2022 Energy Code

Single-Family Envelope

California Energy Commission

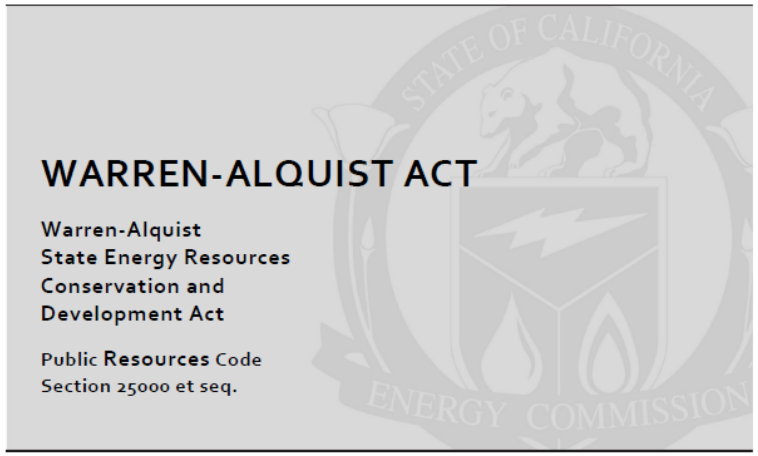
March 2024

Agenda

- Energy Code basics
- Navigating Energy Code
- Fenestration and exterior doors
- Air sealing
- Vapor retarder
- Radiant barrier
- Insulation
- Quality insulation installation (QII)
- Roofing products
- Resources

Energy Code Basics

Energy Code History

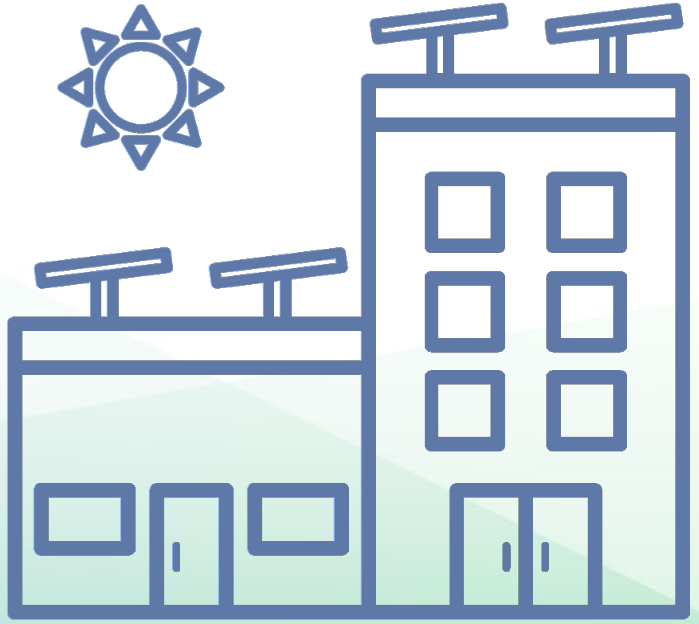


Warren-Alquist Act established California Energy Commission (CEC) in 1974

- Authority to develop and maintain Building Energy Efficiency Standards (Energy Code)
- Requires CEC to update periodically, usually every 3 years
- Requires Energy Code to be cost-effective over economic life of building

2022 Energy Code Goals

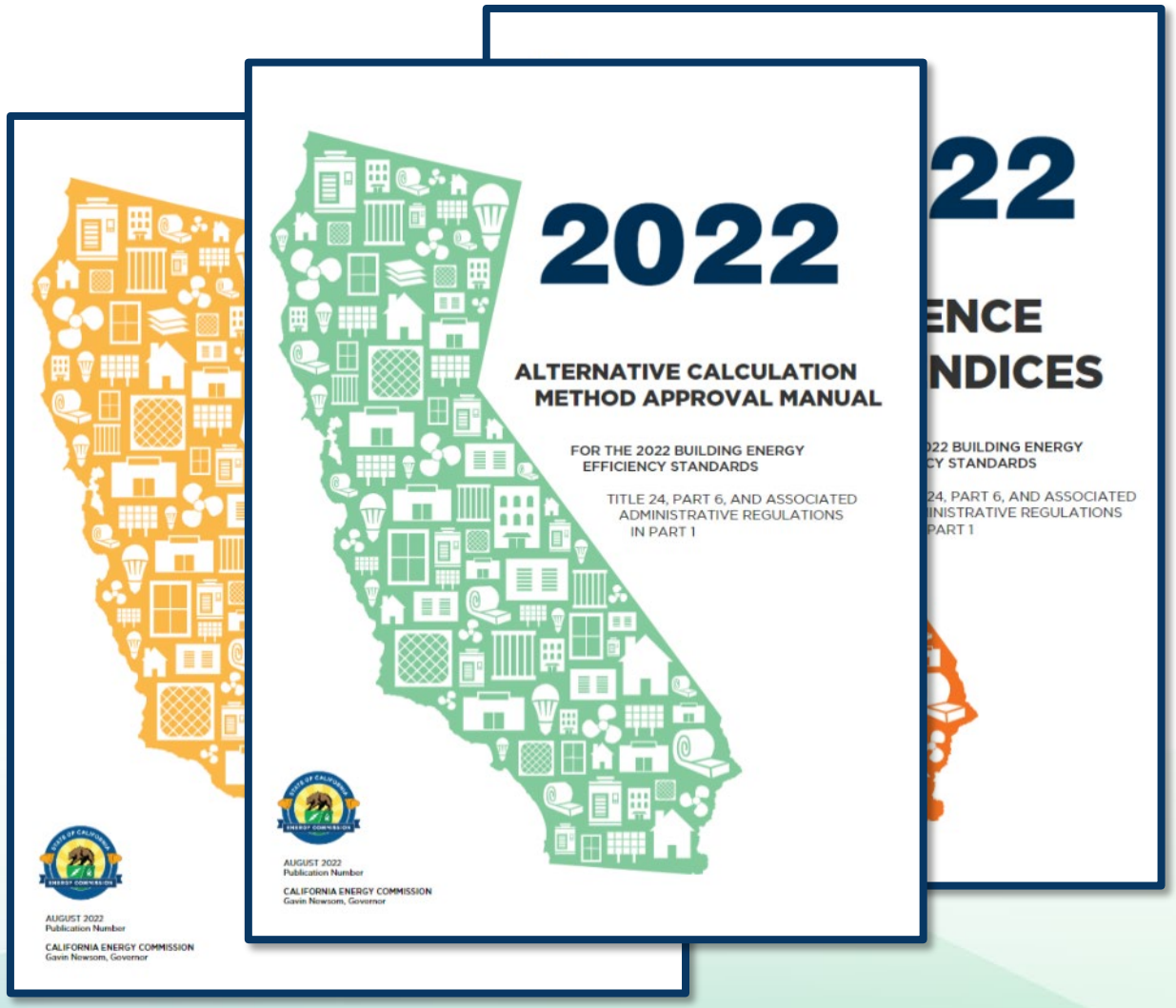
- Increase building energy efficiency cost-effectively
- Contribute to California's greenhouse gas (GHG) reduction goals
- Enable pathways for all-electric buildings
- Reduce residential building impacts on the electricity grid
- Promote demand flexibility and self-utilization of photovoltaic (PV)
- Provide tools for local government reach codes



2022 Energy Code

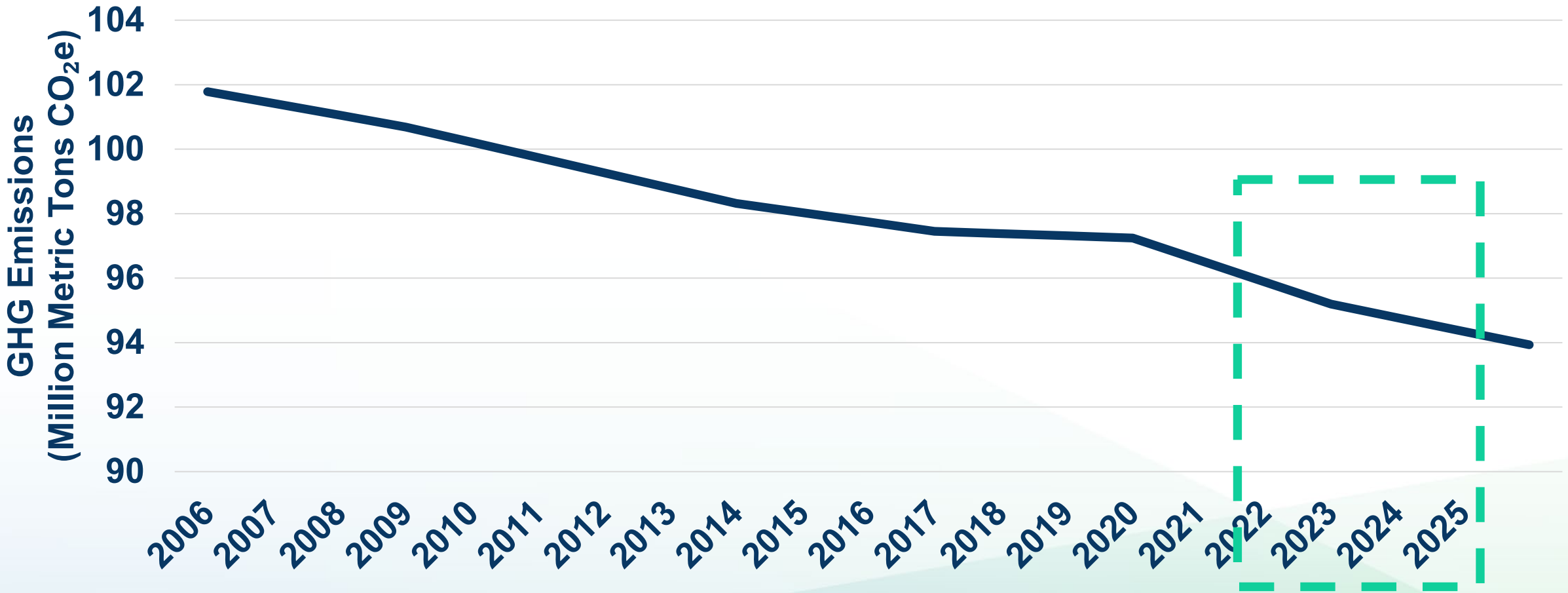
Effective January 1, 2023

- Building permit applications submitted on or after effective date
- Must use approved versions
  - Software
  - Forms



Energy Code Environmental Benefit

Reduced Statewide Emissions



Source: CEC Impact Analysis 2005, 2008, 2013, 2016, 2019, 2022

2022 Documents Online

- Energy Code
- Reference Appendices
- Compliance Manuals
- Software
- Forms

Energy Code Requirements

Mandatory requirements

- Minimum efficiency requirements must always be met
- Can never trade off

Prescriptive requirements

- Predefined efficiency requirements
- May supersede mandatory requirements
- Different requirements for newly constructed buildings, additions, and alterations

Compliance Approaches

Prescriptive approach

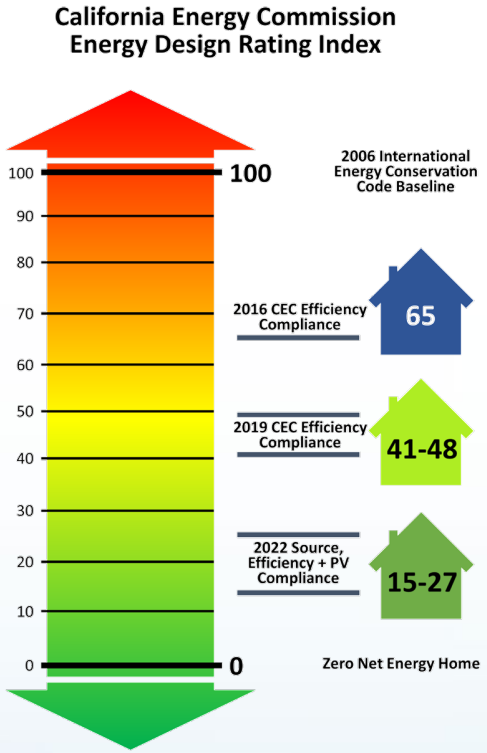
- Simple approach, no trade-offs
- Defines the standard building design
- 2022 heat pump baselines

Performance approach

- Most flexible approach, allows for trade-offs
- Must meet all mandatory requirements
- Requires the use of CEC-approved software
- Proposed building design meets or exceeds standard building design

2022 Performance Approach Metrics

New for 2022



Energy Design Rating (EDR), as defined by the California Energy Commission, is an alternate way to express the energy performance of a building using a scoring system where 100 represents the energy performance of a Residential Energy Services (RESNET) reference home characterization of the 2006 IECC with California modeling assumptions. A score of 0 represents the energy performance of a building that combines high levels of energy efficiency with renewable generation to "zero out" its TDV energy.

Energy performance approach calculations

- Single-family energy design rating (EDR)
  - EDR1: hourly source energy
  - EDR2: time dependent valuation (TDV)
    - Efficiency EDR, PV + flexibility EDR, total EDR

2022 Compliance Software

Performance approach must use approved compliance software versions

- Single-family
  - CBECC-Res 2022.3.0
  - EnergyPro 9.2
  - Wright-Energy 2022.3.0

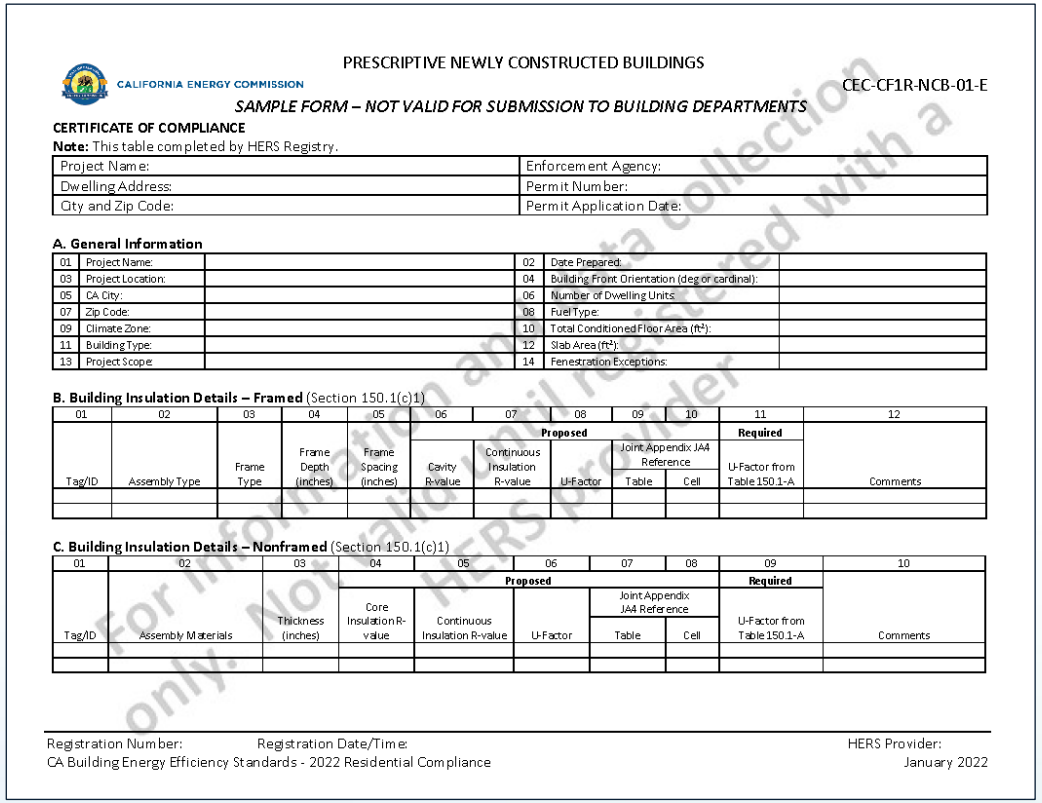
Demonstrating Compliance

Compliance forms confirm Energy Code is met

- Completed by responsible party
  - Designers, consultants, builders, contractors, technicians, HERS raters, etc.
- Submitted to enforcement agencies for verification

Type of form	Single-family
Certificate of compliance	CF1R
Certificate of installation	CF2R
Certificate of verification	CF3R

Certificates of Compliance



PRESCRIPTIVE NEWLY CONSTRUCTED BUILDINGS

CALIFORNIA ENERGY COMMISSION CEC-CF1R-NCB-01-E

SAMPLE FORM – NOT VALID FOR SUBMISSION TO BUILDING DEPARTMENTS

CERTIFICATE OF COMPLIANCE

Note: This table completed by HERS Registry.

Project Name:	Enforcement Agency:
Dwelling Address:	Permit Number:
City and Zip Code:	Permit Application Date:

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	Fenestration Exceptions:	

B. Building Insulation Details – Framed (Section 150.1(c)1)

01	02	03	04	05	06	07	08	09	10	11	12
					Proposed					**Required**	
Tag/ID	Assembly Type	Frame Type	Frame Depth (inches)	Frame Spacing (inches)	Cavity R-value	Continuous Insulation R-value	U-Factor	Joint Appendix JA4 Reference: Table	Joint Appendix JA4 Reference: Cell	U-Factor from Table 150.1-A	Comments

C. Building Insulation Details – Nonframed (Section 150.1(c)1)

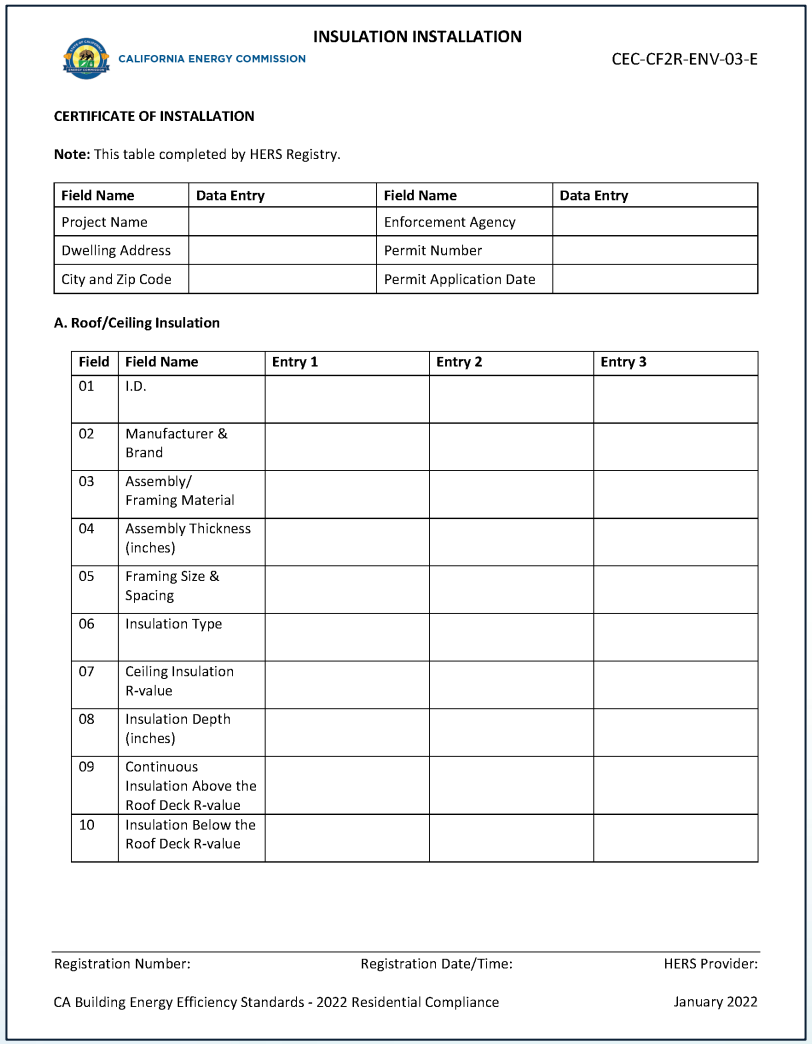
01	02	03	04	05	06	07	08	09	10
			Proposed					**Required**	
Tag/ID	Assembly Materials	Thickness (inches)	Core Insulation R-value	Continuous Insulation R-value	U-Factor	Joint Appendix JA4 Reference: Table	Joint Appendix JA4 Reference: Cell	U-Factor from Table 150.1-A	Comments

Registration Number: Registration Date/Time: HERS Provider:

Certificate of compliance – CF1R

- Demonstrates compliance at design phase
- Completed by designer, architect, energy consultant, engineer, etc.
- Submit with permit application, include with plans
- Plans examiner verifies CF1R matches specs on plans

Certificates of Installation



INSULATION INSTALLATION

CALIFORNIA ENERGY COMMISSION

CEC-CF2R-ENV-03-E

CERTIFICATE OF INSTALLATION

Note: This table completed by HERS Registry.

Field Name	Data Entry	Field Name	Data Entry
Project Name		Enforcement Agency	
Dwelling Address		Permit Number	
City and Zip Code		Permit Application Date	

A. Roof/Ceiling Insulation

Field	Field Name	Entry 1	Entry 2	Entry 3
01	I.D.			
02	Manufacturer & Brand			
03	Assembly/ Framing Material			
04	Assembly Thickness (inches)			
05	Framing Size & Spacing			
06	Insulation Type			
07	Ceiling Insulation R-value			
08	Insulation Depth (inches)			
09	Continuous Insulation Above the Roof Deck R-value			
10	Insulation Below the Roof Deck R-value			

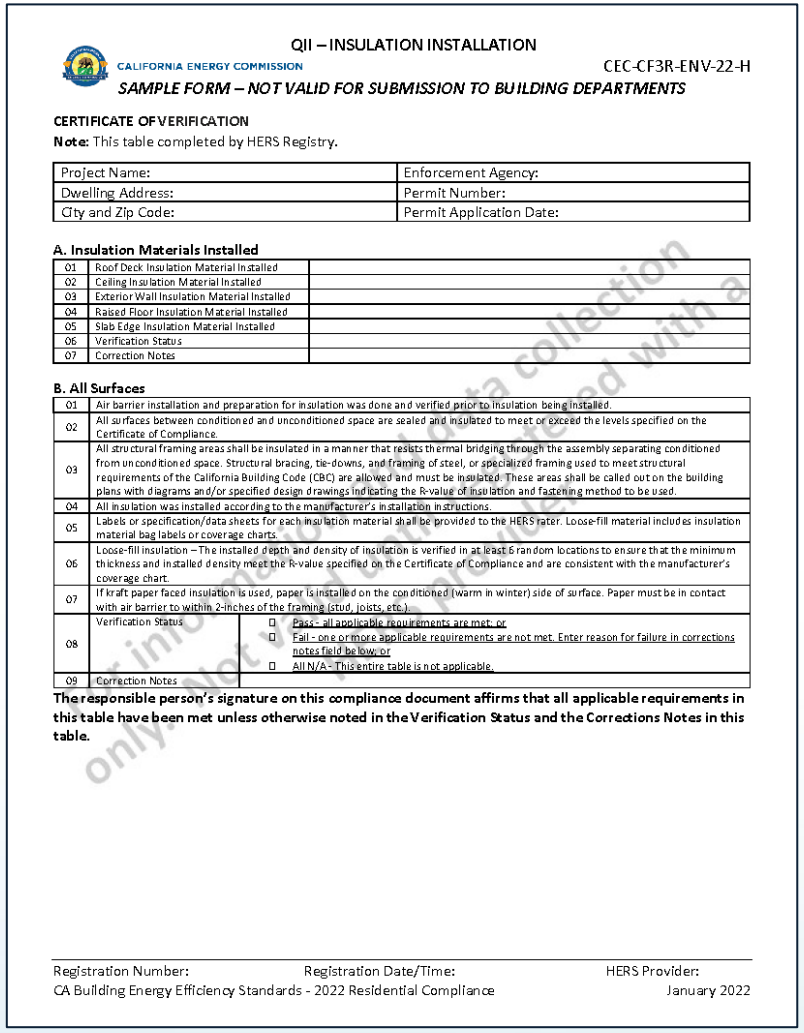
Registration Number: Registration Date/Time: HERS Provider:

CA Building Energy Efficiency Standards - 2022 Residential Compliance January 2022

Certificate of installation – CF2R

- Completed by builder or installing contractor
- Confirms compliance at installation
- Identifies energy efficiency measures installed per the CF1R and mandatory measures
- Left on-site for building inspector
- Inspector verifies documented efficiency and components match installed equipment and systems

Certificates of Verification



QII – INSULATION INSTALLATION

CALIFORNIA ENERGY COMMISSION CEC-CF3R-ENV-22-H

SAMPLE FORM – NOT VALID FOR SUBMISSION TO BUILDING DEPARTMENTS

CERTIFICATE OF VERIFICATION

Note: This table completed by HERS Registry.

