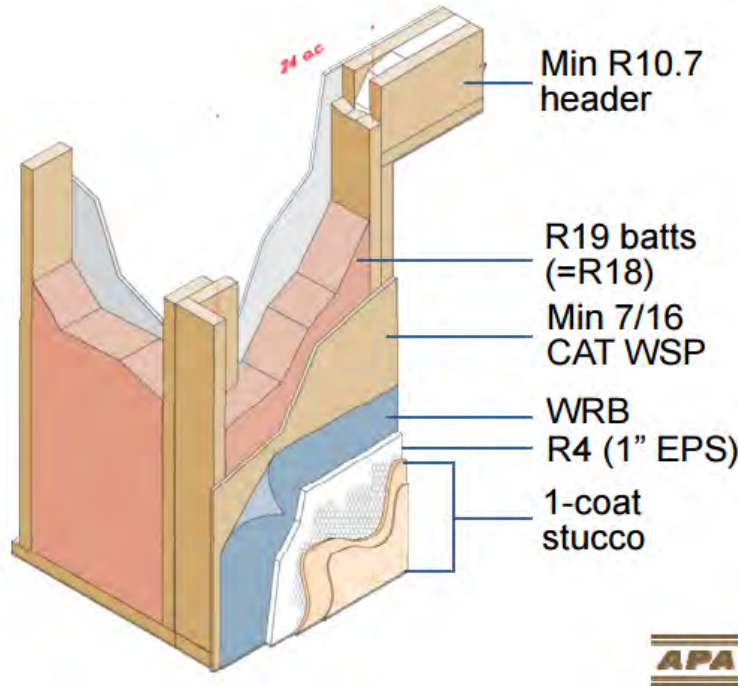
2016 TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN																		
U-factors		Mandatory	Climate Zone															
Walls	Above Grade Framed		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2013 Above Grade Framed		0.102 (2x4) or 0.074 (2x6)	U 0.065: R 15+4 or R 13+5															
			0.051	0.051	0.051	0.051	0.051	0.065	0.065	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051



Framed Wall Assembly



Slide courtesy of CAHP - Master Builder
Advanced Home Design and Building Practices
2016 Code Readiness Program



U-factor	Framing	Stud Spacing	Cavity Insulation	Exterior Insulation	Cavity Insulation Type
0.050	2x6	24" OC	R-19	R-5 (1")	Low density fiberglass batt
0.051	2x6	16" OC	R-21	R-4 (1")	High density batt or BIB
0.049	2x6	16" OC	R-19	R-6 (1.25")	Low density fiberglass batt
0.050	2x4	16" OC	R-15	R-8 (2")	High density batt



**Multiple combinations of similar materials will achieve these same U-factors



Alternative Wall Systems



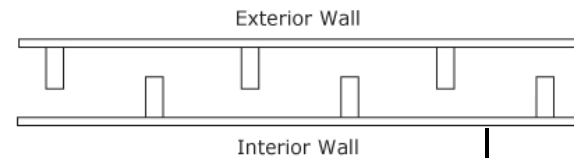
Double Wall



Staggered Stud Wall

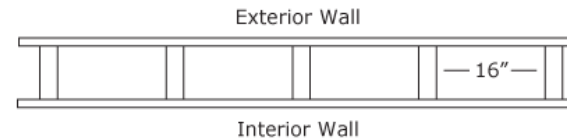
(View from above)

Staggered Stud



Can use 16" or 24" spacing.

Conventional



or more) cavity, providing for increased



staggered cavity reach 0.041 U-Factor

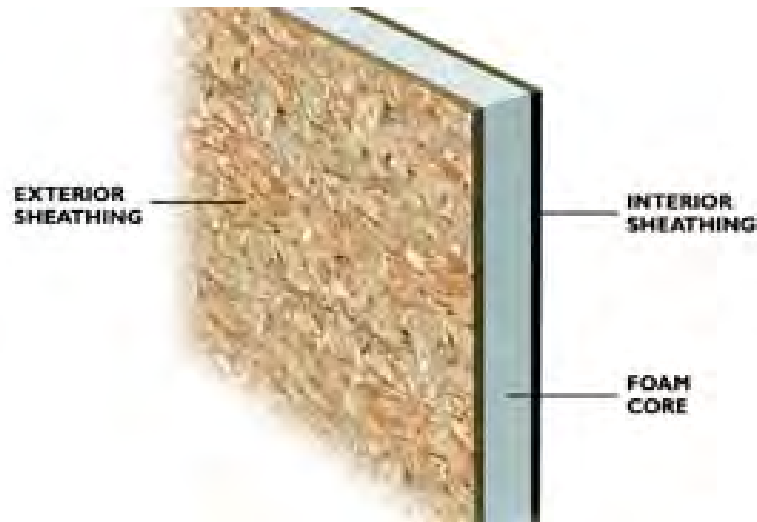


Slide courtesy of CAHP - Master Builder
Advanced Home Design and Building
Practices 2016 Code Readiness Program



Alternative Wall Systems

Structurally Insulated Panels (SIPs)



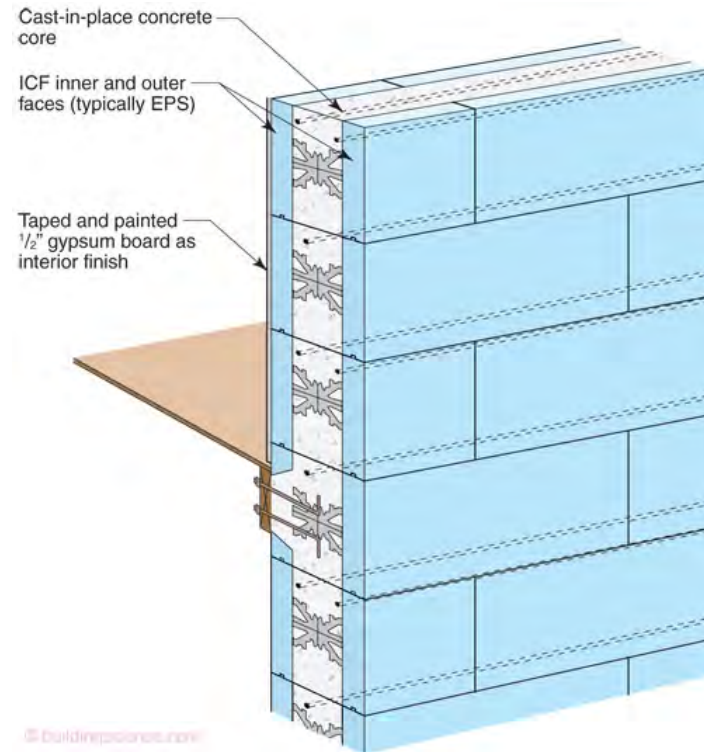
Benefits:

- Minimal thermal bridging
- Factory fabricated
- Lower labor costs
- Seismic durability

Delivery costs can be significant



Insulated Concrete Forms (ICFs)



Slide courtesy of CAHP - Master Builder
Advanced Home Design and Building Practices
2016 Code Readiness Program



Wall: Above Grade – Non Framed



- ✦ Mandatory U-factor = 0.102
 - ✧ 0.102 example: Any 5" or thicker solid concrete wall
- ✦ Prescriptive U-factor = 0.125
 - ✧ Example: 6" solid concrete wall with R-8