Project Name:	Enforcement Agency:
Dwelling Address:	Permit Number:
City and Zip Code:	Permit Application Date:

A. Insulation Materials Installed

01	Roof Deck Insulation Material Installed	
02	Ceiling Insulation Material Installed	
03	Exterior Wall Insulation Material Installed	
04	Raised Floor Insulation Material Installed	
05	Slab Edge Insulation Material Installed	
06	Verification Status	
07	Correction Notes	

B. All Surfaces

01	Air barrier installation and preparation for insulation was done and verified prior to insulation being installed.	
02	All surfaces between conditioned and unconditioned space are sealed and insulated to meet or exceed the levels specified on the Certificate of Compliance.	
03	All structural framing areas shall be insulated in a manner that resists thermal bridging through the assembly separating conditioned from unconditioned space. Structural bracing, tie-downs, and framing of steel, or specialized framing used to meet structural requirements of the California Building Code (CBC) are allowed and must be insulated. These areas shall be called out on the building plans with diagrams and/or specified design drawings indicating the R-value of insulation and fastening method to be used.	
04	All insulation was installed according to the manufacturer's installation instructions.	
05	Labels or specification/data sheets for each insulation material shall be provided to the HERS rater. Loose-fill material includes insulation material bag labels or coverage charts.	
06	Loose-fill insulation – The installed depth and density of insulation is verified in at least 6 random locations to ensure that the minimum thickness and installed density meet the R-value specified on the Certificate of Compliance and are consistent with the manufacturer's coverage chart.	
07	If kraft paper faced insulation is used, paper is installed on the conditioned (warm in winter) side of surface. Paper must be in contact with air barrier to within 2-inches of the framing (stud, joists, etc.).	
08	Verification Status	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable.
09	Correction Notes	

The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.

Registration Number: Registration Date/Time: HERS Provider:

CA Building Energy Efficiency Standards - 2022 Residential Compliance January 2022

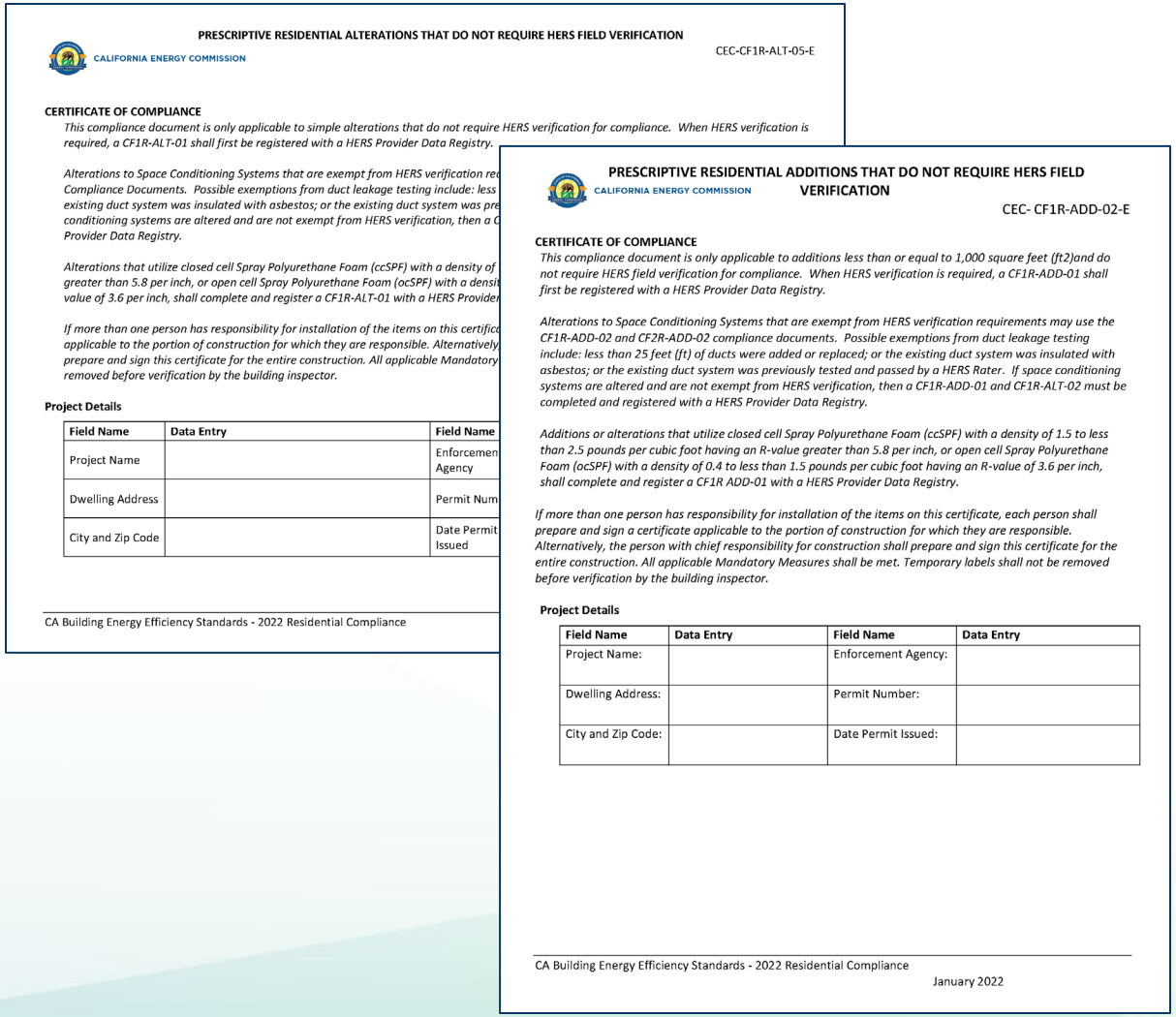
Certificate of verification – CF3R

- Completed by certified HERS rater
- Registered with approved HERS provider
- Confirms compliance with field verification and diagnostic testing requirements
  - Enclosure air leakage
  - Quality insulation installation
- Required for final inspection
- Inspector verifies tests and forms are complete, signed, and registered

Additions and Alterations

CF1R and CF2R

- Non-HERS projects only
- Fillable pdf versions
- Available on 2022 Energy Code webpage



PRESCRIPTIVE RESIDENTIAL ALTERATIONS THAT DO NOT REQUIRE HERS FIELD VERIFICATION

CALIFORNIA ENERGY COMMISSION

CEC-CF1R-ALT-05-E

CERTIFICATE OF COMPLIANCE

This compliance document is only applicable to simple alterations that do not require HERS verification for compliance. When HERS verification is required, a CF1R-ALT-01 shall first be registered with a HERS Provider Data Registry.

Alterations to Space Conditioning Systems that are exempt from HERS verification re Compliance Documents. Possible exemptions from duct leakage testing include: less existing duct system was insulated with asbestos; or the existing duct system was pre conditioning systems are altered and are not exempt from HERS verification, then a C Provider Data Registry.

Alterations that utilize closed cell Spray Polyurethane Foam (ccSPF) with a density of greater than 5.8 per inch, or open cell Spray Polyurethane Foam (ocSPF) with a densi value of 3.6 per inch, shall complete and register a CF1R-ALT-01 with a HERS Provide

If more than one person has responsibility for installation of the items on this certific applicable to the portion of construction for which they are responsible. Alternatively prepare and sign this certificate for the entire construction. All applicable Mandatory removed before verification by the building inspector.

Project Details

Field Name	Data Entry	Field Name
Project Name		Enforcemen Agency
Dwelling Address		Permit Num
City and Zip Code		Date Permit Issued

CA Building Energy Efficiency Standards - 2022 Residential Compliance

PRESCRIPTIVE RESIDENTIAL ADDITIONS THAT DO NOT REQUIRE HERS FIELD VERIFICATION

CALIFORNIA ENERGY COMMISSION

CEC- CF1R-ADD-02-E

CERTIFICATE OF COMPLIANCE

This compliance document is only applicable to additions less than or equal to 1,000 square feet (ft2)and do not require HERS field verification for compliance. When HERS verification is required, a CF1R-ADD-01 shall first be registered with a HERS Provider Data Registry.

Alterations to Space Conditioning Systems that are exempt from HERS verification requirements may use the CF1R-ADD-02 and CF2R-ADD-02 compliance documents. Possible exemptions from duct leakage testing include: less than 25 feet (ft) of ducts were added or replaced; or the existing duct system was insulated with asbestos; or the existing duct system was previously tested and passed by a HERS Rater. If space conditioning systems are altered and are not exempt from HERS verification, then a CF1R-ADD-01 and CF1R-ALT-02 must be completed and registered with a HERS Provider Data Registry.

Additions or alterations that utilize closed cell Spray Polyurethane Foam (ccSPF) with a density of 1.5 to less than 2.5 pounds per cubic foot having an R-value greater than 5.8 per inch, or open cell Spray Polyurethane Foam (ocSPF) with a density of 0.4 to less than 1.5 pounds per cubic foot having an R-value of 3.6 per inch, shall complete and register a CF1R ADD-01 with a HERS Provider Data Registry.

If more than one person has responsibility for installation of the items on this certificate, each person shall prepare and sign a certificate applicable to the portion of construction for which they are responsible. Alternatively, the person with chief responsibility for construction shall prepare and sign this certificate for the entire construction. All applicable Mandatory Measures shall be met. Temporary labels shall not be removed before verification by the building inspector.

Project Details

Field Name	Data Entry	Field Name	Data Entry
Project Name:		Enforcement Agency:	
Dwelling Address:		Permit Number:	
City and Zip Code:		Date Permit Issued:	

CA Building Energy Efficiency Standards - 2022 Residential Compliance

January 2022

Additions and Alterations

Forms exception §10-103

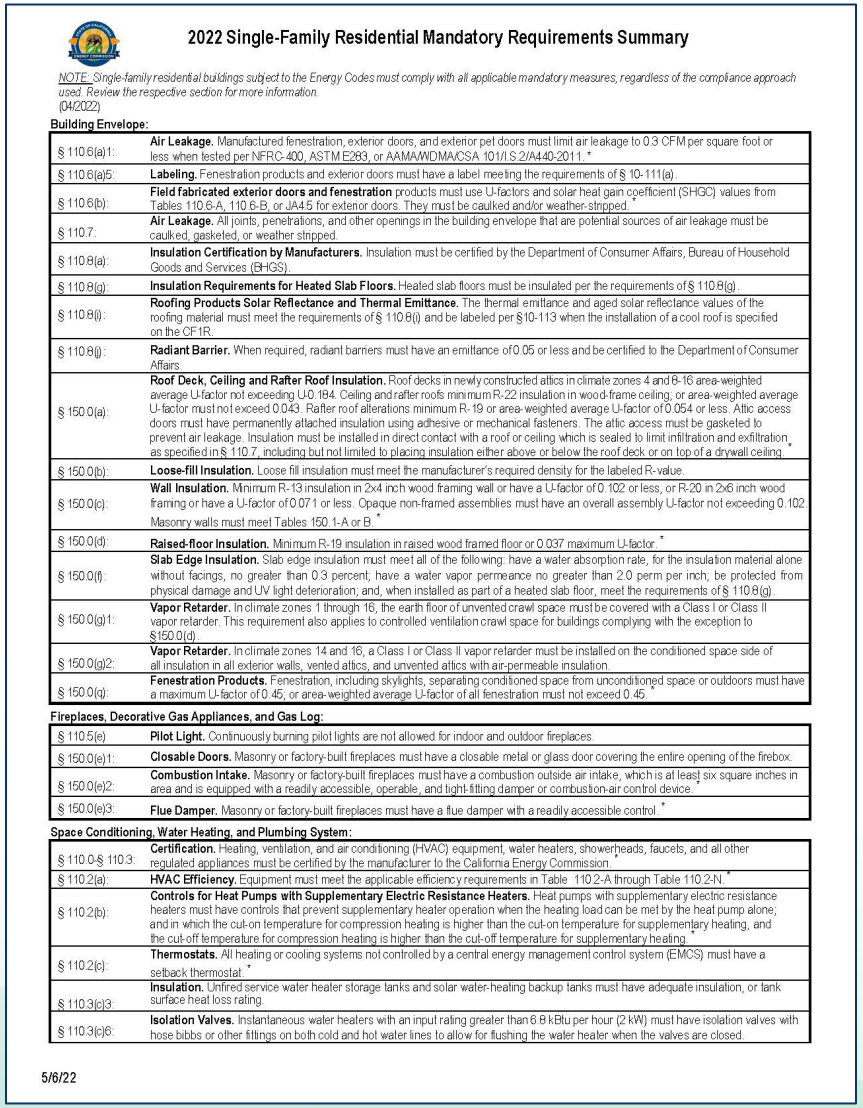
Single-family residential non-HERS alterations, and additions under 300 square feet

- At building departments discretion
  - CF1R and CF2R not required
  - May create simplified forms
  - Include requirements on permit application
  - Project must comply with Energy Code
  - Exempts forms only

Mandatory Requirements Summary

Single-family residential

- Designers may choose to include on plans
- Enforcement agencies may require on plans



2022 Single-Family Residential Mandatory Requirements Summary

NOTE: Single-family residential buildings subject to the Energy Codes must comply with all applicable mandatory measures, regardless of the compliance approach used. Review the respective section for more information.
(04/2022)

Building Envelope:

§ 110.6(a)1:	**Air Leakage.** Manufactured fenestration, exterior doors, and exterior pet doors must limit air leakage to 0.3 CFM per square foot or less when tested per NFRC-400, ASTM E283, or AAMA/WDMA/CSA 101/I.S.2/A440-2011. *
§ 110.6(a)5:	**Labeling.** Fenestration products and exterior doors must have a label meeting the requirements of § 10-111(a).
§ 110.6(b):	**Field fabricated exterior doors and fenestration** products must use U-factors and solar heat gain coefficient (SHGC) values from Tables 110.6-A, 110.6-B, or JA4.5 for exterior doors. They must be caulked and/or weather-stripped. *
§ 110.7:	**Air Leakage.** All joints, penetrations, and other openings in the building envelope that are potential sources of air leakage must be caulked, gasketed, or weather stripped.
§ 110.8(a):	**Insulation Certification by Manufacturers.** Insulation must be certified by the Department of Consumer Affairs, Bureau of Household Goods and Services (BHGS).
§ 110.8(g):	**Insulation Requirements for Heated Slab Floors.** Heated slab floors must be insulated per the requirements of § 110.8(g).
§ 110.8(i):	**Roofing Products Solar Reflectance and Thermal Emittance.** The thermal emittance and aged solar reflectance values of the roofing material must meet the requirements of § 110.8(i) and be labeled per §10-113 when the installation of a cool roof is specified on the CF1R.
§ 110.8(j):	**Radiant Barrier.** When required, radiant barriers must have an emittance of 0.05 or less and be certified to the Department of Consumer Affairs.
§ 150.0(a):	**Roof Deck, Ceiling and Rafter Roof Insulation.** Roof decks in newly constructed attics in climate zones 4 and 8-16 area-weighted average U-factor not exceeding U-0.184. Ceiling and rafter roofs minimum R-22 insulation in wood-frame ceiling, or area-weighted average U-factor must not exceed 0.043. Rafter roof alterations minimum R-19 or area-weighted average U-factor of 0.054 or less. Attic access doors must have permanently attached insulation using adhesive or mechanical fasteners. The attic access must be gasketed to prevent air leakage. Insulation must be installed in direct contact with a roof or ceiling which is sealed to limit infiltration and exfiltration, as specified in § 110.7, including but not limited to placing insulation either above or below the roof deck or on top of a drywall ceiling. *
§ 150.0(b):	**Loose-fill Insulation.** Loose fill insulation must meet the manufacturer's required density for the labeled R-value.
§ 150.0(c):	**Wall Insulation.** Minimum R-13 insulation in 2x4 inch wood framing wall or have a U-factor of 0.102 or less, or R-20 in 2x6 inch wood framing or have a U-factor of 0.071 or less. Opaque non-framed assemblies must have an overall assembly U-factor not exceeding 0.102. Masonry walls must meet Tables 150.1-A or B. *
§ 150.0(d):	**Raised-floor Insulation.** Minimum R-19 insulation in raised wood framed floor or 0.037 maximum U-factor. *
§ 150.0(f):	**Slab Edge Insulation.** Slab edge insulation must meet all of the following: have a water absorption rate, for the insulation material alone without facings, no greater than 0.3 percent; have a water vapor permeance no greater than 2.0 perm per inch; be protected from physical damage and UV light deterioration; and, when installed as part of a heated slab floor, meet the requirements of § 110.8(g).
§ 150.0(g)1:	**Vapor Retarder.** In climate zones 1 through 16, the earth floor of unvented crawl space must be covered with a Class I or Class II vapor retarder. This requirement also applies to controlled ventilation crawl space for buildings complying with the exception to §150.0(d).
§ 150.0(g)2:	**Vapor Retarder.** In climate zones 14 and 16, a Class I or Class II vapor retarder must be installed on the conditioned space side of all insulation in all exterior walls, vented attics, and unvented attics with air-permeable insulation.
§ 150.0(q):	**Fenestration Products.** Fenestration, including skylights, separating conditioned space from unconditioned space or outdoors must have a maximum U-factor of 0.45, or area-weighted average U-factor of all fenestration must not exceed 0.45. *

Fireplaces, Decorative Gas Appliances, and Gas Log:

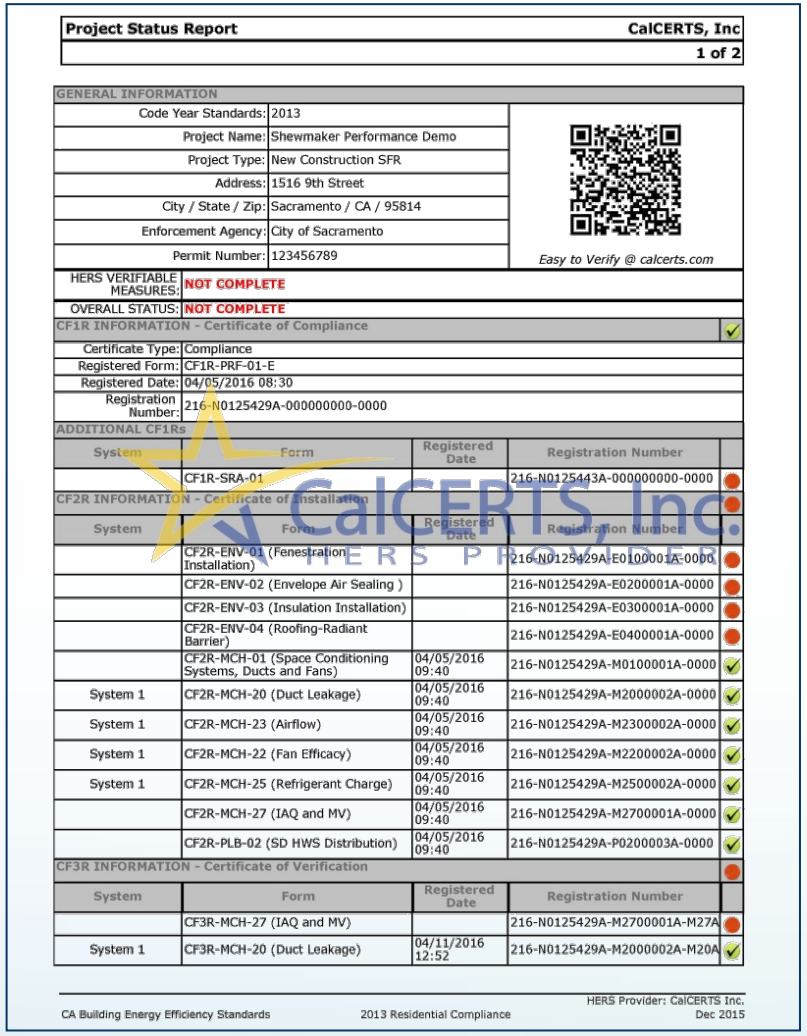
§ 110.5(e)	**Pilot Light.** Continuously burning pilot lights are not allowed for indoor and outdoor fireplaces.
§ 150.0(e)1:	**Closable Doors.** Masonry or factory-built fireplaces must have a closable metal or glass door covering the entire opening of the firebox.
§ 150.0(e)2:	**Combustion Intake.** Masonry or factory-built fireplaces must have a combustion outside air intake, which is at least six square inches in area and is equipped with a readily accessible, operable, and tight-fitting damper or combustion-air control device. *
§ 150.0(e)3:	**Flue Damper.** Masonry or factory-built fireplaces must have a flue damper with a readily accessible control. *

Space Conditioning, Water Heating, and Plumbing System:

§ 110.0-§ 110.3:	**Certification.** Heating, ventilation, and air conditioning (HVAC) equipment, water heaters, showerheads, faucets, and all other regulated appliances must be certified by the manufacturer to the California Energy Commission. *
§ 110.2(a):	**HVAC Efficiency.** Equipment must meet the applicable efficiency requirements in Table 110.2-A through Table 110.2-N. *
§ 110.2(b):	**Controls for Heat Pumps with Supplementary Electric Resistance Heaters.** Heat pumps with supplementary electric resistance heaters must have controls that prevent supplementary heater operation when the heating load can be met by the heat pump alone; and in which the cut-on temperature for compression heating is higher than the cut-on temperature for supplementary heating, and the cut-off temperature for compression heating is higher than the cut-off temperature for supplementary heating. *
§ 110.2(c):	**Thermostats.** All heating or cooling systems not controlled by a central energy management control system (EMCS) must have a setback thermostat. *
§ 110.3(c)3:	**Insulation.** Unfired service water heater storage tanks and solar water-heating backup tanks must have adequate insulation, or tank surface heat loss rating.
§ 110.3(c)6:	**Isolation Valves.** Instantaneous water heaters with an input rating greater than 6.8 kBtu per hour (2 kW) must have isolation valves with hose bibbs or other fittings on both cold and hot water lines to allow for flushing the water heater when the valves are closed.

5/6/22

Project Status Report



Project Status Report — **CalCERTS, Inc** — 1 of 2

GENERAL INFORMATION

Code Year Standards:	2013
Project Name:	Shewmaker Performance Demo
Project Type:	New Construction SFR
Address:	1516 9th Street
City / State / Zip:	Sacramento / CA / 95814
Enforcement Agency:	City of Sacramento
Permit Number:	123456789

Easy to Verify @ calcerts.com

HERS VERIFIABLE MEASURES:	NOT COMPLETE
OVERALL STATUS:	NOT COMPLETE

CF1R INFORMATION - Certificate of Compliance ✓

Certificate Type:	Compliance
Registered Form:	CF1R-PRF-01-E
Registered Date:	04/05/2016 08:30
Registration Number:	216-N0125429A-000000000-0000

ADDITIONAL CF1Rs

System	Form	Registered Date	Registration Number	
	CF1R-SRA-01		216-N0125443A-000000000-0000	●

CF2R INFORMATION - Certificate of Installation ●

System	Form	Registered Date	Registration Number	
	CF2R-ENV-01 (Fenestration Installation)		216-N0125429A-E0100001A-0000	●
	CF2R-ENV-02 (Envelope Air Sealing)		216-N0125429A-E0200001A-0000	●
	CF2R-ENV-03 (Insulation Installation)		216-N0125429A-E0300001A-0000	●
	CF2R-ENV-04 (Roofing-Radiant Barrier)		216-N0125429A-E0400001A-0000	●
	CF2R-MCH-01 (Space Conditioning Systems, Ducts and Fans)	04/05/2016 09:40	216-N0125429A-M0100001A-0000	✓
System 1	CF2R-MCH-20 (Duct Leakage)	04/05/2016 09:40	216-N0125429A-M2000002A-0000	✓
System 1	CF2R-MCH-23 (Airflow)	04/05/2016 09:40	216-N0125429A-M2300002A-0000	✓
System 1	CF2R-MCH-22 (Fan Efficacy)	04/05/2016 09:40	216-N0125429A-M2200002A-0000	✓
System 1	CF2R-MCH-25 (Refrigerant Charge)	04/05/2016 09:40	216-N0125429A-M2500002A-0000	✓
	CF2R-MCH-27 (IAQ and MV)	04/05/2016 09:40	216-N0125429A-M2700001A-0000	✓
	CF2R-PLB-02 (SD HWS Distribution)	04/05/2016 09:40	216-N0125429A-P0200003A-0000	✓

CF3R INFORMATION - Certificate of Verification ●

System	Form	Registered Date	Registration Number	
	CF3R-MCH-27 (IAQ and MV)		216-N0125429A-M2700001A-M27A	●
System 1	CF3R-MCH-20 (Duct Leakage)	04/11/2016 12:52	216-N0125429A-M2000002A-M20A	✓

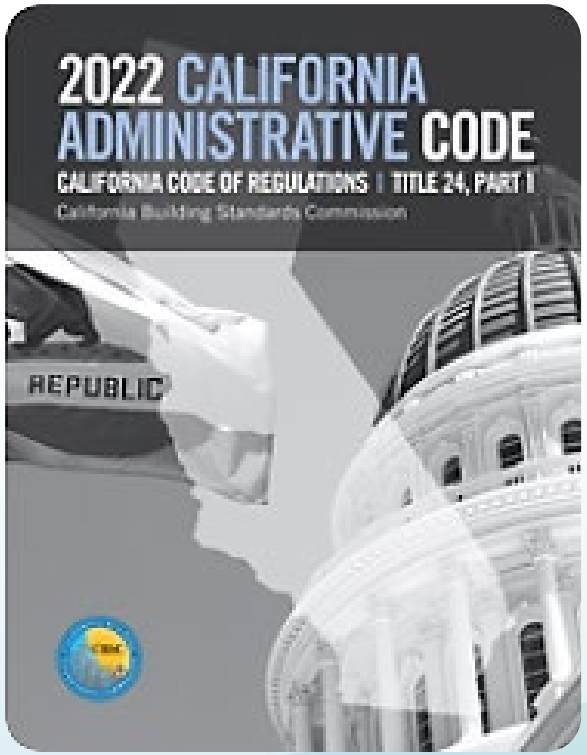
- Summarizes status of all required forms
- Available for any project in HERS registry
- Access directly in registry
- Request hard copy at final inspection to verify compliance
- HERS and Overall Status marked **Complete** to pass inspection
- May accept completed PSR in place of CF2R and CF3R hard copies

Navigating Energy Code

Title 24 – California Building Code

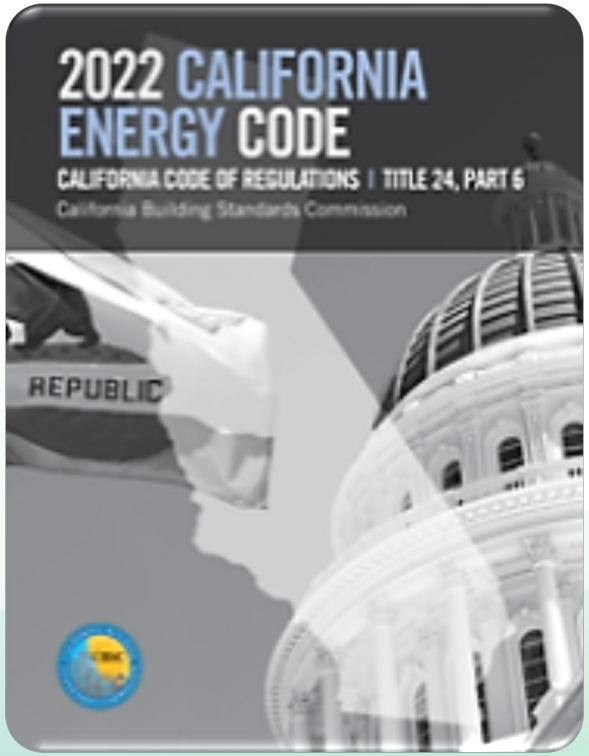
Part 1 - Administrative Code

- Chapter 10
- §§ 10-101 – 10-115
- Administrative requirements



Part 6 - Energy Code

- Subchapters 1 – 9
- §§ 100.0 – 180.4
- Technical requirements



Part 1 Administrative Code

All buildings §§ 10-101 to 10-115

Regulations, definitions, permitting, compliance, enforcement, acceptance testing providers, local ordinances, interpretations, certification, labeling for fenestration and roofs, outdoor lighting zones, community shared solar, and battery storage

Relevant sections

§ 10-111 – Fenestration and door labels

§ 10-112 – Default tables

§ 10-113 – Roofing products

2022 Energy Code Table 100.0-A

Occupancies	Application	Mandatory	Prescriptive	Performance	Additions/Alterations
All Buildings	General	100.0, 100.1, 100.2, 110.0	100.0, 100.1, 100.2, 110.0	100.0, 100.1, 100.2, 110.0	100.0, 100.1, 100.2, 110.0
Single-family	General	150.0	150.1((a), (c))	150.1(a), 150.1(b)	150.2(a), 150.2(b)
Single-family	Envelope (conditioned)	110.6, 110.7, 110.8, 150.0(a), 150.0(b), 150.0(c), 150.0(d), 150.0(e), 150.0(g), 150.0(q)	150.1(a), (c))	150.1(a), 150.1(b)	150.2(a), 150.2(b)
Single-family	HVAC (conditioned)	110.2, 110.5, 150.0(h), 150.0(i), 150.0(j), 150.0(m), 150.0(o)	150.1(a), (c))	150.1(a), 150.1(b)	150.2(a), 150.2(b)
Single-family	Water Heating	110.3, 150.0(j) (n)	150.1(a), (c))	150.1(a), 150.1(b)	150.2(a), 150.2(b)
Single-family	Indoor Lighting (conditioned, unconditioned and parking garages)	110.9, 130.0, 150.0(k)	150.1(a), (c))	150.1(a), 150.1(b)	150.2(a), 150.2(b)
Single-family	Outdoor Lighting	110.9, 130.0, 150.0(k)	150.1(a), (c))	150.1(a), 150.1(b)	150.2(a), 150.2(b)
Single-family	Pool and Spa Systems	110.4, 150.0(p)	N. A.	N.A.	150.2(a), 150.2(b)
Single-family	Solar Ready Buildings	110.10	N. A.	N.A.	N.A.
Single-family	Electric Ready	150.0(s), 150.0(t), 150.0(u), 150.0(v)	N.A.	N.A.	N.A.
Single-family	Solar PV Systems	N.A.	150.1(c)14	150.1(a), 150.1(b)	N.A.

Single-family relevant sections

§ 100.1 Definitions

§ 110.0-110.12 All buildings

§ 150.0 Mandatory requirements

§ 150.1 Prescriptive requirements

§ 150.2 Additions and alterations

Single-family Defined

All buildings § 100.1

New for 2022

Single-family building

- Occupancy group R-3
  - Two or less dwelling units
  - Not multifamily, hotel or motel
- Townhouse
- Occupancy group R-3.1
- Occupancy group U on residential site

Envelope Defined

All buildings § 100.1

Building envelope - ensemble of exterior and demising partitions of a building that enclose conditioned space

Roof

Windows

Walls

Floors

Envelope Definitions

All buildings § 100.1

Exterior wall - separates conditioned space from outdoor space

Demising wall - separates conditioned space from enclosed unconditioned space

Roof - outside cover of a building, including the structural supports, decking, and top layer that is exposed to the outside

Ceiling - demising partition over conditioned space and under unconditioned space

Floor - exterior partition under conditioned space and above outdoor space

Soffit - demising partition under conditioned space and above unconditioned space

Fenestration and Exterior Doors
Single-Family

Administrative §§ 10-111, 10-112

Mandatory §§ 100.1, 110.6, 150.0(q)

Prescriptive § 150.1(c)3, 5

Additions and Alterations §§ 150.2(a)1, 150.2(b)1

Fenestration Definitions

All buildings § 100.1

- **Fenestration product** - a transparent or translucent material plus any sash, frame, mullions, and dividers in façade of a building
- **Glazed door** - an exterior door having a glazed area of 25 percent or greater of the area of the door
- **U-factor** - overall coefficient of thermal transmission through the fenestration
- **Solar heat gain coefficient (SHGC)** - the ratio of solar heat gain entering the space through the fenestration which is released as heat into the space
- Additional updated definitions
  - *Clerestory*
  - *Door*
  - *Overhang projection*
  - *Overhang rise*

Types of Fenestration

All buildings § 100.1

- Manufactured - pre-assembled glazing and frame
  - Commonly used in residential
- Site-built - field-assembled using factory products with the intent of being assembled on-site
  - Storefront or curtain wall system
- Field-fabricated - frame is made at the construction site of materials that were not pre-formed
  - Custom made at site for a specific application

Fenestration and Exterior Doors Administrative Regulations

All buildings §§ 10-111, 10-112

Labeling and certification requirements

- National Fenestration Rating Council (NFRC) is designated to administer certification program
- Temporary labels
  - NFRC manufactured window and door labels
  - CEC default table values
- Label certificates
  - NFRC Component Modeling Approach (CMA)
  - Reference Nonresidential Appendix NA6 alternate default procedure
- Permanent labels

Default tables

- CEC calculates, maintains, and revises

Fenestration Temporary Labels

NFRC

National Fenestration Rating Council®

CERTIFIED

World's Best Window Co.

Series "2000" Casement

Vinyl-Clad Wood Frame

Double Glazing • Argon Fill • Low E

XYZ-X-1-00001-00001

ENERGY PERFORMANCE RATINGS

U-Factor (U.S./I-P)	Solar Heat Gain Coefficient
0.22	0.23

ADDITIONAL PERFORMANCE RATINGS

Visible Transmittance	Air Leakage (U.S./I-P)
0.51	≤ 0.3

Manufacturer stipulates that these ratings conform the applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information.

www.nfrc.org

CEC default

2019 California Energy Commission Default Label
XYZ Manufacturing Co.

Key Features:	☐ Doors	☐ Double-Pane
	☐ Skylight	☐ Glass Block
Frame Type	**Product Type:**	**Product Glazing Type:**
☐ Metal	☐ Operable	☐ Clear
☐ Non-Metal	☐ Fixed	☐ Tinted
☐ Metal, Thermal Break	☐ Greenhouse/Garden Window	☐ Single-Pane
☐ Air space 7/16 in. or greater ☐ With built-in curb ☐ Meets Thermal-Break Default Criteria	----------	To calculate VT see NA6
California Energy Commission Default U-factor =	**California Energy Commission** Default SHGC =	**California Energy Commission** Calculated VT =

Product meets the air infiltration requirements of §110.6(a)1, U-factor criteria of §110.6(a)2, SHGC criteria of §110.6(a)3 and VT criteria of §110.6(a)4 of the 2019 Energy Standards for Residential and Nonresidential Buildings.

Fenestration and Exterior Door Mandatory Requirements

All buildings § 110.6(a)

Manufactured and site-built

- Certified by NFRC
  - Air leakage (0.3 cfm)
  - U-factor
  - SHGC
  - Visual transmittance
- Exterior doors only require air leakage and U-factor
- No NFRC rating - use CEC default values

Site-built

- NA6 alternate default fenestration procedure
  - Single-family and low-rise multifamily
    - Up to 250 square feet
  - Nonresidential and high-rise multifamily
    - Only skylights up to 200 square feet
- Nonresidential and multifamily meet acceptance requirements in NA7.4

NFRC
National Fenestration Rating Council℠
CERTIFIED

World's Best Door Co.
Entrance Door
CPD#000-x-000
Insulated Steel Wood Edge Door

ENERGY PERFORMANCE RATINGS

Product Description* Default Frame** Wood	U-Factor/Solar Heat Gain Coefficient (SHGC)			
	1/4 Lite <41ft	1/2 Lite <90ft	3/4 Lite <110ft	Full Lite >110ft
2/A1/na/AIR/0.250	0.23 —	0.30 —	0.36 0.33	0.40 0.40
2/A1/.020(3)/ARG/0.750	0.21 —	0.24 —	0.26 0.31	0.28 0.36
2/A1/na/AIR/0.675	0.23 —	0.28 —	0.33 0.34	0.34 0.40
3/SS/na/AIR/0.250	0.21 —	0.25 —	0.27 0.35	0.29 0.40
Flush/Embossed	U-Factor 0.19 SHGC 0.04			

Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information.

* #glazing layers / spacer type / low-e emissivity (surface) / gap fill / gap width (na=not applicable)
**per NFRC 100 Section 83.24 † square inches

www.nfrc.org

Fenestration and Exterior Door Mandatory Requirements

All buildings § 110.6(b)

Field-fabricated

- Must use CEC default values
  - U-factor in Table 110.6-A
  - SHGC in Table 110.6-B
- Exterior doors less than 25% glazing use CEC default values
  - U-factor in JA4.5 Table 4.5.1
- Must be caulked and weather-stripped

Fenestration and Exterior Door Mandatory Requirements

All buildings § 110.6

Methods for determining U-factor and SHGC

	Manufactured Windows	Manufactured Skylights	Manufactured Doors	Site-Built Fenestration and Doors	Field-Fabricated Fenestration and Doors	Glass Block
NFRC	✓	✓	✓	✓	n/a	n/a
NFRC - CMA	✓	✓	✓	✓	n/a	n/a
Default Table 110.6-A, B	✓	✓	n/a	✓	✓	✓
Default Table JA 4.5.1	n/a	n/a	✓	✓	✓	n/a
NA6* – less than 250 ft²	n/a	n/a	n/a	✓	n/a	n/a

Fenestration Default U-factor

All buildings Table 110.6-A

FRAME	PRODUCT TYPE	SINGLE PANE U-FACTOR	DOUBLE PANE U-FACTOR	GLASS BLOCK U-FACTOR
Metal	Operable	1.28	0.79	0.87
Metal	Fixed	1.19	0.71	0.72
Metal	Greenhouse or garden window	2.26	1.40	N.A.
Metal	Glazed doors	1.25	0.77	N.A.
Metal	Skylight	1.98	1.30	N.A.
Metal, thermal break	Operable	N.A.	0.66	N.A.
Metal, thermal break	Fixed	N.A.	0.55	N.A.
Metal, thermal break	Greenhouse or garden window	N.A.	1.12	N.A.
Metal, thermal break	Glazed Doors	N.A.	0.59	N.A.
Metal, thermal break	Skylight	N.A.	1.11	N.A.
Nonmetal	Operable	0.99	0.58	0.60
Nonmetal	Fixed	1.04	0.55	0.57
Nonmetal	Glazed Doors	0.99	0.53	N.A.
Nonmetal	Greenhouse or garden window	1.94	1.06	N.A.
Nonmetal	Skylight	1.47	0.84	N.A.

Fenestration Default SHGC

All buildings Table 110.6-B

FRAME TYPE	PRODUCT	GLAZING	Single Pane SHGC	Double Pane SHGC	Glass Block SHGC
Metal	Operable	Clear	0.80	0.70	0.70
Metal	Fixed	Clear	0.83	0.73	0.73
Metal	Operable	Tinted	0.67	0.59	N.A.
Metal	Fixed	Tinted	0.68	0.60	N.A.
Metal, thermal break	Operable	Clear	N.A.	0.63	N.A.
Metal, thermal break	Fixed	Clear	N.A.	0.69	N.A.
Metal, thermal break	Operable	Tinted	N.A.	0.53	N.A.
Metal, thermal break	Fixed	Tinted	N.A.	0.57	N.A.
Nonmetal	Operable	Clear	0.74	0.65	0.70
Nonmetal	Fixed	Clear	0.76	0.67	0.67
Nonmetal	Operable	Tinted	0.60	0.53	N.A.
Nonmetal	Fixed	Tinted	0.63	0.55	N.A.

Exterior Door Default U-factor

Reference Joint Appendix JA4.5

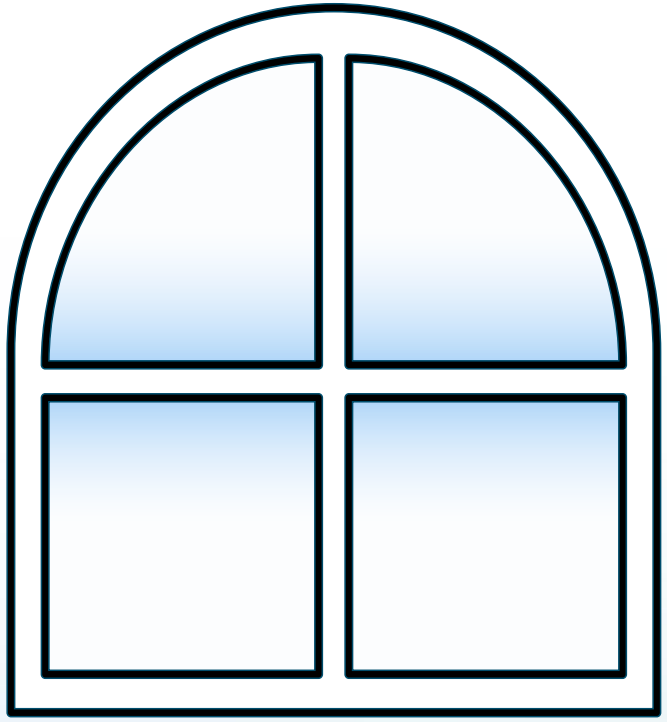
Table 4.5.1 – Doors

Description	U-factor
Uninsulated single-layer metal *swinging doors* or *non-swinging doors*, including single-layer uninsulated access hatches and uninsulated smoke vents:	1.45
Uninsulated double-layer metal *swinging doors* or *non-swinging doors*, including double-layer uninsulated access hatches and uninsulated smoke vents:	0.70
Insulated metal *swinging doors*, including fire-rated *doors*, insulated access hatches, and insulated smoke vents:	0.50
Wood *doors*, minimum nominal thickness of 1-3/4 in. (44 mm), including panel *doors* with minimum panel thickness of 1-1/8 in. (28 mm), and solid core flush *doors*, and hollow core flush *doors*:	0.50
Any other wood *door*:	0.60
Uninsulated single layer metal *roll up doors* including fire rated *door*	1.45
Insulated single layer metal *sectional doors,* minimum insulation nominal thickness of 1-3/8 inch; expanded polystyrene (R-4 per inch).	0.179
Source: ASHRAE 90.1-2007, Section A7.	

Fenestration Mandatory Requirements

Single-family § 150.0(q)

Updated for 2022

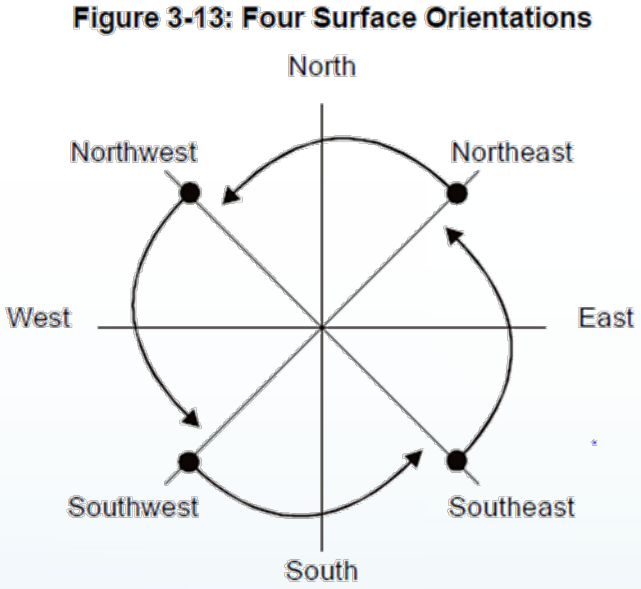


Fenestration products

- Maximum U-factor 0.45
- All climate zones
- Area-weighted average allowed
- Exceptions to U-factor requirement
  - Fenestration area up to 10 square feet or 0.5% of conditioned floor area (CFA)
  - Greenhouse or garden windows up to 30 square feet of fenestration area

Fenestration Prescriptive Requirements

Single-family § 150.1(c)3, Table 150.1-A



Windows, skylights and glazed doors

Per Table 150.1-A

- Maximum U-factor of 0.30
- Maximum SHGC of 0.23
  - No SHGC requirement in climate zones 1, 3, 5, 16
- Total fenestration area 20% maximum
- West-facing fenestration area 5% maximum in climate zones 2, 4, 6-15

Fenestration Prescriptive Requirements

Single-family § 150.1(c)3, Table 150.1-A

Windows, skylights and glazed doors

Exceptions

- No U-factor or SHGC for up to 3 ft^2 in both glazed doors and tubular skylights
- Maximum U-factor of 0.55 and SHGC of 0.30 for up to 16 ft^2 of skylights
- Chromogenic glazing must have controls, cannot be combined in area weighted average with non-chromogenic fenestration
- Unrated site-built may use default tables or NA6 up to 250 ft^2

Fenestration Prescriptive Requirements

Single-family § 150.1(c)4

Shading

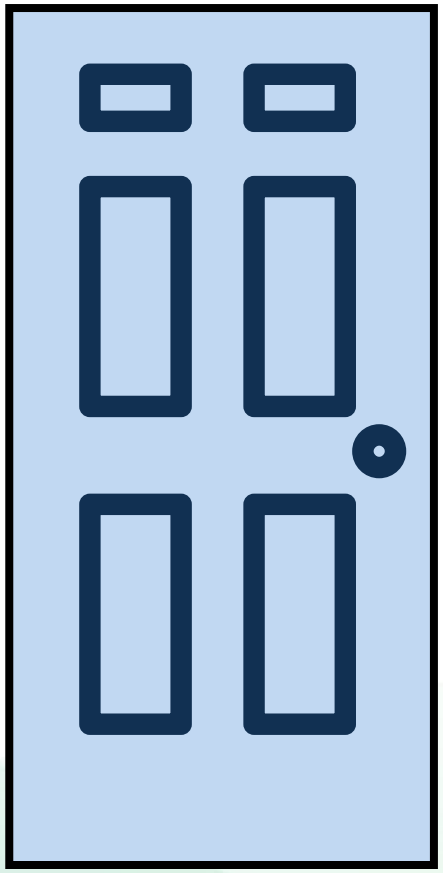
- Either
  - SHGC per § 150.1(c)3A and Table 150.1-A
  - Install exterior operable shading louver or exterior shading device that meets required SHGC
  - Combination of above to achieve same performance as § 150.1(c)3A
- South-facing glazing only: overhangs installed so that south-facing glazing is fully shaded at solar noon on August 21 and substantially exposed to direct sunlight at solar noon on December 21
- Exterior shading devices must be permanently secured with attachments or fasteners that are not intended for removal.
  - Exception: California Building Code (CBC) requires emergency egress or where compliance would conflict with health and safety regulations