2016 TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN

U-factors		Mandatory	Climate Zone															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Walls	Above Grade	0.102	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.059
	Mass Wall Interior		R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 17
	Mass Wall Exterior		0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.070
			R 8.0	R 8.0	R 8.0	R 8.0	R 8.0	R 8.0	R 8.0	R 8.0	R 8.0	R 8.0	R 8.0	R 8.0	R 8.0	R 8.0	R 8.0	R 13



Additions/Alterations



HELPING YOU PLAY YOUR CARDS RIGHT



HPA: Additions

Additions of any size

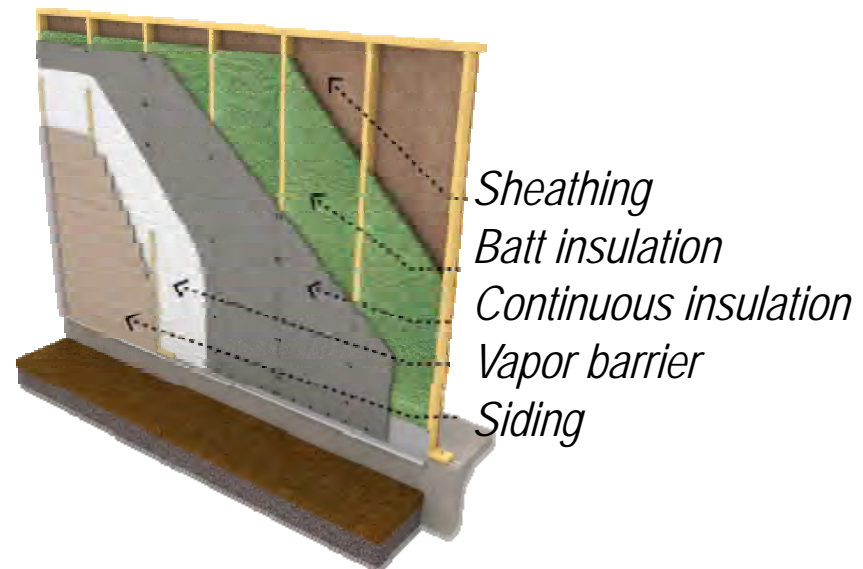
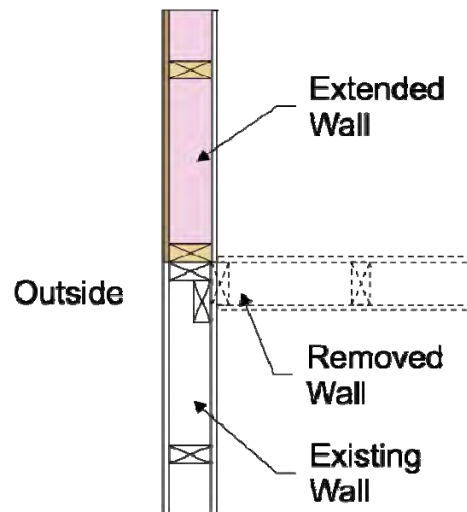
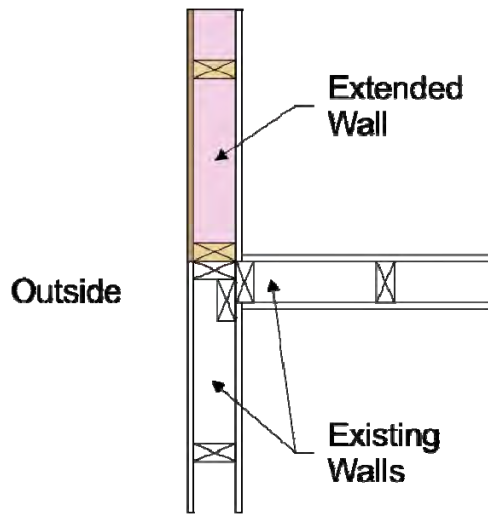
✦ Insulation:

✦ Extended walls:

- **2 x 4 = R-15**
- 2 X 6 = R-19

✦ New walls:

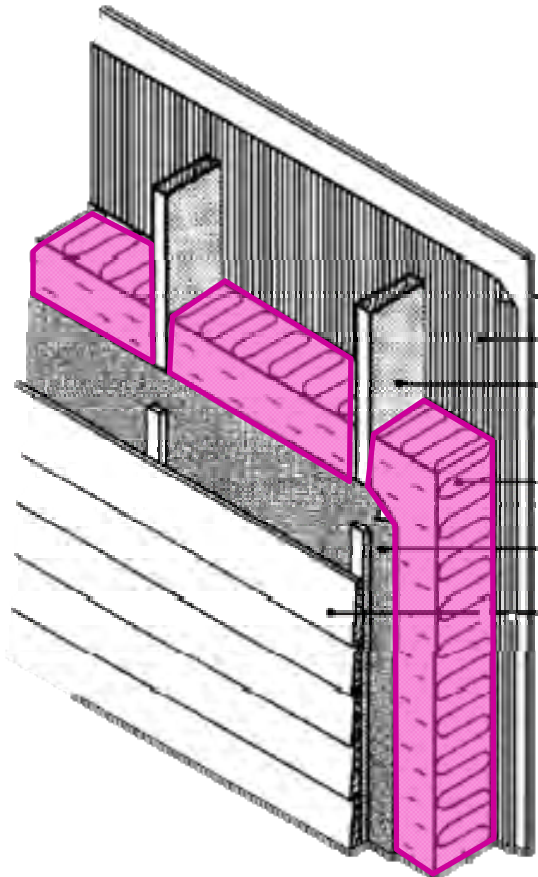
- Package A: U-factor = 0.051 (2 x 6=R-19 + R-5)



Source BASF Corporation



HPA: Alterations



All Alterations

- ✦ Mandatory insulation requirements only:
 - ✧ U-factor (wood framed 2 x 4): 0.102
 - Example: R-13 (JA4.3.1-3A)
 - ✧ U-factor (wood framed 2 x 6): 0.074
 - Example: R-19 (JA4.3.1-5A)



Forms

▶ **What might that look like on the Title 24 forms?**

- CF1R-PRF
- CF1R-NCB
- CF2R's



HELPING YOU PLAY YOUR CARDS RIGHT



Compliance Paperwork: CF1R-NCB-01



STATE OF CALIFORNIA
NEWLY CONSTRUCTED BUILDINGS
 CEC-CF1R-NCB-01-E (Revised 03/16)

CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE CF1R-NCB-01-E

Prescriptive Newly Constructed Buildings (Page 1 of 7)

Project Name: _____ Date Prepared: _____

A. General Information

01 Project Name:	02 Date Prepared:
03 Project Location:	04 Building Front Orientation (deg or cardinal):
05 CA City:	06 Number of Dwelling Units:
07 Zip Code:	08 Fuel Type:
09 Climate Zone:	10 Total Conditioned Floor Area (ft ²):
11 Building Type:	12 Slab Area (ft ²):
13 Project Scope:	14 Exceptions to Fenestration U-factor & SHGC 150.1(c)3A:

B. Opaque Surface Details – Framed (Section 150.1(c)1)

01	02	03	04	05	06		07	08	09	10	11
Tag/ID	Assembly Type	Frame Type	Frame Depth (inches)	Frame Spacing (inches)	Proposed			Appendix JA4 Reference		Required U-Factor from Package A	Comments
					Cavity R-value	Continuous Insulation R-value	U-Factor	Table	Cell		
	wall	wd	2x6	24"	19	5	0.051	4-3-7	6D	0.051	