Exterior Door Prescriptive Requirements

Single-family § 150.1(c)5, Table 150.1-A

Doors separating conditioned from unconditioned space

- Less than 25% glazed
- Must be NFRC rated and labeled
- Exception: fire protection doors between house and garage
- Per Table 150.1-A
  - Maximum U-factor of 0.20



Fenestration Prescriptive Requirements

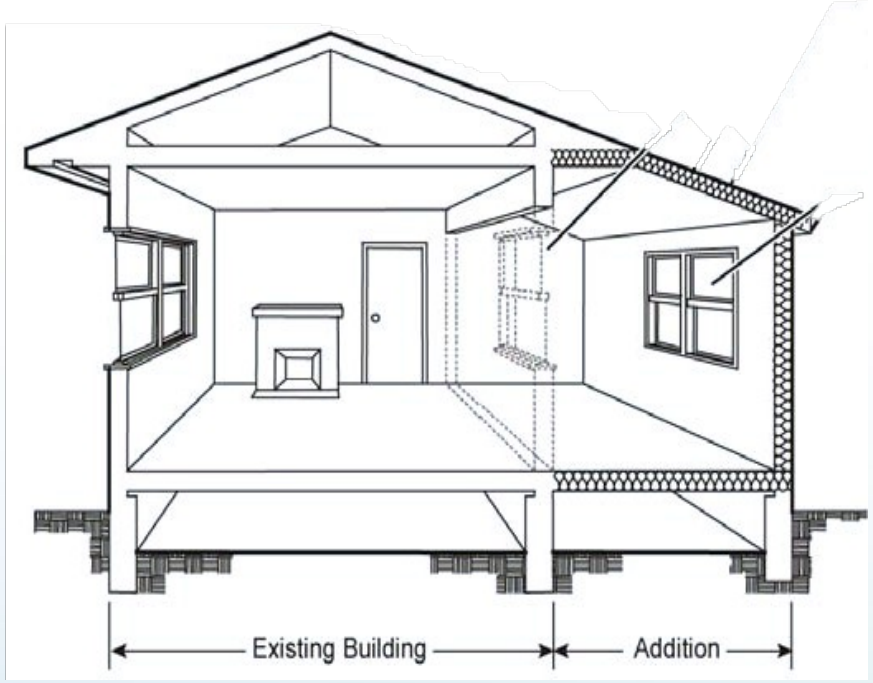
Single-family Table 150.1-A

Climate Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Fenestration Maximum U-factor	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Fenestration Maximum SHGC	NR	0.23	NR	0.23	NR	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	NR
Fenestration Maximum Total Area	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Fenestration Maximum West Facing Area	NR	5%	NR	5%	NR	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	NR
Door Maximum U-factor	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20

Fenestration Prescriptive Requirements

Additions § 150.2(a)1

New windows, skylights, and glazed doors meet § 150.1(c) with modifications



Addition Square Feet	Maximum Total Area Square Feet	Maximum West-Facing Area Square Feet Climate Zones 2, 4, 6-15
Over 700	175 or 20% CFA	70
401 to 700	120 or 25% CFA	60
400 or less	75 or 30% CFA	60

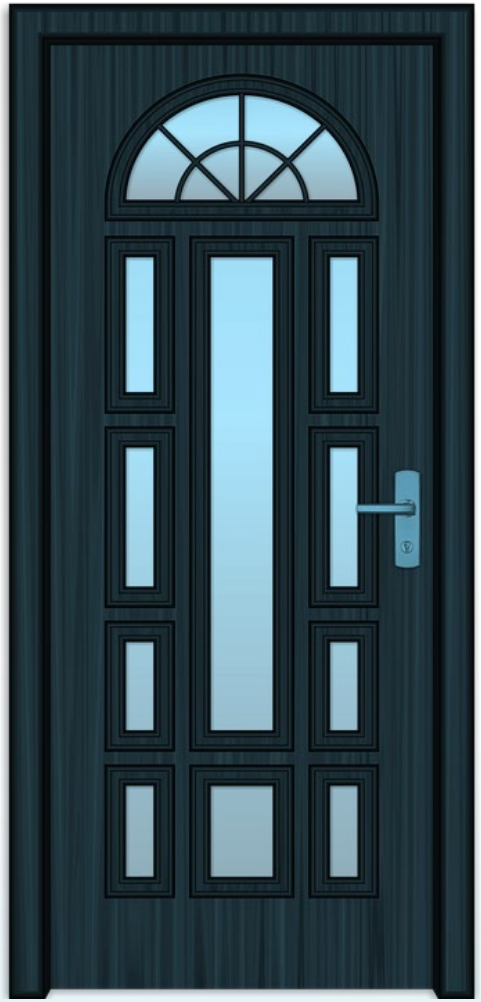
Fenestration Prescriptive Requirements

Alterations § 150.2(b)1A

New windows, skylights, and glazed doors meet § 150.1(c) with modifications

	Square Feet Exempt from Area Requirements	Maximum U-Factor	Maximum SHGC Climate Zones 2, 4, 6-15
Additional Fenestration	Up to 75	0.30	0.23
Replacement Fenestration	Up to 75	0.40	0.35
Additional or Replacement Skylights	Up to 16	0.55	0.30

Test Your Knowledge



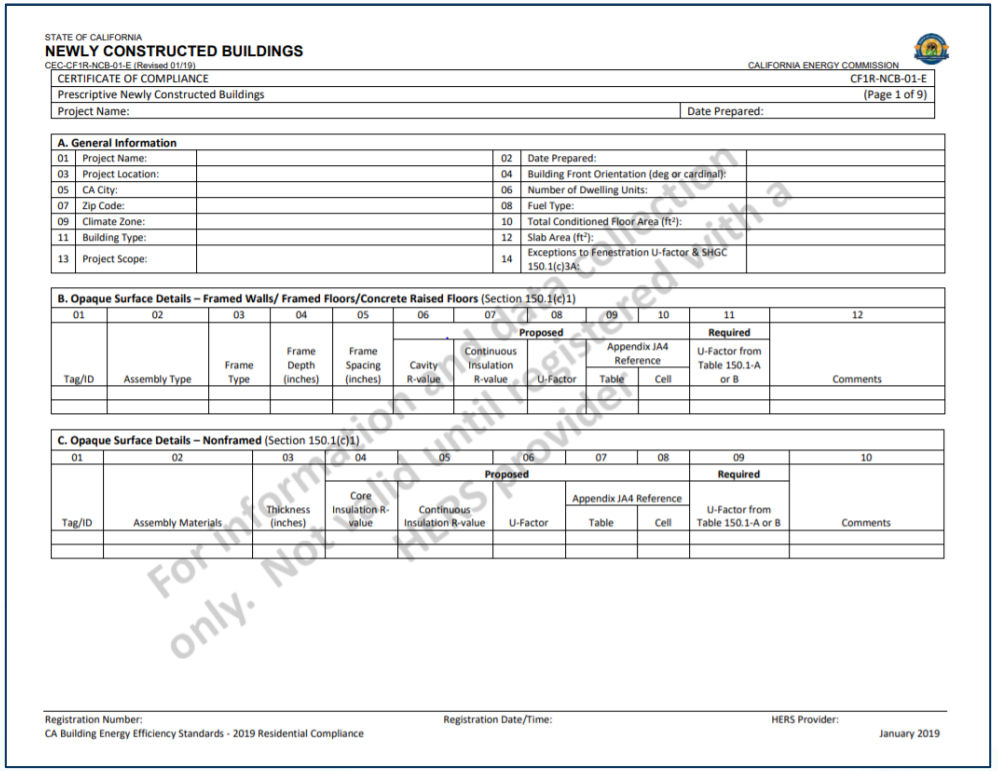
When does an exterior door become fenestration?

When the door has 25% or more glass

- Now considered part of the total fenestration area
- Glass area meets all fenestration requirements
- Solid area meets exterior door requirements

Plans Examiners

- Verify required fenestration values
- Verify required door values
- Verify CF1R values match plans



STATE OF CALIFORNIA
NEWLY CONSTRUCTED BUILDINGS
CEC-CF1R-NCB-01-E (Revised 01/19) — CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE	CF1R-NCB-01-E
Prescriptive Newly Constructed Buildings	(Page 1 of 9)
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 (ft²):	
11	Building Type:		12	Slab Area (ft²):	
13	Project Scope:		14	Exceptions to Fenestration U-factor & SHGC 150.1(c)3A:	

B. Opaque Surface Details – Framed Walls/ Framed Floors/Concrete Raised Floors (Section 150.1(c)1)

01	02	03	04	05	06	07	08	09	10	11	12
					Proposed					Required	
Tag/ID	Assembly Type	Frame Type	Frame Depth (inches)	Frame Spacing (inches)	Cavity R-value	Continuous Insulation R-value	U-Factor	Appendix JA4 Reference: Table	Appendix JA4 Reference: Cell	U-Factor from Table 150.1-A or B	Comments

C. Opaque Surface Details – Nonframed (Section 150.1(c)1)

01	02	03	04	05	06	07	08	09	10
			Proposed					Required	
Tag/ID	Assembly Materials	Thickness (inches)	Core Insulation R-value	Continuous Insulation R-value	U-Factor	Appendix JA4 Reference: Table	Appendix JA4 Reference: Cell	U-Factor from Table 150.1-A or B	Comments

Project Name: Sample ADU - New Construction

Calculation Date/Time: 2023-07-31T12:35:44-07:00

Calculation Description: Sample ADU - New Construction

Input File Name: Sample ADU - New Construction.ribd22

OPAQUE SURFACES

01	02	03	04	05	06	07	08
Name	Zone	Construction	Azimuth	Orientation	Gross Area (ft^2)	Window and Door Area (ft2)	Tilt (deg)
Right Wall	ADU	R-21+R-5 Wall	180	Right	216	64	90
Ceiling Below Attic	ADU	R-38 Ceiling	n/a	n/a	816	n/a	n/a
Floor Over Crawlspace	ADU	R-19 Crawlspace	n/a	n/a	816	n/a	n/a

ATTIC

01	02	03	04	05	06	07	08
Name	Construction	Type	Roof Rise (x in 12)	Roof Reflectance	Roof Emittance	Radiant Barrier	Cool Roof
Attic	Tile Roof +R-19 BRD	Ventilated	5	0.2	0.75	No	Yes

FENESTRATION / GLAZING

01	02	03	04	05	06	07	08	09	10	11	12	13	14
Name	Type	Surface	Orientation	Azimuth	Width (ft)	Height (ft)	Mult.	Area (ft^2)	U-factor	U-factor Source	SHGC	SHGC Source	Exterior Shading
Window 1	Window	Front Wall	Front	270			1	20	0.3	NFRC	0.23	NFRC	Bug Screen
Glazed Door 1	Window	Front Wall	Front	270			1	20	0.53	Table 110.6-A	0.65	Table 110.6-B	Bug Screen
Window 2	Window	Front Wall	Front	270			1	20	0.3	NFRC	0.23	NFRC	Bug Screen
Window 3	Window	Rear Wall	Back	90			1	20	0.3	NFRC	0.23	NFRC	Bug Screen
Window 4	Window	Rear Wall	Back	90			1	4	0.3	NFRC	0.23	NFRC	Bug Screen
Window 5	Window	Rear Wall	Back	90			1	9	0.3	NFRC	0.23	NFRC	Bug Screen
Window 6	Window	Right Wall	Right	180			1	24	0.3	NFRC	0.23	NFRC	Bug Screen
Window 7	Window	Right Wall	Right	180			1	40	0.3	NFRC	0.23	NFRC	Bug Screen

Field Inspectors

At rough frame verify

- Window and skylight values

At final verify

- CF2R installation forms
- Registered with HERS Provider
- Request project status report (PSR)

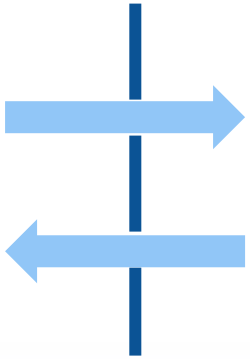
Air Sealing
Single-Family

Mandatory § 110.7

Single-family § 150.1(c)1E

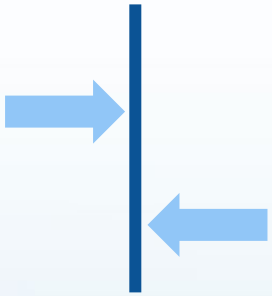
Air Sealing Definitions

All buildings § 100.1



Infiltration - uncontrolled air leakage from outside to inside, through cracks, joints, windows, doors, partitions, or penetrations

Exfiltration - uncontrolled air leakage from inside to outside, through cracks, joints, windows, doors, partitions, or penetrations



Air barrier - a system of materials joined and sealed together to control air flow through the building envelope that separates conditioned from unconditioned space, or that separates adjoining conditioned spaces of different occupancies or uses

Air Sealing Mandatory Requirements

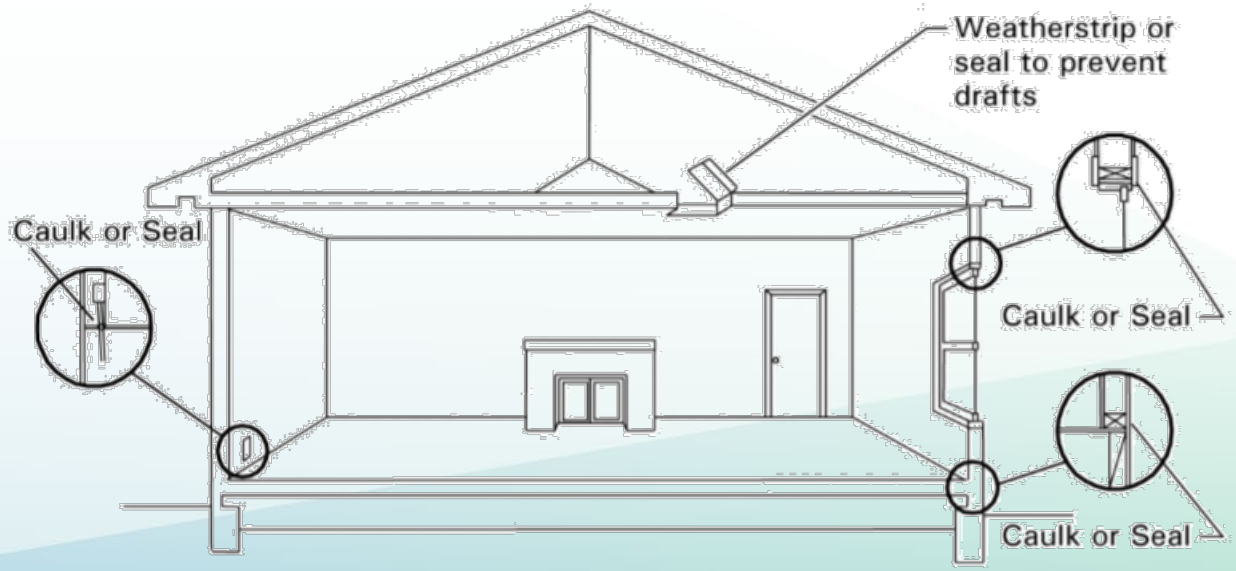
All buildings § 110.7

Most overlooked **MANDATORY** requirement. Major impacts on energy use.

Limit infiltration and exfiltration

- Must caulk, gasket, weather-strip, or seal all joints, penetrations, openings
- New air sealing fact sheet

Figure 3-11: Caulking and Weatherstripping

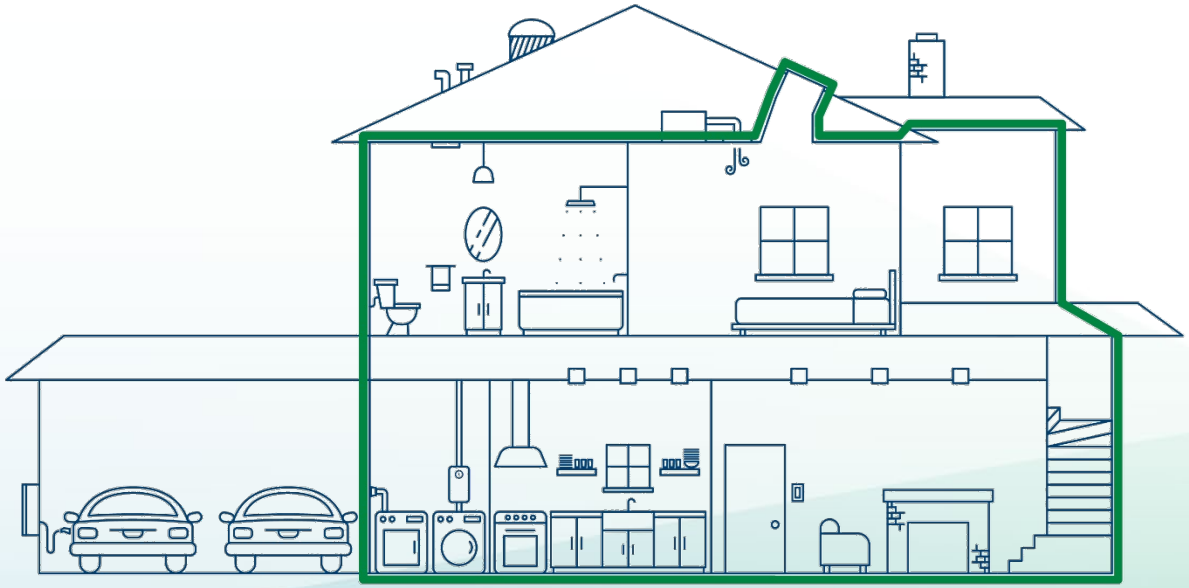


Air Barrier Prescriptive Requirements

Single-family § 150.1(c)1E

Quality insulation installation

- Requires HERS verification of exterior air barrier and installed insulation per Reference Residential Appendix RA3.5



Vapor Retarder

Single-Family

Mandatory § 150.0(g)

Vapor Retarder Definition

All buildings § 100.1

Vapor retarder class - ability of material or assembly to limit the amount of moisture that passes through, meeting CBC Section 202 per ATSM E96

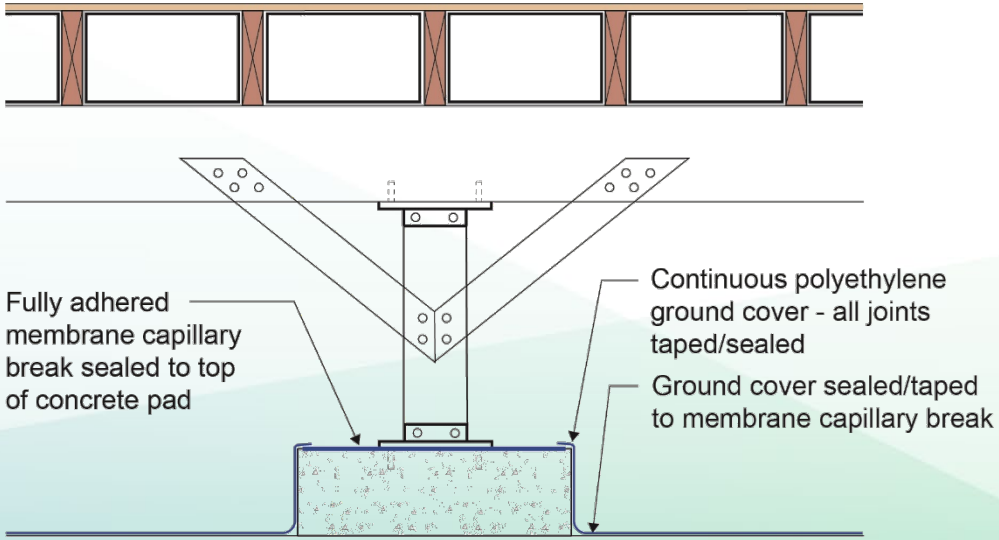
- Class I examples
  - Polyethylene sheet
  - Non-perforated aluminum foil
  - Asphalt roofing shingle
- Class II examples
  - Plywood
  - Kraft-faced insulation batt
  - Roofing felts
- Class III examples
  - Latex paint coat
  - Gypsum board
  - Concrete block

Class	Permeance
Class I	≤ 0.1
Class II	> 0.1 and ≤ 1.0
Class III	< 1.0 and ≤ 10.0

Vapor Retarder Mandatory Requirements

Single-family § 150.0(g)

- Climate zones 14 and 16 Class I or II vapor retarder on conditioned side of insulation
  - Exterior wall
  - Vented attics
  - Unvented attics having air-permeable insulation
- All climate zones Class I or II vapor retarder on-grade
  - Unvented crawl spaces
  - Controlled vent crawl spaces



Radiant Barrier

Single-Family

Mandatory § 110.8(j)

Prescriptive § 150.1(c)2

Radiant Barrier Mandatory Requirements

All buildings §§ 100.1, 110.8(j)

Radiant barrier - highly reflective, low emitting material installed underside of roof deck and inside of gable ends or exterior vertical surfaces in attics to reduce solar heat gain

- Emittance of 0.05 or less
- Tested per ASTM C1371 or E408
- Certified to CA Department of Consumer Affairs

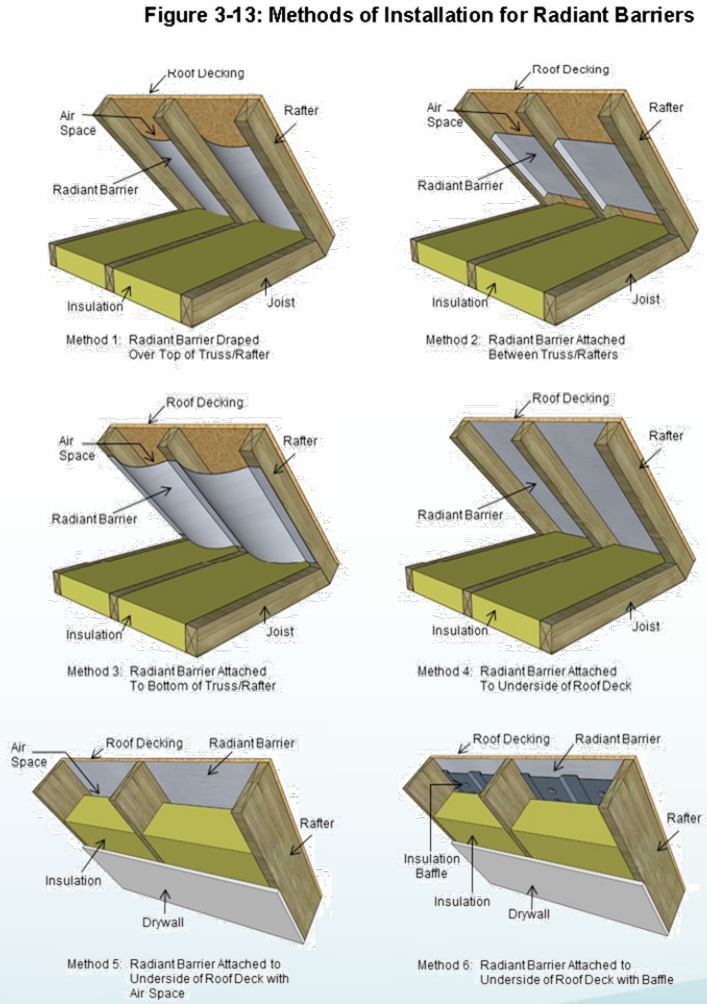
Radiant Barrier Prescriptive Requirements

Single-family § 150.1(c)2

Radiant barrier per Table 150.1-A

- Option B: Climate zones 2-3, 5-7
  - Not required with below roof deck insulation
- Option C: Climate zones 2-15
- Installed per Reference Residential Appendix RA4.2.1
  - Shiny side facing attic
  - On gable ends
  - Minimum free ventilation area

Test Your Knowledge



Should insulation be installed against the radiant barrier?

No, per RA4.2 radiant barriers require an airspace to be effective and provide maximum benefits.

- Table 150.1-A does not require radiant barrier when there is insulation under the roof deck

Insulation
Single-Family

Mandatory §§ 110.8(a-d,g-h), 150.0(a-d,f)

Prescriptive § 150.1(c)1-2

Alterations § 150.2(a)1

Insulation Definitions

All buildings § 100.1

U-factor - a measure of the heat transmission through a wall, roof, floor (all materials in assembly), or a given thickness of a material (insulation)

R-value - capacity of an insulating material to resist heat flow

Lower U-factor is better

Higher R-value is better

Insulation Mandatory Requirements

All buildings § 110.8(a-c, h)

All materials

- Certified to Standards for Insulation Materials (Title 24, Part 12) by the California Department of Consumer Affairs, Bureau of Household Goods and Services
- Restricts use of formaldehyde foam
- Must have fire-retardant on exposed surfaces and be installed according to California Building Code

Wet insulation systems above roofs waterproof membrane

- Meet effective R-value in JA4.2

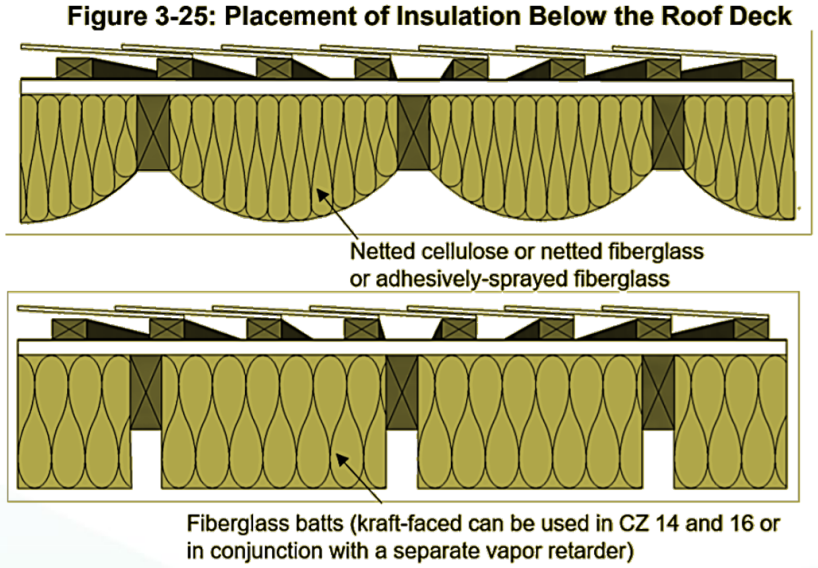
Insulation Roof and Ceiling Mandatory Requirements

Single-family § 150.0(a)1

New for 2022

Roof deck insulation

- Adds roof deck insulation to mandatory requirement
- Climate zones 4 and 8-16
- Maximum U-factor 0.184
- Exceptions:
  - Ducts and air handler located entirely in conditioned space
  - Air handler in unconditioned space with 12 feet or less of supply duct in unconditioned space



Insulation Roof and Ceiling Mandatory Requirements

Single-family § 150.0(a)2-4

Ceiling and rafter roofs

- Maximum U-factor of 0.043
- Minimum R-22 insulation in wood frame
  - Vented attic: installed at ceiling
  - Unvented attic: installed at ceiling or roof
- Attic access door: insulation permanently attached
- Insulation in direct contact with air barrier

Insulation Roof and Ceiling Mandatory Requirements

Single-family § 150.0(b)

Loose-fill insulation

- Minimum installed weight per square foot to meet manufacturer's requirements
- Note: depth rulers alone are not sufficient to determine R-value

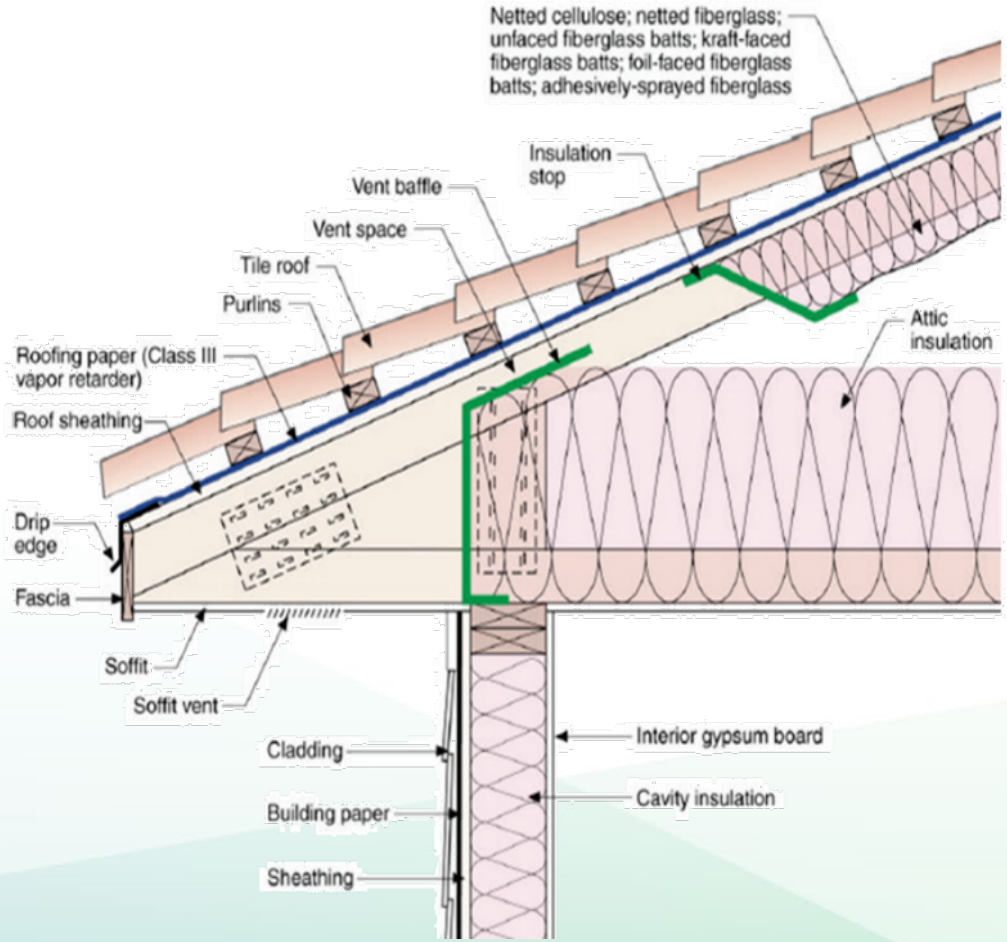
Insulation Roof and Ceiling Prescriptive Requirements

Single-family § 150.1(c)1A

Roof and ceiling insulation

Option B - Table 150.1-A

- Vented attic
- Below roof deck insulation
  - R-19 climate zones 4, 8-16
  - Roof assembly air space required
- Ceiling insulation
  - R-30 climate zones 3, 5-7
  - R-38 climate zones 1-2, 4, 8-16
- Radiant barrier
  - Climate zones 2-3, 5-7



Insulation Roof and Ceiling Prescriptive Requirements

Single-family § 150.1(c)1A

Roof and ceiling insulation

Option C - Table 150.1-A

- Ducts located in conditioned space
- Meet § 150.1(c)9B with HERS verification
- Ceiling insulation
  - R-38 climate zones 1, 11-16
  - R-30 climate zones 2-10
- Radiant barrier
  - Climate zones 2-15

Insulation Roof and Ceiling Prescriptive Requirements

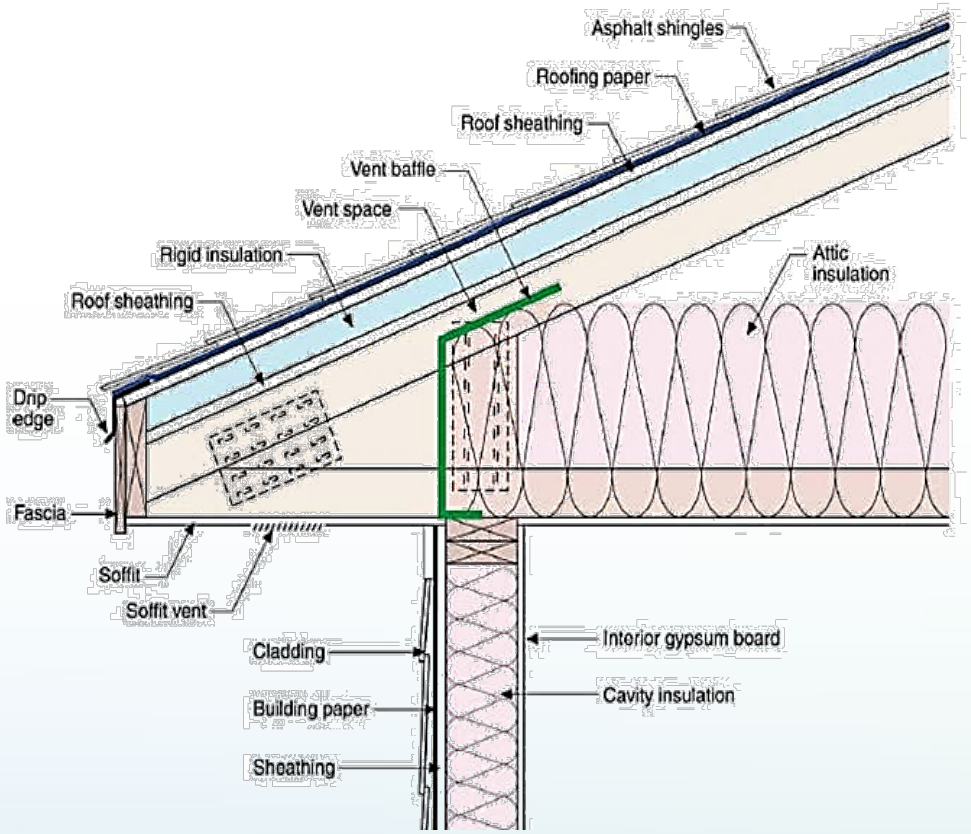
Single-family Table 150.1-A

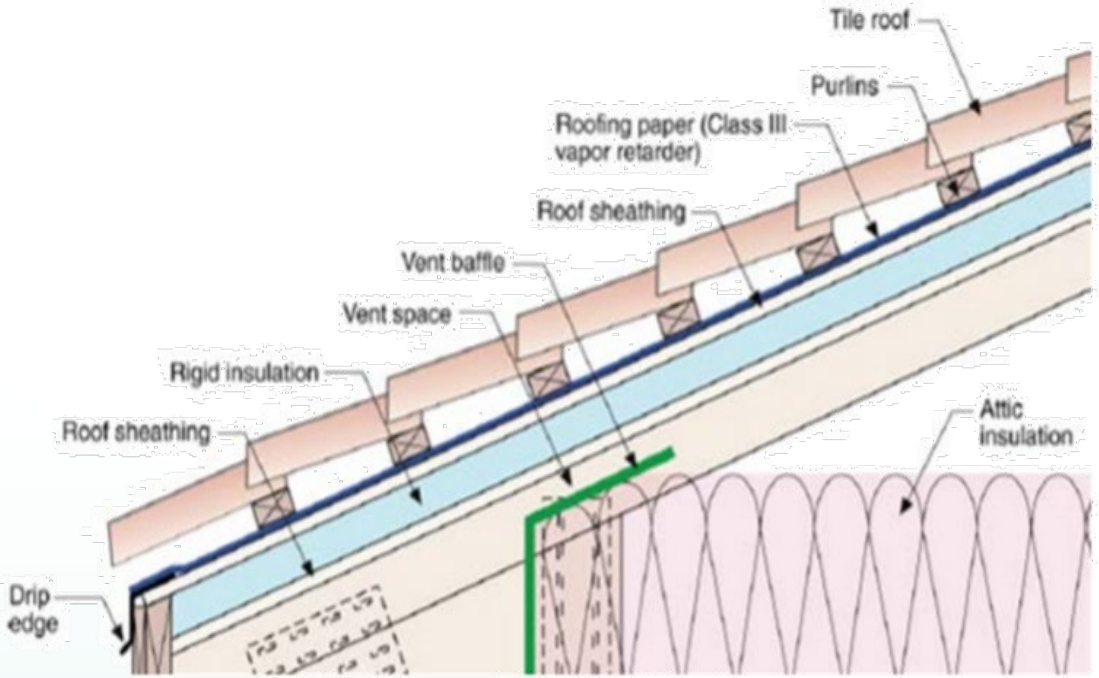
- Roof and celling insulation

	Climate Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Option B §150.1(c)9A	Below Roof Deck Insulation[1,2] (With Air Space)	NR	NR	NR	R19	NR	NR	NR	R19	R19	R19	R19	R19	R19	R19	R19	R19
Option B §150.1(c)9A	Ceiling Insulation	R38	R38	R30	R38	R30	R30	R30	R38	R38	R38	R38	R38	R38	R38	R38	R38
Option B §150.1(c)9A	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	R38	R30	R30	R30	R30	R30	R30	R30	R30	R30	R38	R38	R38	R38	R38	R38
Option C §150.1(c)9B	Radiant Barrier	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR

Insulation Roof and Ceiling Performance

Single-family Compliance Manual





Insulation Roof and Ceiling Performance

Single-family Compliance Manual

Figure 3-44: Standard Truss vs. Raised Heel Energy Truss

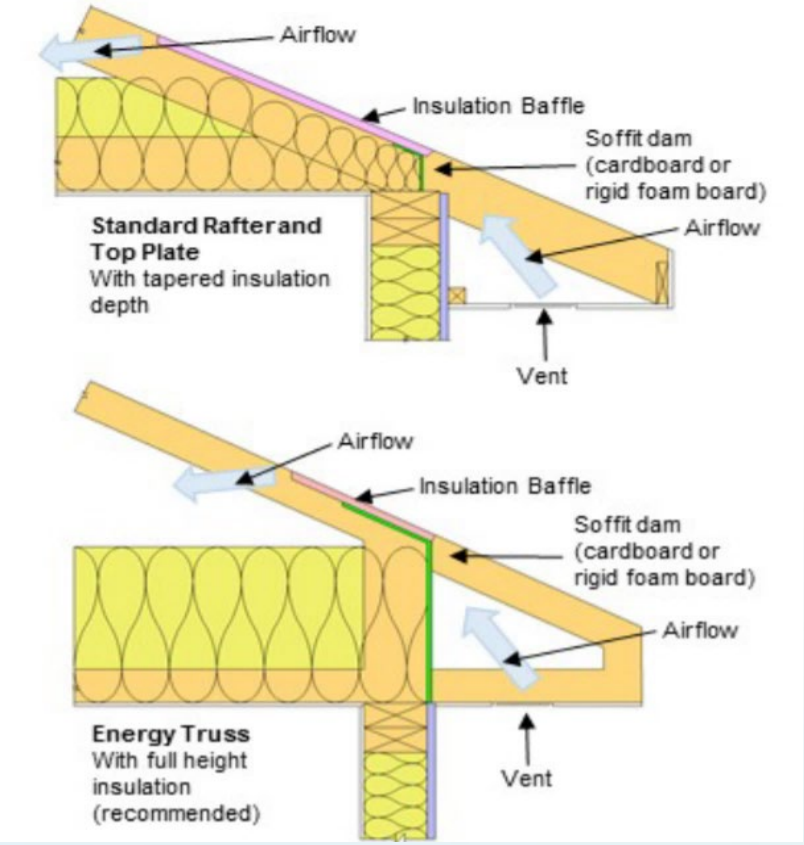
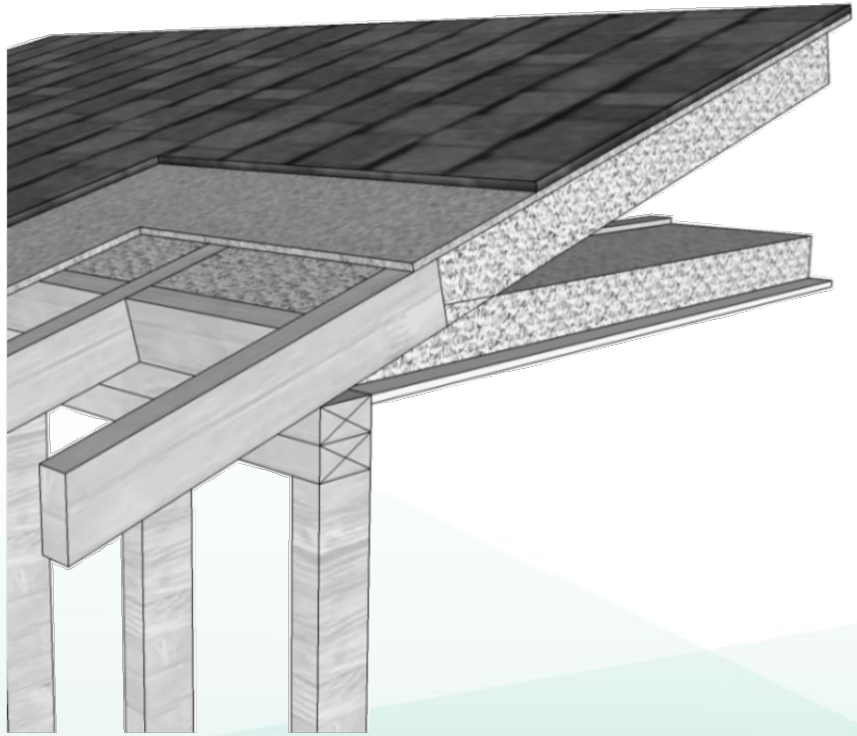


Figure 3-35: Unvented Attic Assembly With Insulation at the Ceiling and Between the Roof Rafters

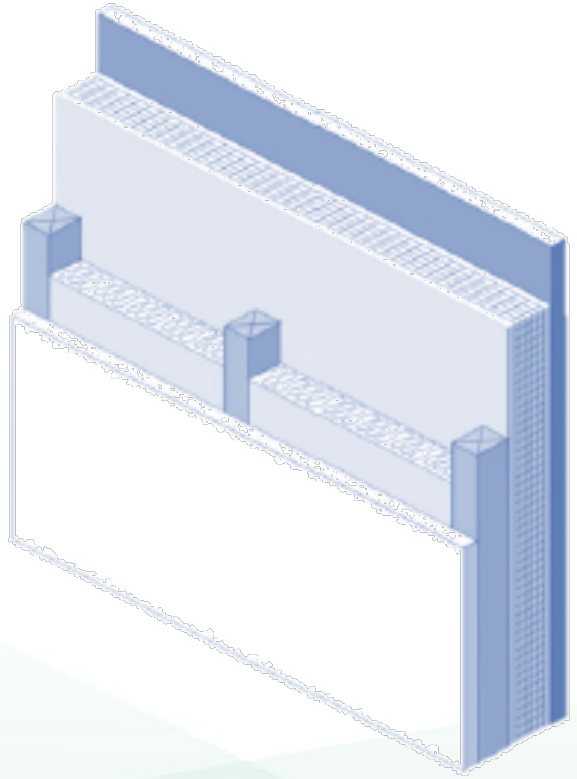


Insulation Walls Mandatory Requirements

Single-family § 150.0(c)

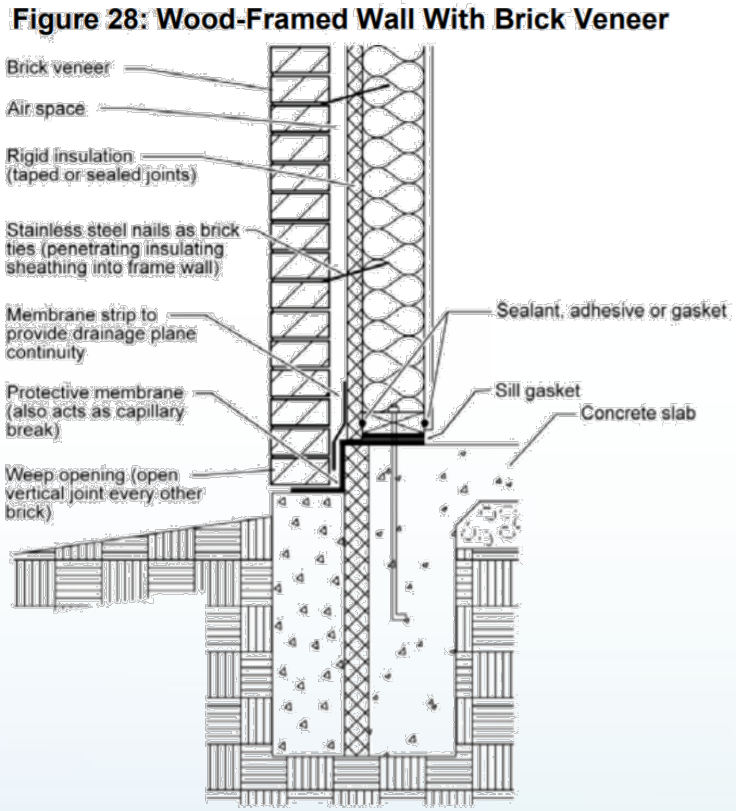
Wall insulation

- 2x4 walls assembly U-factor 0.102
- 2x6 walls assembly U-factor of 0.071
- Opaque non-framed assembly U-factor 0.102
- Masonry walls must meet prescriptive requirements (no trade-offs)
  - Climate zones 1-15, above grade
    - Interior insulation – U-factor 0.077
    - Exterior insulation – U-factor 0.125
  - Climate zone 16, above grade
    - Interior insulation – U-factor 0.059
    - Exterior insulation – U-factor 0.077



Insulation Walls Prescriptive Requirements

Single-family § 150.1(c)1B, Table 150.1-A



Wall insulation per Table 150.1-A

- Climate zones 1-5, 8-16 framed
  - Single family U-factor 0.048
    - 2x6 wood frame with R-21 plus R-5
- Climate zones 6-7 framed
  - U-factor 0.065
    - 2x4 wood frame with R-15 plus R-4
- Mass walls above and below grade must be insulated
- All other unframed walls meet framed U-factors

Insulation Walls Prescriptive Requirements

Single-family Table 150.1-A

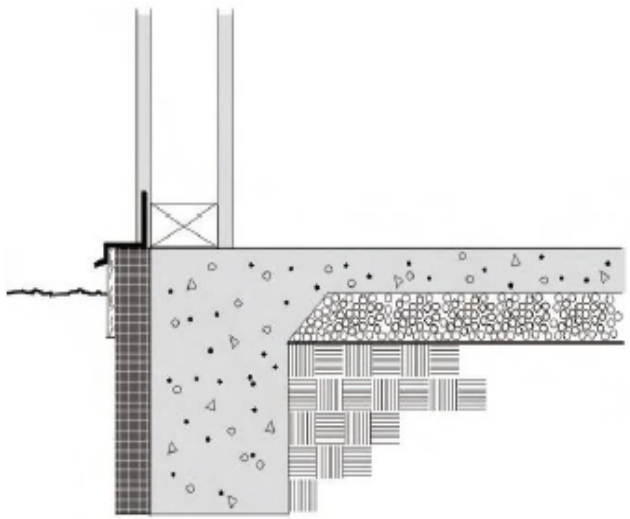
- Wall insulation

Climate Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Above Grade Framed[3]	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048	U 0.065	U 0.065	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048	U 0.048
Above Grade Mass Wall Interior[4,5]	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.059 R17
Above Grade Mass Wall Exterior[4,5]	U 0.125 R8	U 0.125 R8	U 0.125 R8	U 0.125 R8	U 0.125 R8	U 0.125 R8	U 0.125 R8	U 0.125 R8	U 0.125 R8	U 0.125 R8	U 0.125 R8	U 0.125 R8	U 0.125 R8	U 0.125 R8	U 0.125 R8	U 0.077 R13
Below Grade Interior[6]	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.077 R13	U 0.067 R15
Below Grade Exterior[6]	U 0.200 R5	U 0.200 R5	U 0.200 R5	U 0.200 R5	U 0.200 R5	U 0.200 R5	U 0.200 R5	U 0.200 R5	U 0.200 R5	U 0.200 R5	U 0.200 R5	U 0.200 R5	U 0.200 R5	U 0.100 R10	U 0.100 R10	U 0.053 R19