C. Opaque Surface Details – Non-Framed (Section 150.1(c)1)

01	02	03	04	05	06	07	08	09	10	11
Tag/ID	Assembly Type	Assembly Materials	Thickness (inches)	Proposed			Appendix JA4 Reference		Required U-Factor from Package A	Comments
				Core Insulation R-value	Continuous Insulation R-value	U-Factor	Table	Cell		

2x6 (R-19) + R-5

Registration Number: _____ Registration Date/Time: _____ HERS Provider: _____
 CA Building Energy Efficiency Standards - 2016 Residential Compliance March 2016



Compliance Paperwork: CF1R-PRF-01



CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Residential Example

Calculation Date/Time: 18:12, Mon, Jul 18, 2016

CF1R-PRF-01

Calculation Description: Title 24 Analysis

Input File Name: Res Sample.ribd16x

Page 5 of 8

OPAQUE SURFACE CONSTRUCTIONS						
01	02	03	04	05	06	07
Construction Name	Surface Type	Construction Type	Framing	Total Cavity R-value	Winter Design U-value	Assembly Layers
Garage Ext Wall	Exterior Walls	Wood Framed Wall	2x4 @ 16 in. O.C.	none	0.361	<ul style="list-style-type: none"> • Inside Finish: Gypsum Board • Cavity / Frame: no insul. / 2x4 • Exterior Finish: 3 Coat Stucco
R-30 Roof Attic	Ceilings (below attic)	Wood Framed Ceiling	2x4 @ 24 in. O.C.	R 30	0.032	<ul style="list-style-type: none"> • Inside Finish: Gypsum Board • Cavity / Frame: R-9.1 / 2x4 • Over Ceiling Joists: R-20.9 insul.
Attic Garage Roof Cons	Attic Roofs	Wood Framed Ceiling	2x4 Top Chord of Roof Truss @ 24 in. O.C.	none	0.644	<ul style="list-style-type: none"> • Cavity / Frame: no insul. / 2x4 Top Chrd • Roof Deck: Wood Siding/sheathing/decking • Roofing: Light Roof (Asphalt Shingle)
Attic Roof1st Floor Zone	Attic Roofs	Wood Framed Ceiling	2x4 Top Chord of Roof Truss @ 24 in. O.C.	none	0.103	<ul style="list-style-type: none"> • Cavity / Frame: no insul. / 2x4 Top Chrd • Roof Deck: Wood Siding/sheathing/decking • Above Deck Insulation: R8 Sheathing • Roofing: Light Roof (Asphalt Shingle)
R-38 Roof Attic	Ceilings (below attic)	Wood Framed Ceiling	2x4 @ 16 in. O.C.	R 38	0.025	<ul style="list-style-type: none"> • Inside Finish: Gypsum Board • Cavity / Frame: R-9.1 / 2x4 • Over Ceiling Joists: R-28.9 insul.
R-19 Wall	Exterior Walls	Wood Framed Wall	2x6 @ 16 in. O.C.	R 19	0.050	<ul style="list-style-type: none"> • Inside Finish: Gypsum Board • Cavity / Frame: R-19 / 2x6 • Sheathing / Insulation: R5 Sheathing • Exterior Finish: 3 Coat Stucco
R-13 Wall	Interior Walls	Wood Framed Wall	2x4 @ 16 in. O.C.	R 13	0.092	<ul style="list-style-type: none"> • Inside Finish: Gypsum Board • Cavity / Frame: R-13 / 2x4 • Other Side Finish: Gypsum Board
Attic Roof2nd Floor Zone	Attic Roofs	Wood Framed Ceiling	2x4 Top Chord of Roof Truss @ 24 in. O.C.	none	0.103	<ul style="list-style-type: none"> • Cavity / Frame: no insul. / 2x4 Top Chrd • Roof Deck: Wood Siding/sheathing/decking • Above Deck Insulation: R8 Sheathing • Roofing: Light Roof (Asphalt Shingle)
R-0 Floor No Crawlpace	Interior Floors	Wood Framed Floor	2x12 @ 16 in. O.C.	none	0.196	<ul style="list-style-type: none"> • Floor Surface: Carpeted • Floor Deck: Wood Siding/sheathing/decking • Cavity / Frame: no insul. / 2x12 • Ceiling Below Finish: Gypsum Board
R-19 Floor No Crawlpace	Interior Floors	Wood Framed Floor	2x6 @ 16 in. O.C.	R 19	0.048	<ul style="list-style-type: none"> • Floor Surface: Carpeted • Floor Deck: Wood Siding/sheathing/decking • Cavity / Frame: R-19 / 2x6 • Ceiling Below Finish: Gypsum Board

2x6 (R-19) + R-5

Registration Number:

CA Building Energy Efficiency Standards - 2016 Residential Compliance

Registration Date/Time:

Report Version - CF1R-Invalid Version-572

HERS Provider:

Report Generated at: 2016-07-18 18:11:18



Installation Compliance : CF2R-ENV-03-E

STATE OF CALIFORNIA
INSULATION INSTALLATION
 CEC-CF2R-ENV-03-E (Revised 01/16) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF INSTALLATION **CF2R-ENV-03-E**
 (Page 1 of 5)

Insulation Installation

Project Name: _____ Enforcement Agency: _____ Permit Number: _____
 Dwelling Address: _____ City: _____ Zip Code: _____

Medium and light density SPF manufacturers claim various R-values per inch. In California the maximum R-value that can be claimed for ccSPF is an R-value of 5.8 per inch, and for ocSPF is an R-value of 3.6 per inch, unless documentation is provided showing that the product and/or manufacturer has a current ICC Evaluation Service Report (ESR) that shows compliance with Acceptance Criteria for Spray-Applied Foam Plastic Insulation-AC377.

A. Roof/Ceiling Insulation									
01	02	03	04	05	06	07	08	09	10
I.D.	Manufacturer & Brand	Framing Material	Framing Size & Spacing	Insulation Type	ESR Number	Cavity Insulation R-value	Insulation Depth (inches)	Above Deck Insulation R-value	Below Deck Insulation R-value
	Owens Corning	Wd	2x10 24"	Batt	234	38	10	8	N/A

I.D.	Manufacturer & Brand	Framing Material	Framing Size & Spacing	Insulation Type	ESR Number	Cavity Insulation R-value	Insulation Depth (inches)	Exterior Wall Insulation R-value	Interior Wall Insulation R-value

C. Mass Insulation							
01	02	03	04	05	06	07	08
I.D.	Manufacturer & Brand	Location	Mass Thickness (inches)	Furring Strip Type/ Depth (inches)	Insulation Type	Exterior Insulation R-value	Interior Insulation R-value

D. Raised Floor Insulation									
01	02	03	04	05	06	07	08	09	10
I.D.	Manufacturer & Brand	Framing Material	Framing Size & Spacing	Insulation Type	ESR Number	Cavity Insulation R-value	Insulation Depth (inches)	Exterior Floor Insulation R-value	Interior Floor Insulation R-value