Insulation Floors Mandatory Requirements

All buildings § 110.8(g)

Figure 3-6: Perimeter Slab Insulation



Heated slab floors

- Meet requirements in Table 110.8-A for R-value and climate zone
- Must be certified per § 110.8(a)
- Water absorption rate maximum 0.3%
- Vapor permeable maximum 2.0 perm per inch
- Protect exposed material to wind, equipment, moisture and UV
- Rigid plate to prevent intrusion of insects into foundation
- Direct contact with slab and grade

Insulation Floors Mandatory Requirements

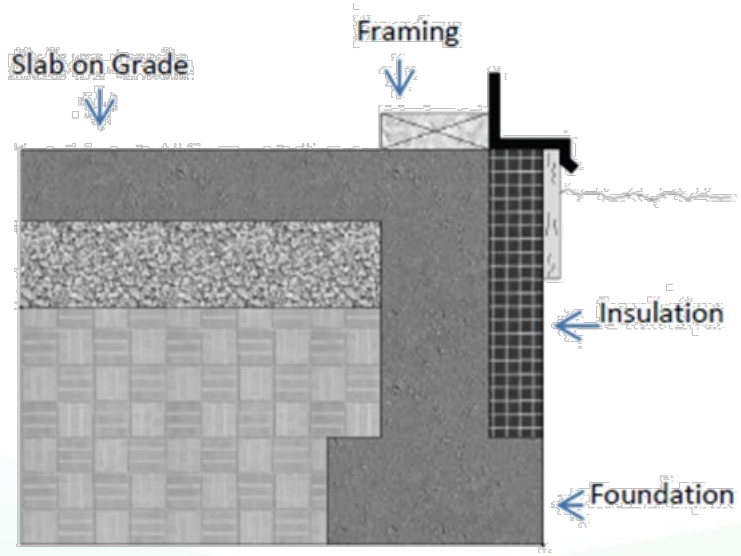
Single-family § 150.0(d, f)

Raised floors

- Maximum assembly U-factor of 0.037
- Minimum R-19 insulation in wood frame

Slab edge insulation

- When required (heated slab and climate zone 16)
  - Water absorption
  - Water vapor permeance
  - Protection from UV & physical damage



Insulation Floors Prescriptive Requirements

Single-family § 150.1(c)1C-D, Table 150.1-A

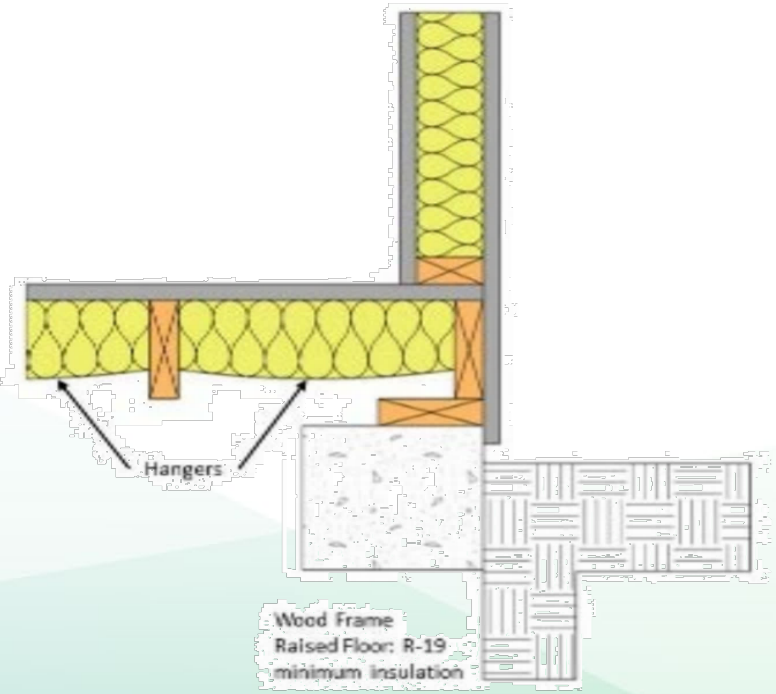
Raised floors

- Framed raised
  - Assembly U-factor 0.037
  - Minimum R-19 wood framed
- Concrete raised
  - Climate zones 1-2, 11, 13-14, 16 U-factor 0.092
  - Climate zones 3-10 U-factor 0.269
  - Climate zones 12, 15 U-factor 0.138

Slab perimeter

- Climate zone 16
  - Maximum assembly U-factor of 0.58
  - Minimum R-7 continuous insulation

Figure 3-30: Raised Floor Insulation



Insulation Floors and QII Prescriptive Requirements

Single-family Table 150.1-A

- Floor insulation and QII

Climate Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Slab Perimeter	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	U 0.58 R 7.0
Raised	U 0.037 R19	U 0.037 R19	U 0.037 R19	U 0.037 R19	U 0.037 R19	U 0.037 R19	U 0.037 R19	U 0.037 R19	U 0.037 R19	U 0.037 R19	U 0.037 R19	U 0.037 R19	U 0.037 R19	U 0.037 R19	U 0.037 R19	U 0.037 R19
Concrete Raised	U 0.092 R8	U 0.092 R8	U 0.269 R0	U 0.269 R0	U 0.269 R0	U 0.269 R0	U 0.269 R0	U 0.269 R0	U 0.269 R0	U 0.269 R0	U 0.092 R8	U 0.138 R4	U 0.092 R8	U 0.092 R8	U 0.138 R4	U 0.092 R8
Quality Insulation Installation (QII)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Quality Insulation Installation Prescriptive Requirements

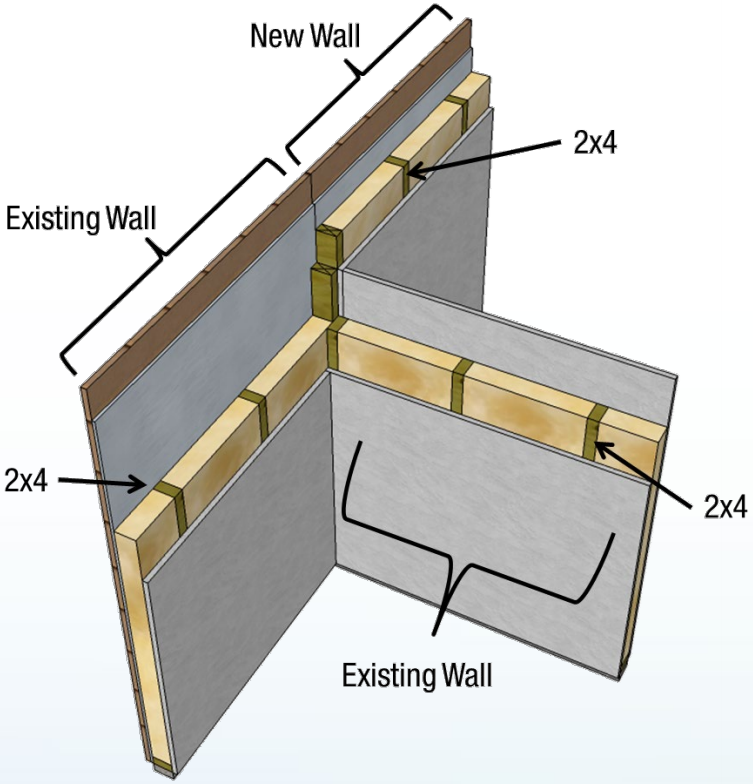
Single-family § 150.1(c)1E

Quality insulation installation

- Requires HERS verification of exterior air barrier and installed insulation
- Meet criteria in Reference Residential Appendix RA3.5

Insulation Additions Prescriptive Requirements

Single-family §150.2(a)1



All additions

- Wall extensions, and walls where existing siding is unaltered
  - R-21 in 2x6 wood-framed, no continuous
  - R-15 in 2x4 wood-framed, no continuous
  - QII exceptions
    - No insulated headers for existing doors and windows
    - No air sealing if existing air barrier not altered

Additions ≤ 700 square feet

- Ceiling insulation
  - R-38 in climate zones 1,11-16
  - R-30 in climate zones 2-10
  - Radiant barrier in climate zones 2-15
  - Exception: R-22 allowed in rafter roofs
- QII not required

Insulation Additions Prescriptive Requirements

Single-family § 150.2(a)1B

Updated for 2022

Roof and ceiling insulation

- Revises attic insulation for additions 700 square feet or less
  - Climate zones 1, 2, 4, 8-16
    - Overall assembly U-factor 0.025
    - Wood framed R-38 or greater
  - Climate zones 3, 5-7
    - Overall assembly U-factor 0.031
    - Wood framed R-30 or greater

Insulation Alterations Mandatory Requirements

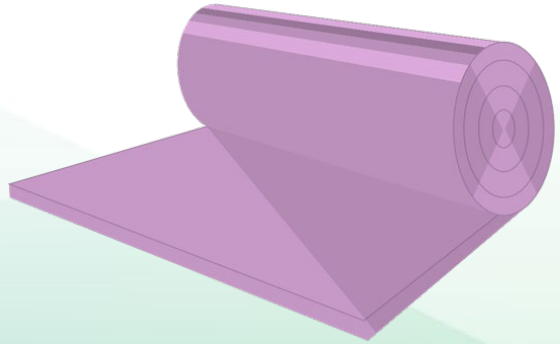
Single-family §§ 110.8(d)1, 150.0(a-d), 150.2(b)

Ceiling and roof insulation

- R-value of new insulation and existing insulation can be combined
- If attic space is too small to meet required R-value
  - Must fill entire space (compliant with Part 2, § 1203.2)
- Meet mandatory requirements in § 150.0(a-b)
  - Exception to § 150.0(a)2: meet U-factor 0.054 or R-19
- Meet § 150.2(b)1I-J where applicable

Wall and floor insulation

- Meet mandatory requirements in § 150.0(c-d)



Insulation Alterations Prescriptive Requirements

Single-family § 150.2(b)1Iiib

New for 2022

Roof replacements of 50% or more

- Adds above deck roof insulation for low-sloped roofs
  - Climate zones 1, 2, 4, 8-16
    - R-14 or U-factor 0.039
  - Several exceptions

Table 150.2-C Insulation Requirements For Roof Alterations

Climate Zone	Continuous Insulation R-value	Roof Assembly U-factor
3, 5-7	NR	NR
1, 2, 4, 8-16	R-14	0.039

Insulation Alterations Prescriptive Requirements

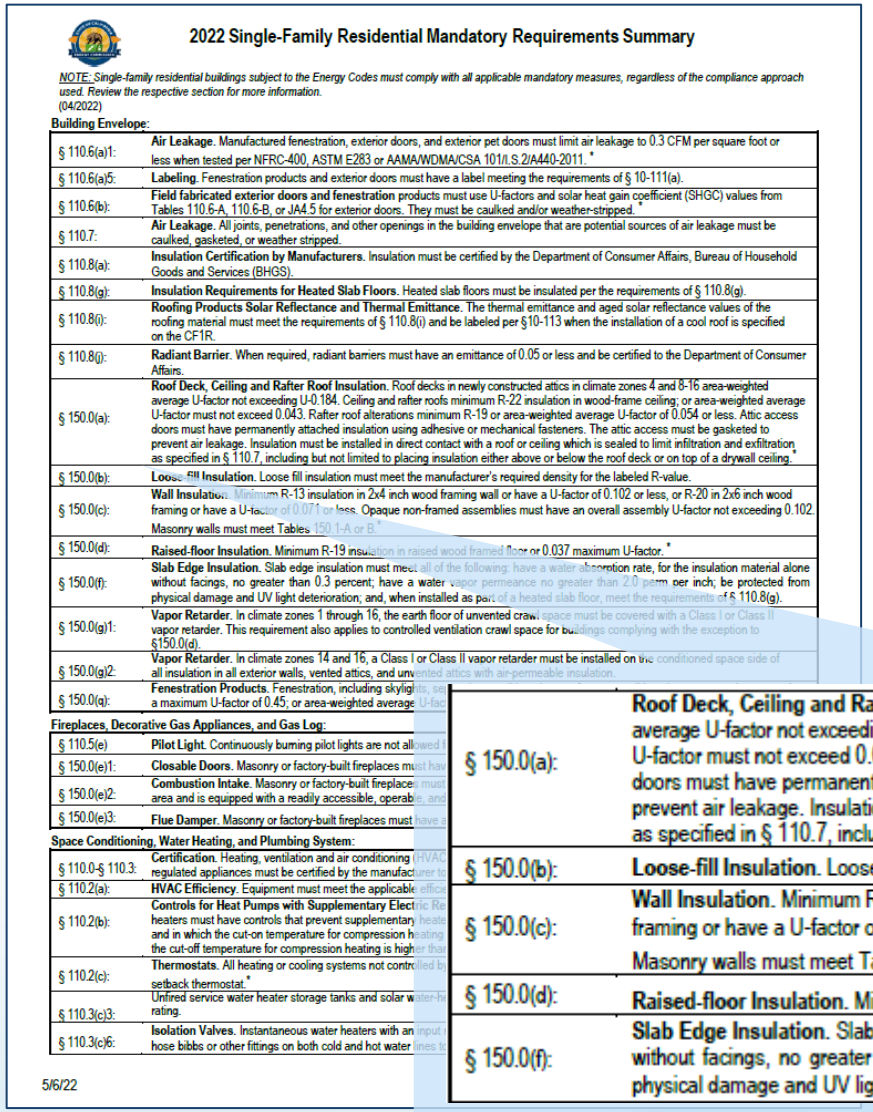
Single-family § 150.2(b)1J

New for 2022

Adds insulation for vented attics

- Attic ceiling alterations or entirely new ducts or complete replacement per § 150.2(b)1Diia
  - Climate zones 1-4, 6, 8-16 assembly U-factor 0.020 or R-49
    - Exception: climate zones 1, 3, 6 with existing R-19
  - Air seal all accessible areas of ceiling in climate zones 2, 4, 8-16
    - Exception: existing R-19
  - Recessed luminaires must be insulated in climate zones 1-4, 8-16
    - IC rated or fire-proof cover
    - Exception: climate zones 1-4, 8-10 with existing R-19
  - Attic ventilation comply per CBC requirements
- Additional exceptions
  - R-38 existing insulation installed at ceiling
  - Alteration would disturbance asbestos
  - Knob and tube wiring located in attic
  - Accessible attic space not large enough to accommodate R-value, entire accessible space shall be filled with insulation and comply with § 806.3 of Title 24, Part 2.5.
  - Attic space above altered dwelling unit is shared with other dwelling units and §150.2(b)1J not triggered for other dwelling units

Test Your Understanding



2022 Single-Family Residential Mandatory Requirements Summary

NOTE: Single-family residential buildings subject to the Energy Codes must comply with all applicable mandatory measures, regardless of the compliance approach used. Review the respective section for more information.
(04/2022)

Building Envelope:

§ 110.6(a)1:	**Air Leakage**. Manufactured fenestration, exterior doors, and exterior pet doors must limit air leakage to 0.3 CFM per square foot or less when tested per NFRC-400, ASTM E283 or AAMA/WDMA/CSA 101/I.S.2/A440-2011.*
§ 110.6(a)5:	**Labeling**. Fenestration products and exterior doors must have a label meeting the requirements of § 10-111(a).
§ 110.6(b):	**Field fabricated exterior doors and fenestration** products must use U-factors and solar heat gain coefficient (SHGC) values from Tables 110.6-A, 110.6-B, or JA4.5 for exterior doors. They must be caulked and/or weather-stripped.*
§ 110.7:	**Air Leakage**. All joints, penetrations, and other openings in the building envelope that are potential sources of air leakage must be caulked, gasketed, or weather stripped.
§ 110.8(a):	**Insulation Certification by Manufacturers**. Insulation must be certified by the Department of Consumer Affairs, Bureau of Household Goods and Services (BHGS).
§ 110.8(g):	**Insulation Requirements for Heated Slab Floors**. Heated slab floors must be insulated per the requirements of § 110.8(g).
§ 110.8(i):	**Roofing Products Solar Reflectance and Thermal Emittance**. The thermal emittance and aged solar reflectance values of the roofing material must meet the requirements of § 110.8(i) and be labeled per §10-113 when the installation of a cool roof is specified on the CF1R.
§ 110.8(j):	**Radiant Barrier**. When required, radiant barriers must have an emittance of 0.05 or less and be certified to the Department of Consumer Affairs.
§ 150.0(a):	**Roof Deck, Ceiling and Rafter Roof Insulation**. Roof decks in newly constructed attics in climate zones 4 and 8-16 area-weighted average U-factor not exceeding U-0.184. Ceiling and rafter roofs minimum R-22 insulation in wood-frame ceiling; or area-weighted average U-factor must not exceed 0.043. Rafter roof alterations minimum R-19 or area-weighted average U-factor of 0.054 or less. Attic access doors must have permanently attached insulation using adhesive or mechanical fasteners. The attic access must be gasketed to prevent air leakage. Insulation must be installed in direct contact with a roof or ceiling which is sealed to limit infiltration and exfiltration as specified in § 110.7, including but not limited to placing insulation either above or below the roof deck or on top of a drywall ceiling.*
§ 150.0(b):	**Loose-fill Insulation**. Loose fill insulation must meet the manufacturer's required density for the labeled R-value.
§ 150.0(c):	**Wall Insulation**. Minimum R-13 insulation in 2x4 inch wood framing wall or have a U-factor of 0.102 or less, or R-20 in 2x6 inch wood framing or have a U-factor of 0.071 or less. Opaque non-framed assemblies must have an overall assembly U-factor not exceeding 0.102. Masonry walls must meet Tables 150.1-A or B.*
§ 150.0(d):	**Raised-floor Insulation**. Minimum R-19 insulation in raised wood framed floor or 0.037 maximum U-factor.*
§ 150.0(f):	**Slab Edge Insulation**. Slab edge insulation must meet all of the following: have a water absorption rate, for the insulation material alone without facings, no greater than 0.3 percent; have a water vapor permeance no greater than 2.0 perm per inch; be protected from physical damage and UV light deterioration; and, when installed as part of a heated slab floor, meet the requirements of § 110.8(g).
§ 150.0(g)1:	**Vapor Retarder**. In climate zones 1 through 16, the earth floor of unvented crawl space must be covered with a Class I or Class II vapor retarder. This requirement also applies to controlled ventilation crawl space for buildings complying with the exception to §150.0(d).
§ 150.0(g)2:	**Vapor Retarder**. In climate zones 14 and 16, a Class I or Class II vapor retarder must be installed on the conditioned space side of all insulation in all exterior walls, vented attics, and unvented attics with air-permeable insulation.
§ 150.0(q):	**Fenestration Products**. Fenestration, including skylights, se... a maximum U-factor of 0.45; or area-weighted average U-fac...

Fireplaces, Decorative Gas Appliances, and Gas Log:

§ 110.5(e)	**Pilot Light**. Continuously burning pilot lights are not allowed ...
§ 150.0(e)1:	**Closable Doors**. Masonry or factory-built fireplaces must hav...
§ 150.0(e)2:	**Combustion Intake**. Masonry or factory-built fireplaces must ... area and is equipped with a readily accessible, operable, and ...
§ 150.0(e)3:	**Flue Damper**. Masonry or factory-built fireplaces must have a ...

Space Conditioning, Water Heating, and Plumbing System:

§ 110.0-§ 110.3:	**Certification**. Heating, ventilation and air conditioning (HVAC) ... regulated appliances must be certified by the manufacturer to ...
§ 110.2(a):	**HVAC Efficiency**. Equipment must meet the applicable effic...
§ 110.2(b):	**Controls for Heat Pumps with Supplementary Electric Re...** heaters must have controls that prevent supplementary heater... and in which the cut-on temperature for compression heating... the cut-off temperature for compression heating is higher than...
§ 110.2(c):	**Thermostats**. All heating or cooling systems not controlled b... setback thermostat.*
§ 110.3(c)3:	Unfired service water heater storage tanks and solar water-h... rating.
§ 110.3(c)6:	**Isolation Valves**. Instantaneous water heaters with an input ... hose bibbs or other fittings on both cold and hot water lines to...

5/6/22

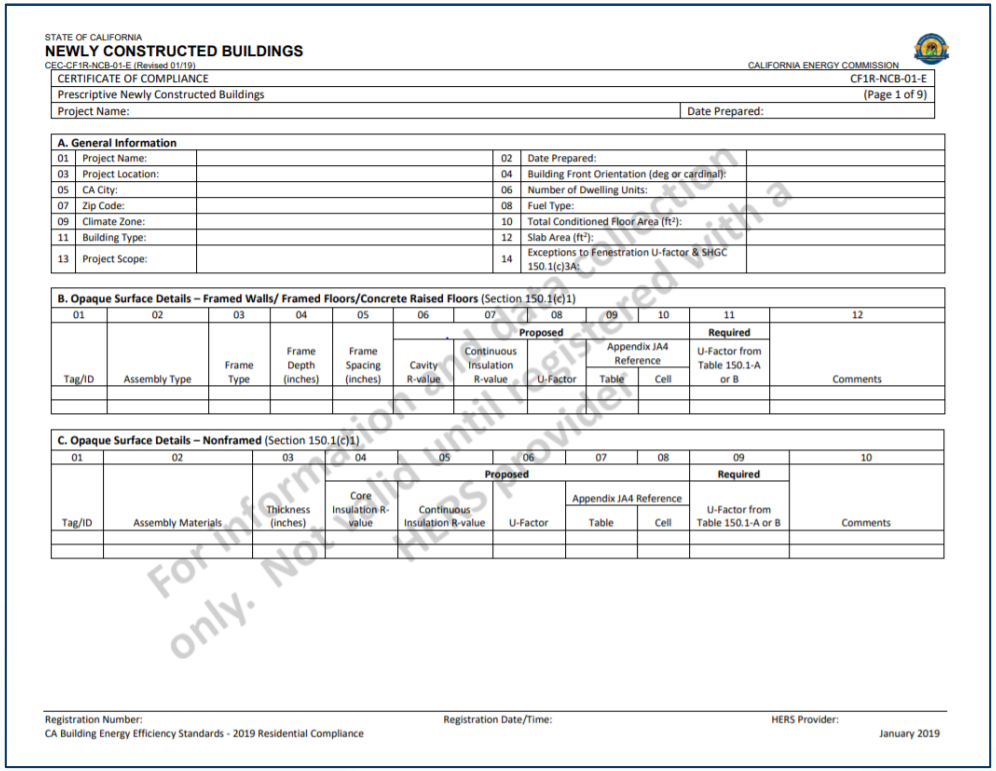
§ 150.0(a):	**Roof Deck, Ceiling and Rafter Roof Insulation**. Roof decks in newly constructed attics in climate zones 4 and 8-16 area-weighted average U-factor not exceeding U-0.184. Ceiling and rafter roofs minimum R-22 insulation in wood-frame ceiling; or area-weighted average U-factor must not exceed 0.043. Rafter roof alterations minimum R-19 or area-weighted average U-factor of 0.054 or less. Attic access doors must have permanently attached insulation using adhesive or mechanical fasteners. The attic access must be gasketed to prevent air leakage. Insulation must be installed in direct contact with a roof or ceiling which is sealed to limit infiltration and exfiltration as specified in § 110.7, including but not limited to placing insulation either above or below the roof deck or on top of a drywall ceiling.*
§ 150.0(b):	**Loose-fill Insulation**. Loose fill insulation must meet the manufacturer's required density for the labeled R-value.
§ 150.0(c):	**Wall Insulation**. Minimum R-13 insulation in 2x4 inch wood framing wall or have a U-factor of 0.102 or less, or R-20 in 2x6 inch wood framing or have a U-factor of 0.071 or less. Opaque non-framed assemblies must have an overall assembly U-factor not exceeding 0.102. Masonry walls must meet Tables 150.1-A or B.*
§ 150.0(d):	**Raised-floor Insulation**. Minimum R-19 insulation in raised wood framed floor or 0.037 maximum U-factor.*
§ 150.0(f):	**Slab Edge Insulation**. Slab edge insulation must meet all of the following: have a water absorption rate, for the insulation material alone without facings, no greater than 0.3 percent; have a water vapor permeance no greater than 2.0 perm per inch; be protected from physical damage and UV light deterioration; and, when installed as part of a heated slab floor, meet the requirements of § 110.8(g).

Are there mandatory insulation requirements for single-family?

- Yes. When using performance method, must still meet mandatory minimum assembly U-factors
  - Modeling software will not flag when lower than the mandatory
  - Mandatory requirements summary may be included on plans

Plans Examiners

- Verify required insulation values
  - Mandatory assembly U-factors
- Verify QII with HERS verification
- Verify CF1R values match plans
- Penalized if R-values are less, U-factors are more, or no QII



STATE OF CALIFORNIA
NEWLY CONSTRUCTED BUILDINGS
CEC-CF1R-NCB-01-E (Revised 01/19) — CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE	CF1R-NCB-01-E
Prescriptive Newly Constructed Buildings	(Page 1 of 9)
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 (ft²):		
11	Building Type:	12	Slab Area (ft²):		
13	Project Scope:	14	Exceptions to Fenestration U-factor & SHGC 150.1(c)3A:		

B. Opaque Surface Details – Framed Walls/ Framed Floors/Concrete Raised Floors (Section 150.1(c)1)

01	02	03	04	05	06	07	08	09	10	11	12
					Proposed					Required	
Tag/ID	Assembly Type	Frame Type	Frame Depth (inches)	Frame Spacing (inches)	Cavity R-value	Continuous Insulation R-value	U-Factor	Appendix JA4 Reference: Table	Appendix JA4 Reference: Cell	U-Factor from Table 150.1-A or B	Comments

C. Opaque Surface Details – Nonframed (Section 150.1(c)1)

01	02	03	04	05	06	07	08	09	10
			Proposed					Required	
Tag/ID	Assembly Materials	Thickness (inches)	Core Insulation R-value	Continuous Insulation R-value	U-Factor	Appendix JA4 Reference: Table	Appendix JA4 Reference: Cell	U-Factor from Table 150.1-A or B	Comments

For information and data collection only. Not valid until registered with a HERS provider.

Registration Number: — Registration Date/Time: — HERS Provider:
CA Building Energy Efficiency Standards - 2019 Residential Compliance — January 2019

CF1R-PRF-01

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 tables below. Registered CF2Rs and CF3Rs are required to be completed in the HERS Registry

- Quality insulation installation (QII)
- Indoor air quality ventilation
- Kitchen range hood
- Minimum Airflow
- Verified SEER/SEER2
- Verified Refrigerant Charge
- Fan Efficacy Watts/CFM
- Verified HSPF2
- Verified heat pump rated heating capacity
- Duct leakage testing

BUILDING - FEATURES INFORMATION

01	02	03	04	05	06	07
Project Name	Conditioned Floor Area (ft^2)	Number of Dwelling Units	Number of Bedrooms	Number of Zones	Number of Ventilation Cooling Systems	Number of Water Heating Systems
Sample ADU - New Construction	816	1	1	1	1	1

ZONE INFORMATION

01	02	03	04	05	06	07
Zone Name	Zone Type	HVAC System Name	Zone Floor Area (ft^2)	Avg. Ceiling Height	Water Heating System 1	Status
ADU	Conditioned	HP HVAC System	816	9	DHW System 1	New

OPAQUE SURFACES

01	02	03	04	05	06	07	08
Name	Zone	Construction	Azimuth	Orientation	Gross Area (ft^2)	Window and Door Area (ft2)	Tilt (deg)
Front Wall	ADU	R-21+R-5 Wall	270	Front	306	60	90
Left Wall	ADU	R-21+R-5 Wall	0	Left	216	0	90
Rear Wall	ADU	R-21+R-5 Wall	90	Back	306	33	90

CF1R-PRF-01

OPAQUE SURFACE CONSTRUCTIONS

01	02	03	04	05	06	07	08
Construction Name	Surface Type	Construction Type	Framing	Total Cavity R-value	Interior / Exterior Continuous R-value	U-factor	Assembly Layers
R-21+R-5 Wall	Exterior Walls	Wood Framed Wall	2x6 @ 16 in. O. C.	R-21	None / 5	0.048	Inside Finish: Gypsum Board Cavity / Frame: R-21 / 2x6 Sheathing / Insulation: R-5 Sheathing Exterior Finish: Synthetic Stucco
Tile Roof +R-19 BRD	Attic Roofs	Wood Framed Ceiling	2x4 Top Chord of Roof Truss @ 24 in. O. C.	R-19	None / None	0.049	Roofing: 10 PSF (RoofTileAirGap) Tile Gap: present Roof Deck: Wood Siding/sheathing/decking Cavity / Frame: R-13.0 / 2x4 Top Chrd Under Roof Joists: R-6.0 insul.
R-19 Crawlspace	Floors Over Crawlspace	Wood Framed Floor	2x6 @ 16 in. O. C.	R-19	None / None	0.049	Floor Surface: Carpeted Floor Deck: Wood Siding/sheathing/decking Cavity / Frame: R-19 / 2x6
R-38 Ceiling	Ceilings (below attic)	Wood Framed Ceiling	2x4 Bottom Chord of Truss @ 24 in. O. C.	R-38	None / None	0.025	Over Ceiling Joists: R-28.9 insul. Cavity / Frame: R-9.1 / 2x4 Btm Chrd Inside Finish: Gypsum Board

BUILDING ENVELOPE - HERS VERIFICATION

01	02	03	04	05
Quality Insulation Installation (QII)	High R-value Spray Foam Insulation	Building Envelope Air Leakage	CFM50	CFM50
Required	Not Required	N/A	n/a	n/a

Field Inspectors

At foundation verify

- Slab edge insulation (if applicable)

At rough frame verify

- Air sealing

At insulation stage verify

- Wall and raised floor insulation values
- QII (requires HERS)

At final verify

- Ceiling insulation values
- CF2R and CF3R installation forms
- Registered with HERS Provider
- Request project status report (PSR)

Quality Insulation Installation

Single-Family

Prescriptive § 150.1(c)1E

Quality Insulation Installation

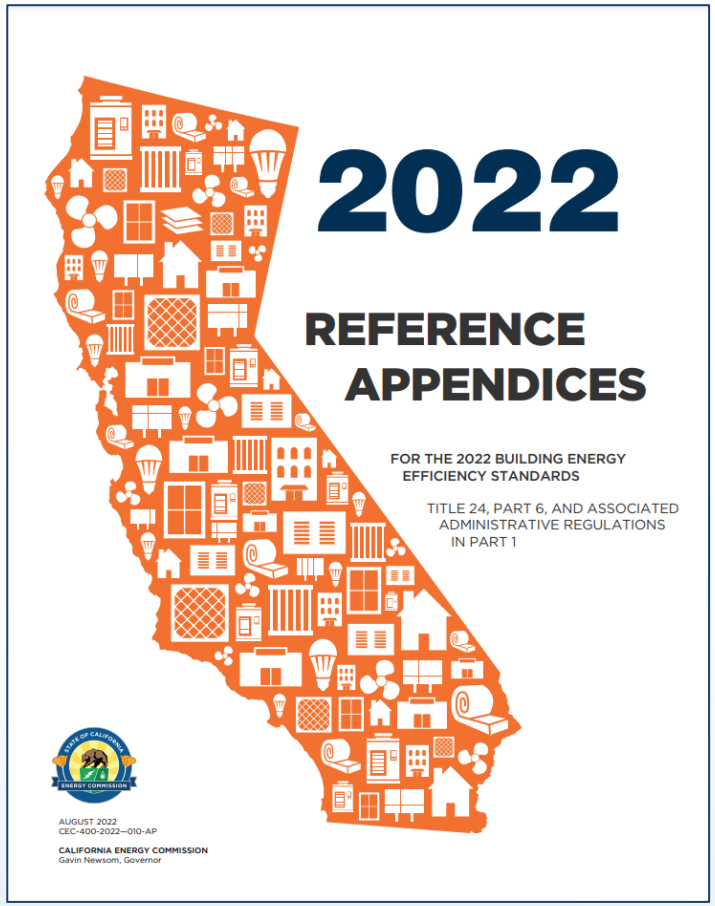
Single-family § 150.1(c)1E

What is quality insulation installation?

- Certified HERS rater verifies quality of exterior air barrier and installed insulation
  - Ensure air-tight building
  - Ensure full U-factor of assembly
- Prescriptive requirement in § 150.1(c)1E
- Without QII performance modeling calculations derate cavity insulation by 30%

Quality Insulation Installation

Reference Residential Appendix RA3.5



QII Resources

- Reference Residential Appendix RA3.5
- Energy Code Ace – QII fact sheet
- CalCERTS - QII booklet
- Cheers - QII YouTube video
- Wise Warehouse – QII YouTube videos
  - Available in Spanish
- NAIMA - 25 Checkpoints
- Manufacturer's installation guides

Quality Insulation Installation

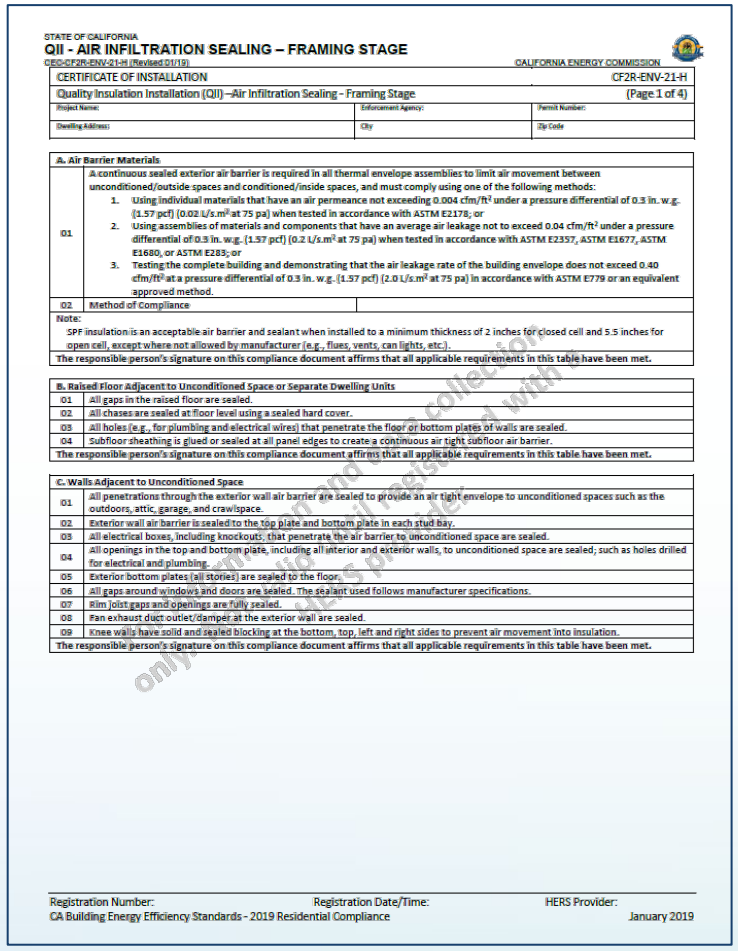
Single-family

Design stage meeting

- QII Checklist
- Who is responsible for what
  - Framing
  - Electrical
  - Plumbing
  - HVAC
  - Insulation
- When will HERS rater verify different stages

Quality Insulation Installation HERS Requirements

CF2R-ENV-21-H, CF3R-ENV-21-H



STATE OF CALIFORNIA
QII - AIR INFILTRATION SEALING – FRAMING STAGE
CEC-CF2R-ENV-21-H (Revised 01/19) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF INSTALLATION CF2R-ENV-21-H
Quality Insulation Installation (QII)–Air Infiltration Sealing - Framing Stage (Page 1 of 4)

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

A. Air Barrier Materials		
01	A continuous sealed exterior air barrier is required in all thermal envelope assemblies to limit air movement between unconditioned/outside spaces and conditioned/inside spaces, and must comply using one of the following methods: 1. Using individual materials that have an air permeance not exceeding 0.004 cfm/ft² under a pressure differential of 0.3 in. w.g. (1.57 psf) (0.02 L/s.m² at 75 pa) when tested in accordance with ASTM E2178; or 2. Using assemblies of materials and components that have an average air leakage not to exceed 0.04 cfm/ft² under a pressure differential of 0.3 in. w.g. (1.57 psf) (0.2 L/s.m² at 75 pa) when tested in accordance with ASTM E2357, ASTM E1677, ASTM E1680, or ASTM E283; or 3. Testing the complete building and demonstrating that the air leakage rate of the building envelope does not exceed 0.40 cfm/ft² at a pressure differential of 0.3 in. w.g. (1.57 psf) (2.0 L/s.m² at 75 pa) in accordance with ASTM E779 or an equivalent approved method.	
02	Method of Compliance	
Note: SPF insulation is an acceptable air barrier and sealant when installed to a minimum thickness of 2 inches for closed cell and 5.5 inches for open cell, except where not allowed by manufacturer (e.g., flues, vents, can lights, etc.).		
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.		

B. Raised Floor Adjacent to Unconditioned Space or Separate Dwelling Units	
01	All gaps in the raised floor are sealed.
02	All chases are sealed at floor level using a sealed hard cover.
03	All holes (e.g., for plumbing and electrical wires) that penetrate the floor or bottom plates of walls are sealed.
04	Subfloor sheathing is glued or sealed at all panel edges to create a continuous air tight subfloor air barrier.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

C. Walls Adjacent to Unconditioned Space	
01	All penetrations through the exterior wall air barrier are sealed to provide an air tight envelope to unconditioned spaces such as the outdoors, attic, garage, and crawlspace.
02	Exterior wall air barrier is sealed to the top plate and bottom plate in each stud bay.
03	All electrical boxes, including knockouts, that penetrate the air barrier to unconditioned space are sealed.
04	All openings in the top and bottom plate, including all interior and exterior walls, to unconditioned space are sealed; such as holes drilled for electrical and plumbing.
05	Exterior bottom plates (all stories) are sealed to the floor.
06	All gaps around windows and doors are sealed. The sealant used follows manufacturer specifications.
07	Rim joist gaps and openings are fully sealed.
08	Fan exhaust duct outlet/damper at the exterior wall are sealed.
09	Knee walls have solid and sealed blocking at the bottom, top, left and right sides to prevent air movement into insulation.
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 - 2019 Residential Compliance January 2019

QII Checklist – Framing Stage

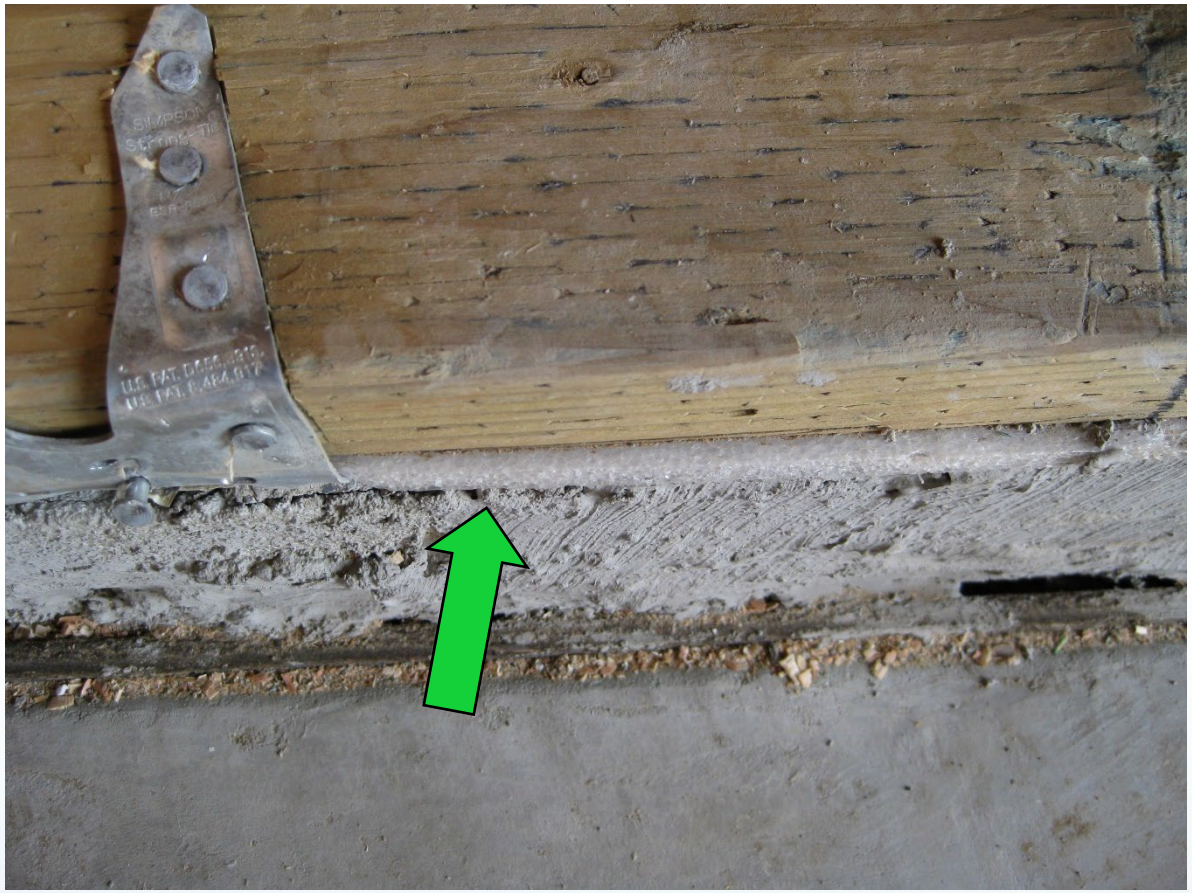
A. Air barrier materials
B. Raised floor
C. Walls and knee walls
D. Ceiling air barrier
E. Roof air barrier – unvented attic
F. Conditioned space above or adjacent to garage
G. Cantilevered floor air barrier
H. Walls for attached porch, attic, double wall
I. Air barriers in multifamily dwellings

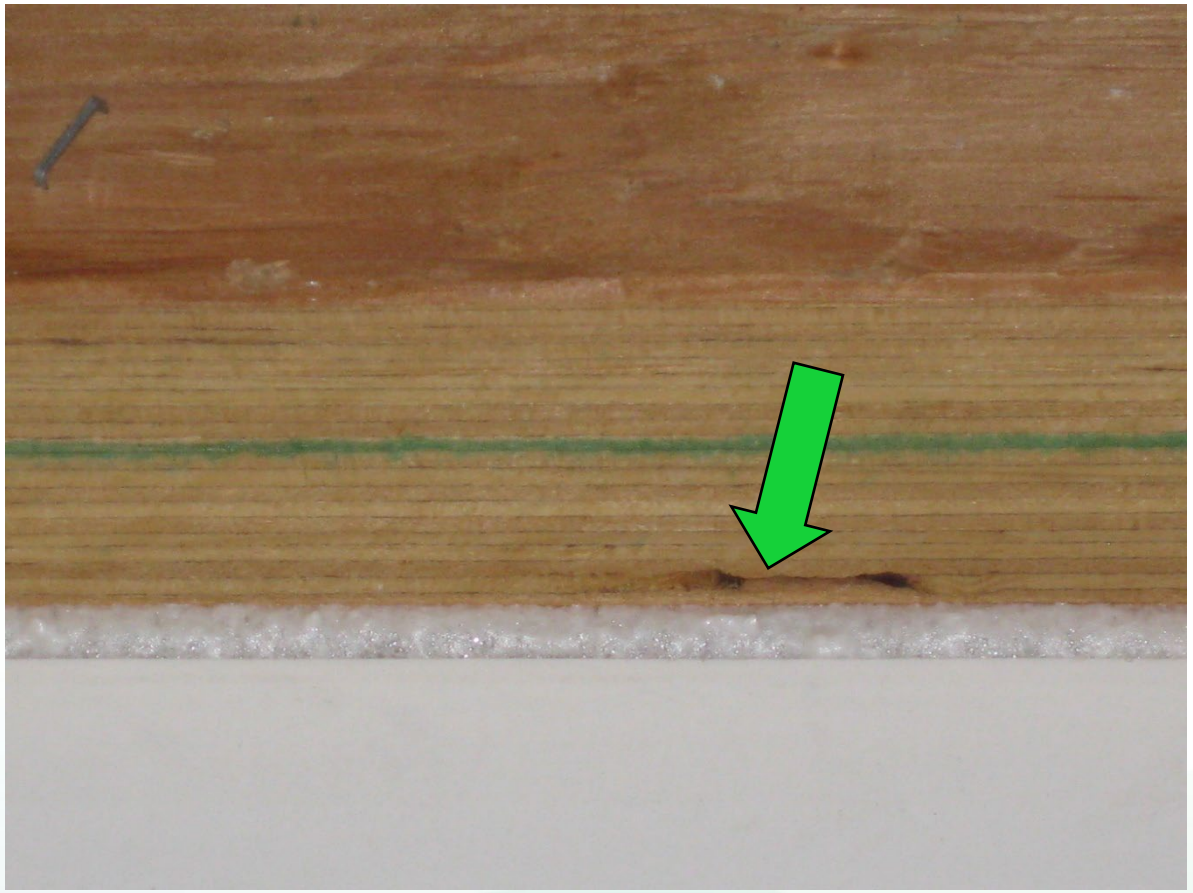
CF2R-ENV-21-H
Page 1

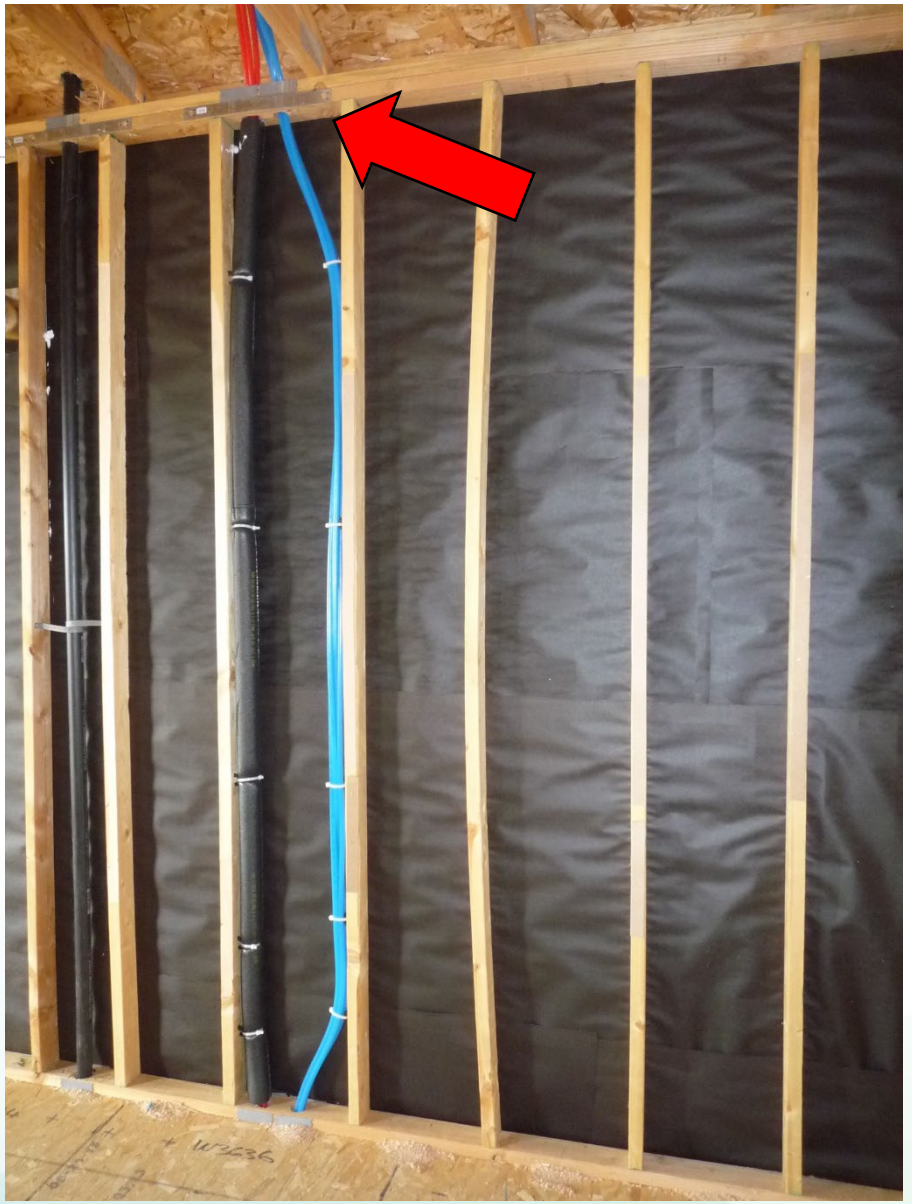
A. Air Barrier Materials		
01	A continuous sealed exterior air barrier is required in all thermal envelope assemblies to limit air movement between unconditioned/outside spaces and conditioned/inside spaces, and must comply using one of the following methods: 1. Using individual materials that have an air permeance not exceeding 0.004 cfm/ft² under a pressure differential of 0.3 in. w.g. (1.57 pcf) (0.02 L/s.m² at 75 pa) when tested in accordance with ASTM E2178; or 2. Using assemblies of materials and components that have an average air leakage not to exceed 0.04 cfm/ft² under a pressure differential of 0.3 in. w.g. (1.57 pcf) (0.2 L/s.m² at 75 pa) when tested in accordance with ASTM E2357, ASTM E1677, ASTM E1680, or ASTM E283; or 3. Testing the complete building and demonstrating that the air leakage rate of the building envelope does not exceed 0.40 cfm/ft² at a pressure differential of 0.3 in. w.g. (1.57 pcf) (2.0 L/s.m² at 75 pa) in accordance with ASTM E779 or an equivalent approved method.	
02	Method of Compliance	
Note: SPF insulation is an acceptable air barrier and sealant when installed to a minimum thickness of 2 inches for closed cell and 5.5 inches for open cell, except where not allowed by manufacturer (e.g., flues, vents, can lights, etc.).		
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.		