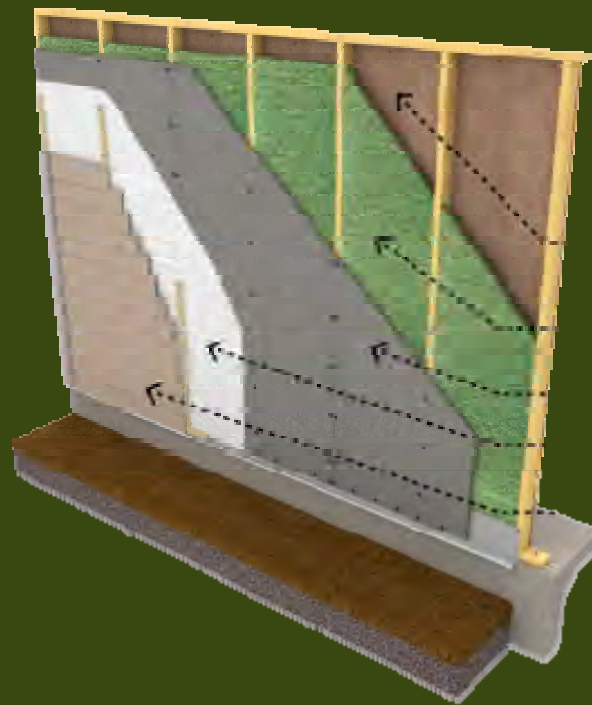
E. Slab Floor/Perimeter Insulation (See Section F. for Insulation Requirements for Heated Slabs)							
01	02	03	04	05	06	07	08
I.D.	Manufacturer & Brand	Floor Type	Insulation Type	Insulation Depth (inches)	Insulation R-Value	Vertical Insulation Length (inches)	Horizontal Insulation Length (feet)

2x6 (R-19) + R-5

Registration Number: _____ Registration Date/Time: _____ HERS Provider: _____
 CA Building Energy Efficiency Standards - 2016 Residential Compliance January 2016



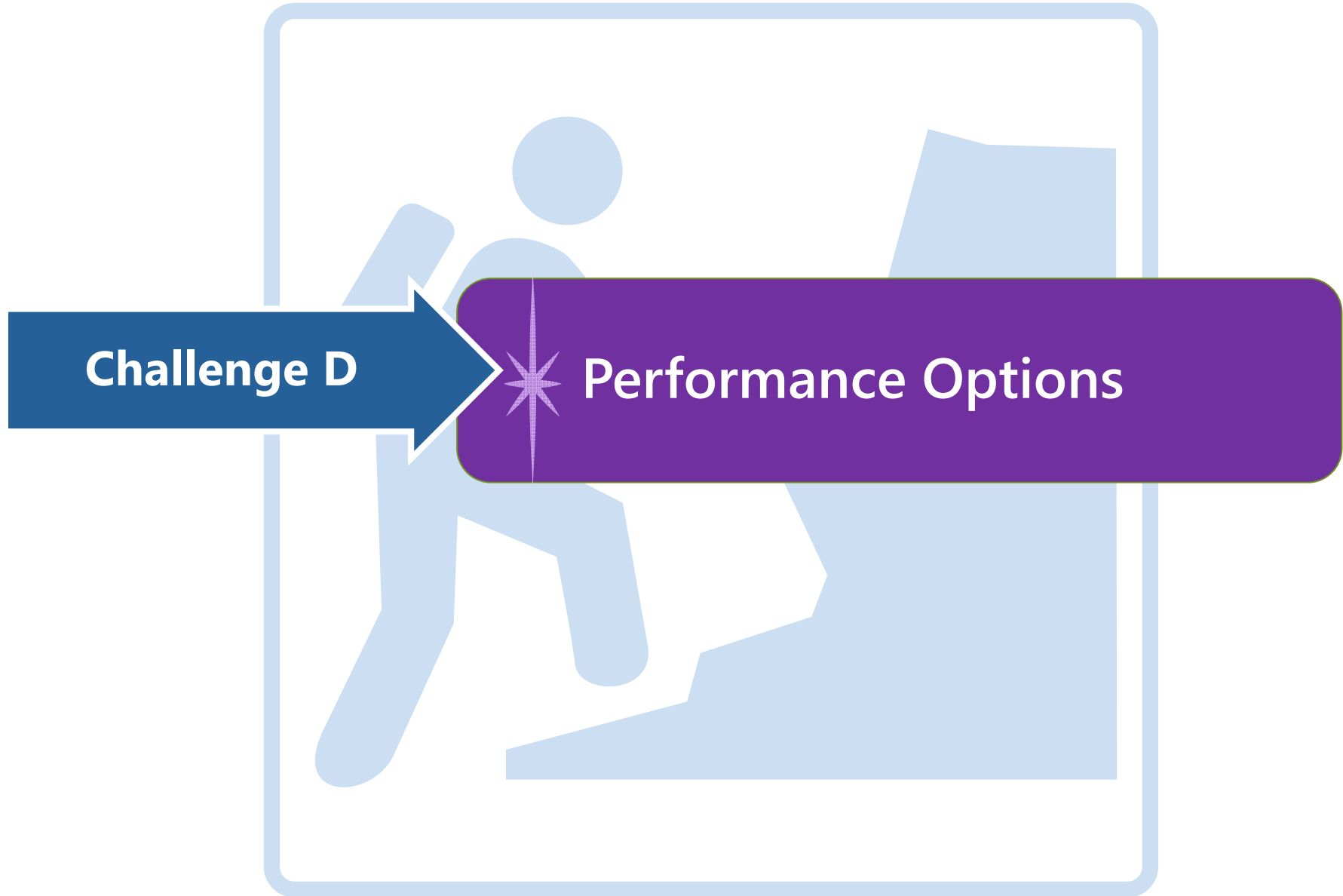
High Performance Walls



Source: BASF Corporation



Challenge D





Trading Building Features



- ✦ Prescriptive measures can be traded using the performance method:
 - TDV penalty
 - Not meeting prescriptive requirements of CZ
 - + TDV credits
 - Exceeding prescriptive requirements of CZ



Performance Options

Envelope

- ✦ Unvented Attic
- ✦ High density spray on insulation (HERS verified)
- ✦ HERS verified tight home
- ✦ ?

HVAC

- ✦ Increased efficiency
- ✦ Alternative system types (i.e. radiant)
- ✦ HERS measures (i.e. ducts in conditioned space)
- ✦ ?

DHW

- ✦ Increased efficiency
- ✦ Combined hydronic system
- ✦ HERS measures (i.e. distribution credits)
- ✦ ?

Renewables

- ✦ Solar hot water system (thermal storage)
- ✦ Photo voltaic (PV): not in CZ 6 or 7



Envelope



SOME Performance Options

- ✦ HERS
 - ✧ Quality Insulation Installation (QII)
 - ✧ Tight home
- ✦ Unvented attic
 - ✧ Ducts in unvented attic not considered “conditioned” unless it is a directly conditioned space
- ✦ High density spray on insulation
 - ✧ Must be verified by HERS rater for performance credit



HVAC



SOME Performance Options

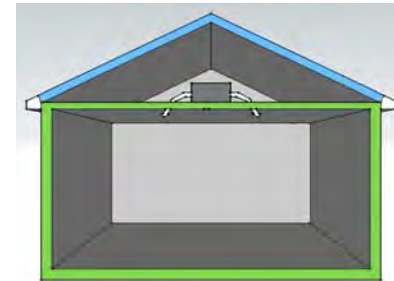
- ✦ Increased efficiency
 - ✧ CEC cannot require increased efficiency beyond Federal minimums
 - ✧ Triggers HERS verification
- ✦ Alternative systems
 - ✧ Ductless
 - Radiant
 - Mini ductless split
- ✦ HERS
 - ✧ Ducts in conditioned space
 - tight ducts in conditioned space
 - ✧ Duct design (reduced duct surface, etc.)



Four Ways to Reduce Duct Loss

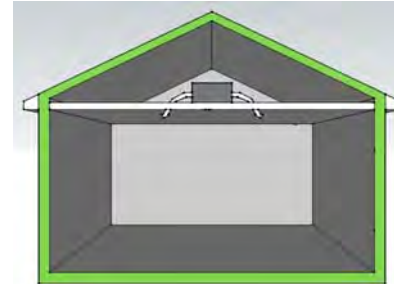
1. Cool attic or High Performance Attic (**HPA**)

- No change to thermal envelope
- Vented attic
- Addition of insulation at roof deck



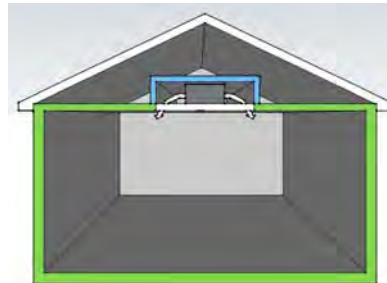
2. Sealed attic or Unvented Attic or (**UVA**)

- Move thermal envelope

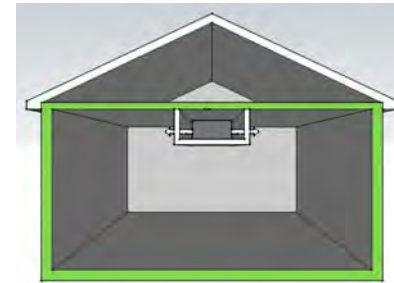


3. In the house or Ducts in Conditioned Space (**DCS**)

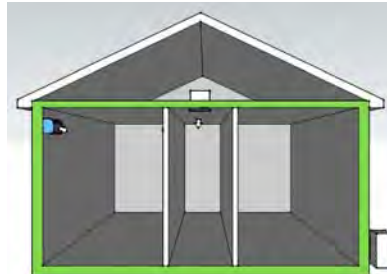
- Relocate ducts and air handling unit inside the home



or

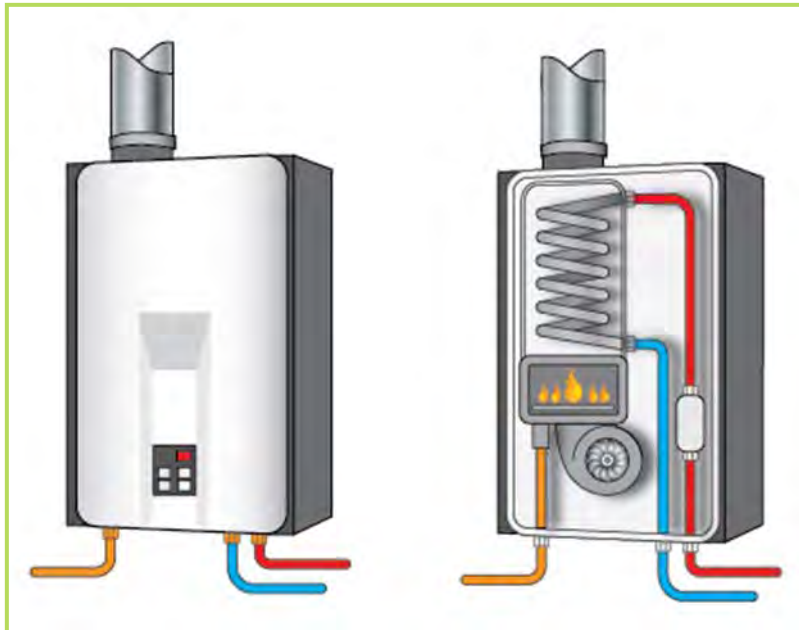


4. Go ductless!





DHW



- ✦ HERS
 - ✦ Pipe insulation
 - ✦ Distribution design
 - Point of use / Compact design / Parallel piping

SOME Performance Options

- ✦ Increased efficiency
 - ✦ CEC cannot require increased efficiency beyond Federal minimums
- ✦ Alternative systems
 - ✦ Combined hydronic
 - ✦ Solar thermal storage
 - ✦ Geothermal



Residential PV Systems



Increased PV Credit

- ✦ The PV System Credit is available only if:
 - ✧ The Performance Approach is used
 - ✧ The project is in Climate Zones 1-5, 8-16
 - ✧ The system is:
 - ≥ 2 kWdc* for Single Family
 - ≥ 1 kWdc* for Multi Family
 - ✧ The amount of credit will depend upon the Climate Zone and the Conditioned Floor Area of the dwelling.
- ✦ PV System credit does not require HERS verification unless getting rebate from the New Solar Homes Partnership (NSHP)

* kilowatts direct current

A typical 1kWdc system often has approximately four PV panels

For the 2019 Standards, the PV tradeoff will no longer be available to trade away the 2016 HPA and HPW (AND not allowed for current CAHP programs)



Forms

- ▶ **What might that look like on the Title 24 forms?**
 - CF1R-PRF
 - CF2R's





Permit Compliance : CF1R-PRF-01



CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Residential Example

Calculation Date/Time: 18:12, Mon, Jul 18, 2016

Page 2 of 8

Calculation Description: Title 24 Analysis

Input File Name: Res Sample.ribd16x

ENERGY DESIGN RATING

Energy Design Rating (EDR) is an alternate way to express the energy performance of a building using a scoring system where 100 represents the energy performance of the Residential Energy Services (RESNET) reference home characterization of the 2006 International Energy Conservation Code (IECC). A score of zero represents the energy performance of a building that combines high levels of energy efficiency with renewable generation to "zero out" its TDV energy. Because EDR includes consideration of components not regulated by Title 24, Part 6 (such as domestic appliances and consumer electronics), it is not used to show compliance with Part 6 but may instead be used by local jurisdictions pursuing local ordinances under Title 24, Part 11 (CALGreen).

As a Standard Design building under the 2016 Building Energy Efficiency Standards is significantly more efficient than the baseline EDR building, the EDR of the Standard Design building is provided for Information. Similarly, the EDR score of the Proposed Design is provided separately from the EDR value of installed PV so that the effects of efficiency and renewable energy can both be seen

EDR of Standard Design	EDR of Proposed Design	EDR Value of Proposed PV	Final EDR of Proposed Design
45.2	45.1	22.0	23.2

- Design meets Tier 1 requirement of 15% or greater code compliance margin (CALGreen A4.203.1.2.1) and QII verification prerequisite.
- Design meets Tier 2 requirement of 30% or greater code compliance margin (CALGreen A4.203.1.2.2) and QII verification prerequisite.
- Design meets Zero Net Energy (ZNE) Design Designation requirement for Single Family in climate zone CZ10 (Riverside) (CALGreen A4.203.1.2.3) including on-site photovoltaic (PV) renewable energy generation sufficient to achieve a Final Energy Design Rating (EDR) of zero or less. The PV System must be verified.

ENERGY DESIGN RATING PV SYSTEM INPUTS - DETAILED

DC System Size (kW)	Module Type	CFI	Azimuth (deg)	Tilt Input	Array Angle (deg)	Tilt: (x in 12)	Inverter Eff. (%)
2	Standard	<input type="checkbox"/>	180	deg	22.0	4.8	96

REQUIRED SPECIAL FEATURES

The following are features that must be installed as condition for meeting the modeled energy performance for this computer analysis.

- PV System: 2.0 kWdc**

HERS FEATURE SUMMARY

The following is a summary of the features that must be field-verified by a certified HERS Rater as a condition for meeting the modeled energy performance for this computer analysis. Additional detail is provided in the building components tables below.

- Building-level Verifications:
 - IAQ mechanical ventilation
- Cooling System Verifications:
 - Minimum Airflow
 - Verified SEER
 - Refrigerant charge or fault indicator display
 - Fan Efficacy Watts/CFM
- HVAC Distribution System Verifications:
 - Duct Sealing
- Domestic Hot Water System Verifications:
 - -- None --

HERS

PV

Registration Number:

CA Building Energy Efficiency Standards - 2016 Residential Compliance

Registration Date/Time:

Report Version - CF1R-Invalid Version-572

HERS Provider:

Report Generated at: 2016-07-18 18:11:18



Installation Compliance : CF2R-SPV-01-E

STATE OF CALIFORNIA
PHOTOVOLTAIC SYSTEMS
 CEC-CF2R-SPV-01a-E (Revised 01/16)

CALIFORNIA ENERGY COMMISSION

CF2R-SPV-01-E
(Page 1 of 2)

Project Name:	Enforcement Agency:	Project Address:
Dwelling Address:	City:	Zip Code:

The installer is required to fill out this compliance document for all newly installed Photovoltaic Systems (PV) when the CF1R shows PV as required for compliance. Only single family residences and townhouses may install a PV system for compliance purposes. The performance compliance approach must be utilized and the project must be located in climate zones 9-15. Procedures for verifying compliance are described in Reference Residential Appendix RA4.6.

The installer is required to fill out this compliance document for all newly installed Photovoltaic Systems (PV) when the PV system is being used to claim an exception to the Solar Ready requirements of Section 110.10, specifically Exception 1 to Section 110.10(b)1A for single family residences or Exception 1 to Section 110.10(b)1B for low-rise multifamily buildings. High-rise Multifamily buildings and Hotel/Motel Occupancies with fewer than 10 stories and nonresidential buildings with 3 stories or fewer must use the NRCI-SPV-01-E to claim Exception 1 to Section 110.10(b)1B.

A. General Information

A. General Information		
01	Is this PV system being used to claim a Compliance Credit for PV installation in a single family residence?	Yes
02	Is this PV system being used to comply with the Solar Ready Area Exception?	

05	Enter Module Nameplate DC Power Rating Measure Under Standard Test Conditions (Watts)	
06	Enter Number of Modules used in the PV System	
07	Installed PV System Nameplate DC Power Rating (Watts)	
08	Compliance Statement:	
09	PV array installed at either: <ul style="list-style-type: none"> A roof pitch no greater than 2.4° (ratio of rise to run no greater than 0.5:12); or A roof pitch greater than 2.4° and no greater than 30.3° (ratio of rise to run no greater than 7:12) and with an orientation between 110° and 270° relative to true north. 	
10	The PV System is equipped with one of the following: <ul style="list-style-type: none"> A system energy production meter that is integral to the inverter; A standalone system energy production meter; An energy production monitoring system. 	
11	Any obstruction that projects above a PV array shall be located twice the distance, measured in the horizontal plane, of the height difference between the highest point of the obstruction and the horizontal projection of the nearest point of the PV array, measured in the vertical plane.	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.		
Registration Number: _____ Registration Date/Time: _____ HERS Provider: _____ CA Building Energy Efficiency Standards - 2016 Residential Compliance January 2016		

Residential HERS Measures

HERS-verified Measure	Mandatory	Prescriptive	(if credit taken) Performance
Mechanical			
Duct sealing (maximum leakage)	X ^A		
Indoor air quality ventilation (based on ASHRAE Standard 62.2)	X		
Refrigerant charge or Installation of a charge indicator display		CZ 2, 8-15	CZ 1, 3-7, 16
Duct design (reduced surface area, high insulation, and duct location)			X
Ducts entirely in conditioned space		Option C	X
Low leakage ducts entirely in conditioned space			X
Ducts <12 feet outside conditioned space			X
Low leakage air handlers			X
Cooling coil air flow and air handler fan watt draw AND/OR Verified return duct design and air filter device	X		
High SEER			X
High EER			X
Photovoltaic (PV) system capacity to qualify for PV rebate via New Solar Home Partnership			X
Central fan integrated ventilation cooling systems		Optional ^B	
Zonal control			X
Evaporatively cooled condensers			X
Ice storage air conditioners			X
Plumbing			
Pipe insulation		Optional ^D	X
Verified design (parallel piping, compact design, point of use)			X
Multifamily recirculation loops			X
Envelope			
Quality insulation installation (QII)		Optional ^D	X ^C
Building envelope sealing			X
HERS verified pre-existing conditions			X

^A Unless it is a ductless system (e.g., ductless mini splits)

^B A project may comply prescriptively by using either a central fan integrated ventilation cooling system.

✦ If a central fan integrated cooling system is used, it requires HERS verification, and it must meet duct leakage, fan watt draw and airflow requirements.

✦ If a whole house fan is used, it does NOT require HERS verification.

^C If QII is used for compliance credit, multiple inspections are required to confirm that QII standards are met.

^D If the prescriptive option of not installing a tankless water heater is chosen, then HERS verification apply.



Next Steps



HELPING YOU PLAY YOUR CARDS RIGHT



A new website developed by the Statewide Codes & Standards Program to help you meet the requirements of Title 24, Part 6

We offer **FREE**



A variety of tools to help you identify the forms, installation techniques, and building energy standards relevant to building projects in California



Classroom and online trainings on Title 24, Part 6.



Fact Sheets, Trigger Sheets, Checklists, and FAQs to help you understand when Title 24, Part 6 is "triggered" and how to correctly comply when it is



visit us at
www.EnergyCodeAce.com



“What’s Changed”

HVAC AND DOMESTIC HOT WATER: Mandatory Measures

Color background indicates code language: NO CHANGE REVISED NEW FOR 2016

Measure	T-24 Section	Notes
Systems & Equipment <i>§110.0 has added new language regarding conformance to Title 20</i>	110.0(b)	New language regarding certification of manufactured systems, equipment, appliances and building components that need to meet Title 20 requirements (regulated appliances), or certification requirements per Title 24, Part 6 (not a regulated appliance under Title 20). Certification to the Energy Commission is the responsibility of the manufacturer.
Heating Equipment Efficiency	110.2(a)	Table 110.2-B: Heating mode water and groundwater source heat pumps COP minimum values (1/1/2017). Table 110.2-E: SPVHP and PTHP COP minimum values (1/1/2017). Table 110.2-J: Oil-fired unit heater minimum efficiency increased to 81% E _c (1/1/2017). Table 110.2-K: Boiler minimum efficiencies to change 3/2/2020.
Cooling Equipment Efficiency	110.2(a)	Table 110.2-A: Air conditioners: air cooled and water cooled IEER minimum values (1/1/2016). Table 110.2-B: Air and water cooled heat pumps IEER and EER minimum values (1/1/2016). Table 110.2-D: Air and water cooled chillers Path A and B minimum efficiencies (1/1/2017). Table 110.2-E: Cooling mode PTAC, PTHP and SPVAC EER minimum values (1/1/2017). Table 110.2-G: Evaporative cooling towers added.
Space Conditioning Equipment	110.2(b-f)	No Change
Service Water Heating Systems & Equipment Installation	110.3(a)(b) 110.3(c)7	No Change. NOTE: Temperature control listed in ASHRAE Handbook HVAC Applications Guide volume 2011 is Table 3 (as is stated within Standards); in volume 2015 it can be found in Chapter 50, Table 19. Isolation valves. Instantaneous water heaters with an input rating greater than 6.8 kBtu/hr (2 kW) shall have isolation valves on both the cold water supply and the hot water pipe leaving the water heater, and hose bibbs or other fittings on each valve for flushing the water heater when the valves are closed.
Pool & Spas	110.4(a)(b)	No Change
Pilot Lights	110.5(a-d)	No Change
Residential HVAC & Water Heating	150.0(e) Fireplaces 150.0(h) 3B Equipment 150.0(i) Thermostats 150.0(j) Water system insulation 150.0(m)1 Air distribution 150.0(m)2-12 150.0(m)13 Duct and air grille sizing 150.0(n-p)	No Change Liquid line filter dryers required per manufacturers' instructions for AC and heat pump systems. Allows for EMCS instead of setback thermostat when required per §110.2(c). Since federal standards have increased minimum efficiency on tank water heaters, an R-12 external blanket is no longer required since they are provided via internal tank insulation by manufacturer (to meet minimum federal efficiency). Minor changes in language regarding below grade piping, cooling system piping, and insulation protection. Minimum duct insulation, no matter where it is located, such as inside the conditioned space, must be insulated with a minimum of R-4.2. 11. Duct testing: Total leakage shall not exceed 5% for single family homes and townhouses. All others: No Change Slight change in language specifically to single zone central forced air system for the airflow fan watt draw minimum requirements. Zonally controlled central forced air systems shall be capable of simultaneously delivering, in every zonal control mode, airflow from the dwelling, through the air handler fan and delivered to the dwelling ≥350 CFM per ton of nominal cooling capacity, and operating at an air-handling unit fan efficacy of ≤ 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 Some new exceptions apply for small duct high velocity systems and multispeed/variable speed compressor systems. No Change



Residential Plans Examiner Checklist

Dynamic or Static

★ Dynamic:

- ✦ Computer is required
- ✦ Adobe Reader is required
- ✦ Organized to help organize plan check for all the Title 24 Part 6 certificate of Compliance forms (NRCC)
- ✦ You can choose to have predetermined "Plan Check Responses" populated for items not meeting code.

★ Static:

- ✦ No computer required ☺

EnergyCodeAce
Helping you play your code right

Ace Resources 2016 Residential - Title 24, Part 6
Energy Plans Review

Permit Number: _____ Permit Applicant: _____ Review Date: _____
Project Name: _____ Phone: _____ Email: _____ Updated: _____
Project Address: _____ Plans Examiner: _____
Phone: _____ Email: _____

This is a dynamic document that creates a custom Part 6 checklist for a project scope. This checklist can also be used to create a set of example correction comments that may be used or modified by the plans examiner.
Would you like to use the simple correction comments feature? YES

The dynamic version of this checklist is available on www.EnergyCodeAce.com under the Resources Ace.

Envelope	HVAC	Domestic Hot Water (DHW)	Solar Ready
<input type="checkbox"/> Performance <input type="checkbox"/> CFIR-P6F-01	<input type="checkbox"/> Performance <input type="checkbox"/> CFIR-P6F-01	<input type="checkbox"/> Performance <input type="checkbox"/> CFIR-P6F-01	<input type="checkbox"/> Mandatory <input type="checkbox"/> SRA-01-E Solar Ready <input type="checkbox"/> SRA-02-E Min Solar Zone
<input type="checkbox"/> Prescriptive New Home <input type="checkbox"/> NCB-01-E Addition <input type="checkbox"/> ADD-01-E HERS <input type="checkbox"/> ADD-02-E non-HERS Alteration <input type="checkbox"/> ALT-01-E HERS <input type="checkbox"/> ALT-05-E non-HERS Support Documents <input type="checkbox"/> ENV-02-E Area Weighted <input type="checkbox"/> ENV-03-E SHGC <input type="checkbox"/> ENV-04-E Cool Roof	<input type="checkbox"/> Prescriptive New Home <input type="checkbox"/> NCB-01-E Addition <input type="checkbox"/> ADD-01-E HERS <input type="checkbox"/> ADD-02-E non-HERS Alteration <input type="checkbox"/> ALT-02-E HERS <input type="checkbox"/> ALT-03-E CZ 1, 3-7, 16 <input type="checkbox"/> ALT-04-E CZ 2, 8-15 <input type="checkbox"/> ALT-05-E non-HERS Support Documents <input type="checkbox"/> PLB-01-E Hydronic Heating	<input type="checkbox"/> Prescriptive New Home, Addition, Alteration Solar Water Heating: <input type="checkbox"/> SH-01-E 0G300 <input type="checkbox"/> SH-02-E 0G100	<input type="checkbox"/> Lighting <input type="checkbox"/> No forms for submittal Must be integrated into design
			Form Key Mandatory requirements Prescriptive requirements Performance path Expand All Items Clear All

Certificate of Compliance (CFIR) General Information		YES	NO
Are the following items contained on the plans? If "NO", items to be corrected per plan check comments:			
Has only one Certificate of Compliance (CFIR) been submitted as part of this permit FOR THE SAME FEATURE?	\$10-103	<input type="checkbox"/>	<input type="checkbox"/>
Do all pages of the CFIR have the same "Report Generated" date and time?	Performance path only	<input type="checkbox"/>	<input type="checkbox"/>
Are all CFIR documents printed on the plans?	\$10-105	<input type="checkbox"/>	<input type="checkbox"/>
Are all CFIR documents signed and dated by the: Responsible building designers or owners? Documentation authors?	Electronic (HERS registered) or wet signature Electronic	<input type="checkbox"/>	<input type="checkbox"/>
If HERS verification required, has the CFIR been registered with a HERS provider?	If there are any HERS measures, registration required for ALL forms	\$10-103	<input type="checkbox"/>
Is the climate zone correct?	Based on zip code	\$100.1(b)	<input type="checkbox"/>
Is the site orientation correct?	Performance path only, Accuracy last plan used!		<input type="checkbox"/>
Total conditioned floor area (ft ²)		\$100.1(b)	<input type="checkbox"/>
Number of bedrooms and number of dwelling units: Bedrooms (per dwelling) Multifamily & hotel/motel units	Alt. Accuracy & handwritten	\$100.1(b)	<input type="checkbox"/>
Number of stories above grade: Principal heating source	Not including mezzanine or lifts	\$100(c)	<input type="checkbox"/>

Coming soon!



Residential Building Inspector Checklist

2016 Residential - Title 24, Part 6
Building Inspector
Energy Inspection Checklist

Permit Number: _____

Project Address: _____
Contacts: _____

OVERALL REQUIREMENT	YES	NO
All compliance documents completed, signed and registered, if required. (HERS verification triggers registration.)	<input type="checkbox"/>	<input type="checkbox"/>
CFIR (Certificate of Compliance - most current, if revised from plan review)	<input type="checkbox"/>	<input type="checkbox"/>
CFIR (Certificates of Installation)	<input type="checkbox"/>	<input type="checkbox"/>
CFIR (Certificates of Verification - HERS)	<input type="checkbox"/>	<input type="checkbox"/>
Define Fuel Type <input type="checkbox"/> natural gas <input type="checkbox"/> propane <input type="checkbox"/> electricity	<input type="checkbox"/>	<input type="checkbox"/>

Does installed measure and/or HERS-verified data match CFIR and meet all mandatory requirements?						
Measure	Required Forms			Notes	YES	NO
	Form Name	CFIR	CFIR			
ENVELOPE						
Fenestration	ENV-01				<input type="checkbox"/>	<input type="checkbox"/>
Insulation	ENV-03				<input type="checkbox"/>	<input type="checkbox"/>
Roofing (cool roof, radiant barrier)	ENV-04				<input type="checkbox"/>	<input type="checkbox"/>
HERS Measures (if required)	ENV-20 & MCH-24				<input type="checkbox"/>	<input type="checkbox"/>
Envelope Air Leakage	ENV-21, 22, 23, 24				<input type="checkbox"/>	<input type="checkbox"/>
Quality Insulation Installation (QII)					<input type="checkbox"/>	<input type="checkbox"/>
HVAC						
Equipment	MCH-01				<input type="checkbox"/>	<input type="checkbox"/>
Whole House Fan (ventilation cooling)	MCH-02, MCH-30				<input type="checkbox"/>	<input type="checkbox"/>
Evaporative Coolers	MCH-04				<input type="checkbox"/>	<input type="checkbox"/>
HERS Measures						
Duct leakage	MCH-20				<input type="checkbox"/>	<input type="checkbox"/>
Duct location	MCH-21				<input type="checkbox"/>	<input type="checkbox"/>
Fan Efficacy	MCH-22				<input type="checkbox"/>	<input type="checkbox"/>
Airflow Rate	MCH-23				<input type="checkbox"/>	<input type="checkbox"/>
Refrigerant Charge	MCH-25				<input type="checkbox"/>	<input type="checkbox"/>
High SEER or EER	MCH-26				<input type="checkbox"/>	<input type="checkbox"/>
IAQ Ventilation	MCH-27				<input type="checkbox"/>	<input type="checkbox"/>
Return Duct and Filter Grille	MCH-28				<input type="checkbox"/>	<input type="checkbox"/>
Buried Ducts	MCH-29				<input type="checkbox"/>	<input type="checkbox"/>
PLUMBING						
Distribution						
Non-HERS: Centralized system (multifamily)	PLB-01				<input type="checkbox"/>	<input type="checkbox"/>
Individual system	PLB-02				<input type="checkbox"/>	<input type="checkbox"/>
HERS: Centralized system (multifamily)	PLB-21				<input type="checkbox"/>	<input type="checkbox"/>
Individual system	PLB-22				<input type="checkbox"/>	<input type="checkbox"/>
Pools and Spas	PLB-03				<input type="checkbox"/>	<input type="checkbox"/>
Solar Hot Water	STH-01				<input type="checkbox"/>	<input type="checkbox"/>
ELECTRICAL						
PV Systems						
Lighting: Single Family	SPV-01				<input type="checkbox"/>	<input type="checkbox"/>
Lighting: Multifamily	LTG-01				<input type="checkbox"/>	<input type="checkbox"/>
	LTG-02				<input type="checkbox"/>	<input type="checkbox"/>

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Static

- ✦ No computer required 😊
- ✦ Provides guidance on which building features must be documented with which forms
- ✦ These forms are designed to be a verification tool in the field.

Coming soon!



WISE: Attics

www.wisewarehouse.org



[CODE REQUIREMENTS](#) [PRODUCTS/SOLUTIONS](#) [CASE STUDIES](#) [RESOURCES](#) [EVENTS & FORUMS](#) [ABOUT US](#)



The WISE program engages builders, manufactures, contractors in a variety of events throughout California covering best practices in high performance wall and attic construction. This page includes WISE coordinated events, as well as links to other programs relevant to advancement of HPA/HPW building techniques. Some of these events may be eligible for Continuing Education Units (CEU) if indicated in the program description.



EPIC WISE



Builder Solutions to Meeting Compliance



- ✦ Meet with Builders to present solutions:
 - ✦ Including the senior management, project management and purchasing for the project

- ✦ WISE team will present multiple solutions for meeting high performance walls and attics along with projected cost
 - ✦ WISE team will work to understand builder concerns and address each one
 - ✦ Builder team will select a solution best suited for their product



On the Job TRAINING!



- ✦ Create a working group including:
 - ✦ Builder, WISE team, Architect, Engineers, Energy Consultant, HERS Rater, Relevant Subcontractors and Product Manufactures

- ✦ Working Group will ensure that:
 - ✦ All plans and details are done correctly to implement the chosen solution;
 - ✦ All subcontractors, consultants and builder staff understand all installation requirements;
 - ✦ Nothing is being bid that is unnecessary by reviewing all contract scopes of work and subcontractor bids;
 - ✦ Installers are working efficiently and the product is installed properly through on-site training.



Manufacturer Benefits



✦ Proper product installation:

- ✦ Insures that the builders are installing the products correctly.
 - Increases product satisfaction and performance.

✦ Builder networking:

- ✦ The builders will see how the product should be installed.
 - Allows builders to experiment with new technologies
- ✦ Manufacturers are invited to provide the training on their products.
 - Gives the builder experience *with* the product as opposed to relying on product literature.
- ✦ Participating in the trainings helps build a line of communication with builders.



CAHP

<http://cahp-p>

california
advanced homes
Master Builder

CAHP Master Builder Product Catalogue



California Advanced Homes Institute

3.2 Below Deck Insulation Products

Johns Manville Unfaced Fiberglass Batts



Johns Manville makes a fiberglass batt that can be used in high performance unvented attics. The batts cover the attic's framing and trusses and are wired into place on the underside of the roof deck. The wiring keeps the batts from sagging or falling, and creates a layer of insulation below the roofline. The batts come in a number of widths and depths. R-values range from R-11 to R-38 (R-value of R-3.2 per inch).

For the purpose of building high-performance attics, builders have been using 24" wide batts to fit around framing and trusses. The batts are formaldehyde-free, unfaced and provide a level of sound protection.

This product is currently on the market and is available for installation.

Figure 6: Johns Manville Unfaced Fiberglass Batts

www.jm.com

Owens Corning Boxed Netting



Figure 7: Owens Corning Boxed Netting

The Boxed Netting System by Owens Corning is blown in fiberglass held with netting installed on the underside of the roof deck. Builders use Owens Corning's Boxed Netting, in conjunction with Owens Corning's foam sealant and ProPink® EcoTouch Loosefill blown-in insulation, to create high-performance, unvented attics. The netting is designed to hang from the truss top chord or rafter and deliver a cavity depth that creates a uniform insulation layer.

It does this by enveloping the framing members in insulation. It is available in a wide range of R-values (R-22 through R-49 per inch), independent of the size of the roof deck framing.

The netting includes an integrated vapor retarder to provide moisture management for California climate zones 1,2,3,11,12, and 16.

Owens Corning has an installation guide describing their high performance attic systems called *PRO PINK® High Performance Conditioned Attic System*:

<http://www2.owenscorning.com/literature/pdfs/HPCA%20Installation%20Instructions.pdf>

This product is currently on the market and is available for installation.



Master Builder through CAHP

<http://cahp-pge.com/masterbuilder/>

2013 Title 24 CAHP Master Builder Modeling Guidebook

October 2015

- ★ Guidance on HOW to model high performance features;

EnergyPro

1. Create a roof in the building tree
2. Click on the New Assembly field for the roof
3. Add the insulation R-value to the appropriate Added Insulation field. **NOTE:** Please ensure modeling with EnergyPro 6.7 or later version. The capability of modeling extra insulation to roof deck is not available to the previous versions due to the software automatically assigns an additional insulation to attic floor.
 - a. For above roof deck insulation, enter an R-value in the Added *Exterior* Insulation field
 - b. For below roof deck insulation, enter an R-value in the Added *Interior* Insulation field
4. If the project team is using spray-foam insulation requiring QII inspection by a HERS rater, the user may check the “spray foam insulation requiring QII inspection” box. **NOTE:** Requires HERS testing.



Figure 4: Example Roof Deck Insulation in EnergyPro (Left)

Figure 5: Example Spray Foam Roof Deck Insulation in EnergyPro (Right)