B. Raised Floor Adjacent to Unconditioned Space or Separate Dwelling Units	
01	All gaps in the raised floor are sealed.
02	All chases are sealed at floor level using a sealed hard cover.
03	All holes (e.g., for plumbing and electrical wires) that penetrate the floor or bottom plates of walls are sealed.
04	Subfloor sheathing is glued or sealed at all panel edges to create a continuous airtight subfloor air barrier.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

C. Walls Adjacent to Unconditioned Space	
01	All penetrations through the exterior wall air barrier are sealed to provide an airtight envelope to unconditioned spaces such as the outdoors, attic, garage, and crawlspace.
02	Exterior wall air barrier is sealed to the top plate and bottom plate in each stud bay.
03	All electrical boxes, including knockouts, that penetrate the air barrier to unconditioned space are sealed.
04	All openings in the top and bottom plate, including all interior and exterior walls, to unconditioned space are sealed; such as holes drilled for electrical and plumbing.
05	Exterior bottom plates (all stories) are sealed to the floor.
06	All gaps around windows and doors are sealed. The sealant used follows manufacturer specifications.
07	Rim joist gaps and openings are fully sealed.
08	Fan exhaust duct outlet/damper at the exterior wall are sealed.
09	Knee walls have solid and sealed blocking at the bottom, top, left and right sides to prevent air movement into insulation.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	



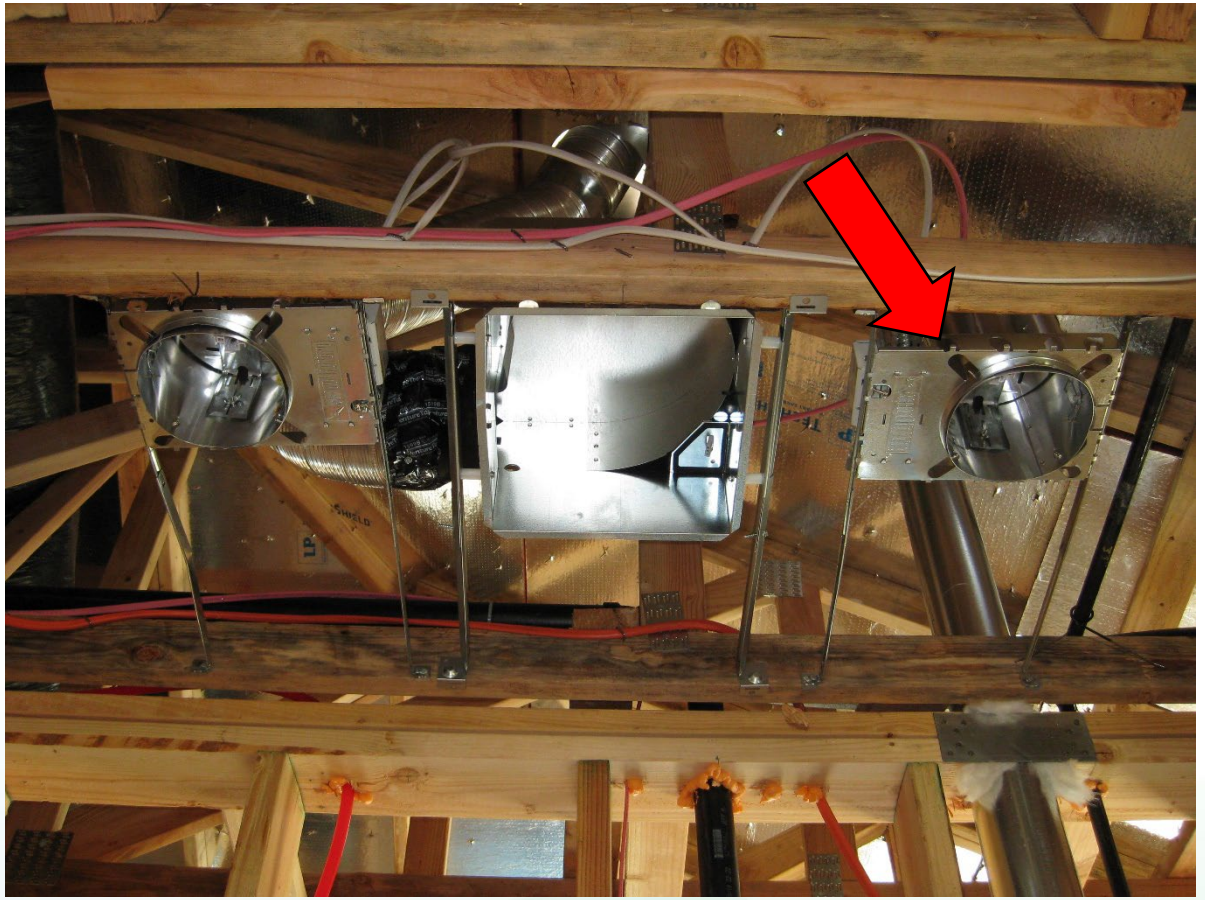


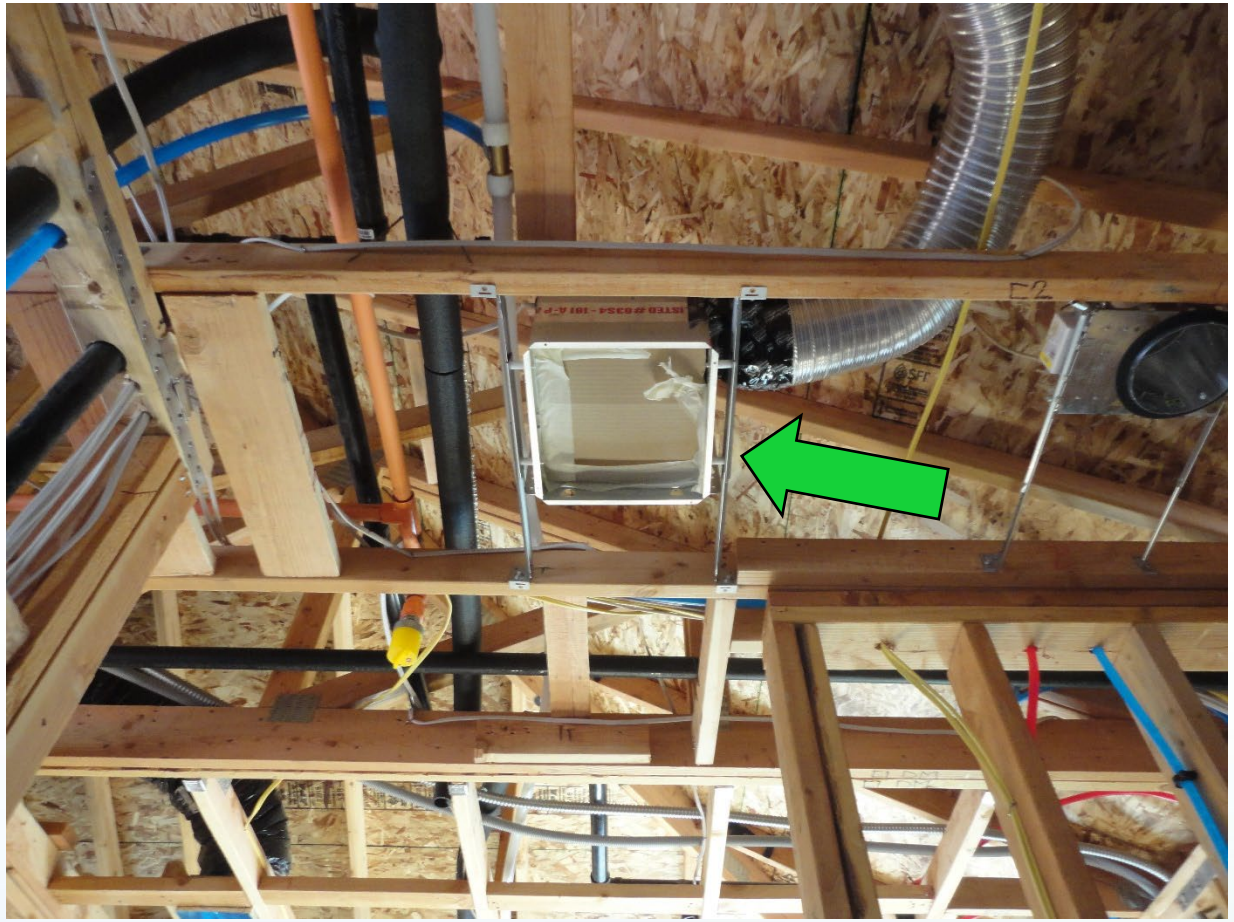


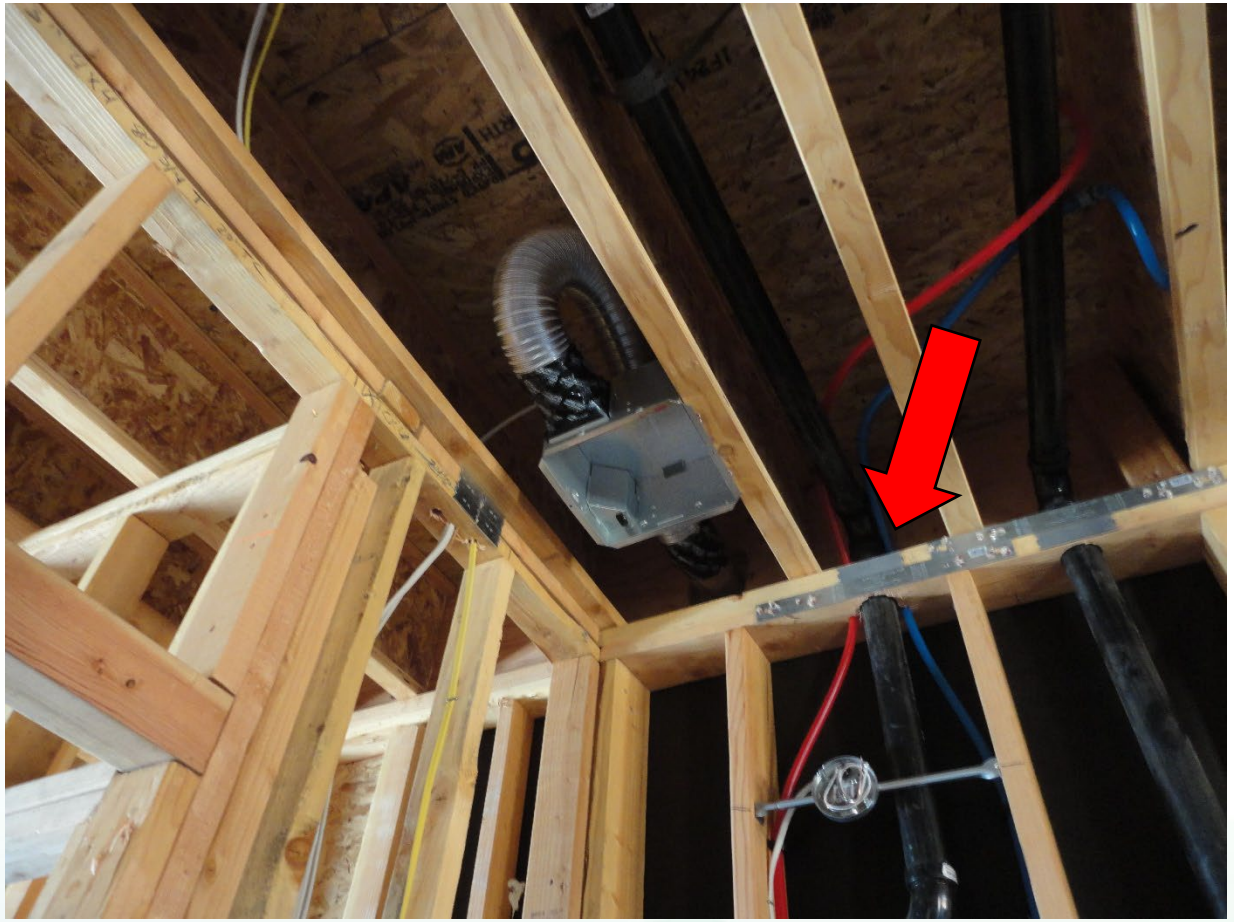

R-6.0

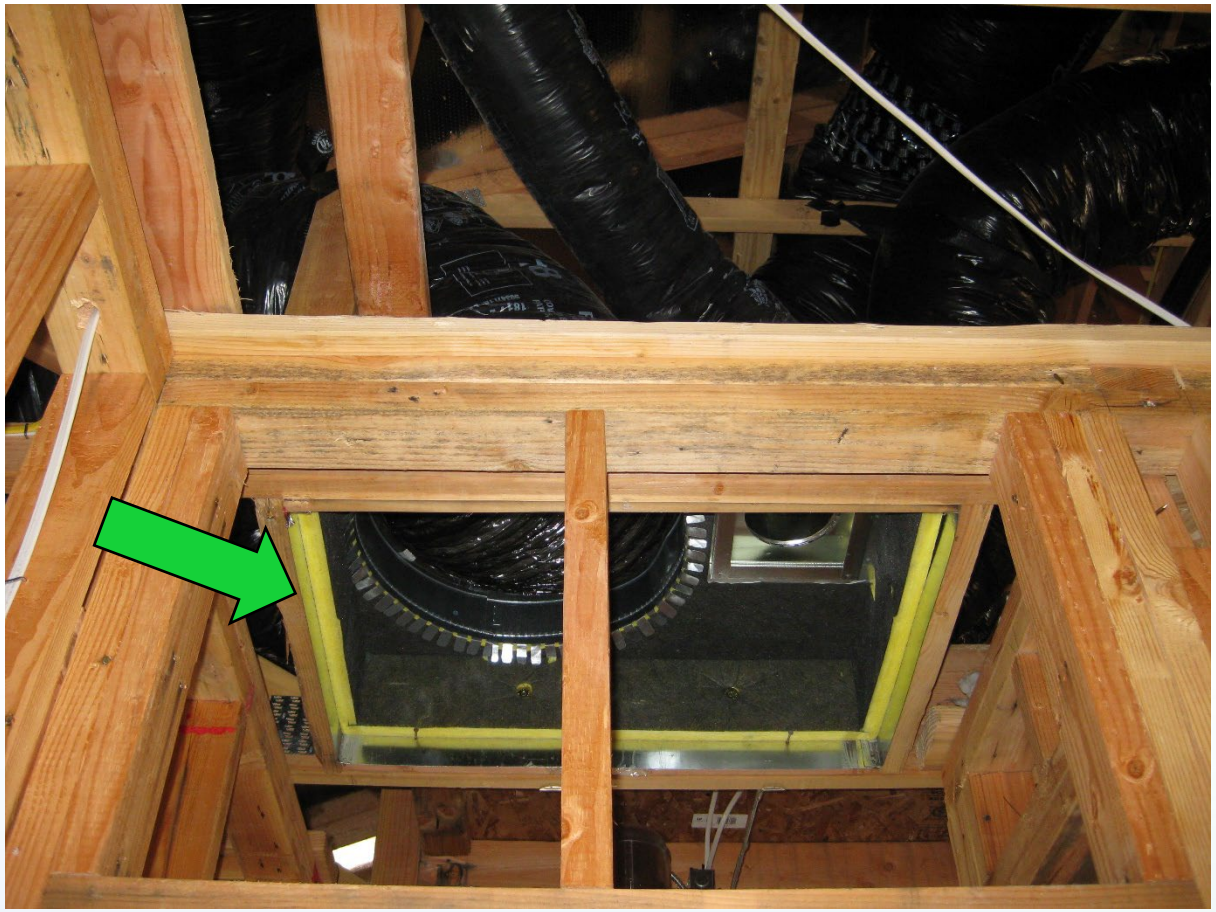
D. Ceiling Air Barrier Adjacent to Unconditioned Space	
01	There is a continuous air barrier at the ceiling level. All openings into walls, drops, chases or double walls are sealed.
02	All penetrations through the top plate of interior and exterior walls are sealed.
03	Fire sprinklers penetrating a ceiling air barrier shall be sealed to prevent air movement according to the manufacturer's instructions.
04	All fixtures cut into ceiling air barrier (e.g., HVAC registers, electrical boxes, fire alarm boxes, exhaust fan housing, and recessed lighting fixtures) are sealed to the surrounding dry wall. If it is not possible to seal the fixture directly, a secondary air barrier shall be created around the fixture.
05	All installed recessed lighting fixtures that penetrate the ceiling to unconditioned space are rated to be Insulation Contact and Airtight (IC and AT) which allow direct contact with insulation.
06	All dropped ceiling areas are covered with hard covers that are sealed to the framing, or else the bottom and sides of dropped ceiling areas are all insulated and sealed as ceilings and walls as required on the Certificate of Compliance.
07	All vertical chases (e.g., HVAC ducts and plumbing) and soffits are sealed at the ceiling level.
08	Chimneys and flues require sheet metal flashing at the ceiling level. The flashing shall be sealed to the chimney/flue with fire rated caulk. The flashing shall be sealed to the surrounding framing.
09	Framing locations where air may move down into the walls from the attic (e.g., double walls, pocket doors, architectural bump-outs, etc.) have a sealed hard cover to prevent air movement.
10	Attic access forms an airtight seal between the conditioned space and unconditioned space. Vertical attic access requires mechanical compression using screws or latches.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

E. Roof Air Barrier – Unvented Attics Adjacent to Unconditioned Space	
01	There is a continuous air barrier at the roof deck and gable ends.
02	Chimneys and flues require sheet metal flashing at the roof deck. The flashing is sealed to the chimney/flue with fire rated caulk. The flashing is sealed to the surrounding framing.
03	All penetrations in the roof deck and gable ends for plumbing, electrical, etc. are sealed.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	










R-6.0

F. Conditioned Space Above or Adjacent to Garage Air Barrier	
01	All penetrations in the subfloor above the garage into conditioned space must follow the raised floor air barrier requirements.
02	Infiltration between the space above the garage and the subfloor is prevented by one of the following methods: • Seal all edges of the garage ceiling (typically drywall) at the perimeter of the garage to create a continuous airtight surface between the garage and adjacent conditioned envelope. Seal all plumbing, electrical, and mechanical penetrations between the garage and adjacent conditioned space. For an open-web truss, airtight blocking is added on all four sides of the garage perimeter. Insulation can be placed on the garage ceiling. • Seal the band joist above the wall at the garage to conditioned space transition. Seal all subfloor seams and penetrations between the garage and adjacent conditioned space. Insulation must be placed in contact with the subfloor below the conditioned space.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

G. Cantilevered Floor Air Barrier	
01	Airtight blocking is installed between joists where the wall rim joist would have been located in the absence of a cantilever.
02	Exterior sheathing is installed to the bottom of the cantilever so that there is a continuous air and weather barrier for the cantilever. The cantilevered joist must be insulated to the same R-value as would be required for the subfloor prior to closing.
03	Any gaps, cracks or penetrations in the air barrier of the cantilever are sealed. Recessed can lights in the cantilever are IC and AT and properly sealed to the sheathing.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

H. Walls for Attached Porch, Attic, Double Wall Air Barrier	
01	An exterior wall air barrier is required at the intersection of the porch and exterior wall when there is conditioned space on the other side. The exterior wall includes an air barrier where the attic attaches to the conditioned space.
02	Truss framing blocking is used at the top and bottom of each wall/roof section.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

I. Air Barriers in Multifamily Dwellings	
01	Each dwelling unit must be sealed to stop air movement between dwelling units. Treat adjacent dwelling units as unconditioned space for air sealing.
02	All penetrations through the floor and ceiling of each dwelling unit are sealed, including electric and gas utilities, water pipes, drain pipes, fire protection service pipes, and communication wiring.
03	Elevator penthouse, mechanical penthouse, stairwell doors, roof access hatches, and plumbing stacks that separate conditioned and unconditioned space are all sealed.
04	Vertical chases for garbage chutes, elevator shafts, HVAC ducting and plumbing shall be treated as unconditioned space for sealing.
05	Common hallways shall be treated as unconditioned space for sealing.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

J. Special Requirements for SIPs	
01	SIPs are considered an air barrier when properly sealed at top, bottom, sides and all penetrations.
02	Air barrier is continuous across all surfaces, including between SIPs and non-SIP sections.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

K. Special Requirements for ICF	
01	ICF sections are considered an air barrier when properly sealed at top, bottom, sides and all penetrations.
02	Air barrier is continuous across all surfaces, including between ICF and non-ICF sections.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Installation documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Documentation Author Company Name:	Date Signed:
Address:	CEA/HERS Certification Identification (If applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Installation is true and correct.
2. I am either: a) a responsible person eligible under Division 3 of the Business and Professions Code in the applicable classification to accept responsibility for the system design, construction, or installation of features, materials, components, or manufactured devices for the scope of work identified on this Certificate of Installation and attest to the declarations in this statement, or b) I am an authorized representative of the responsible person **and** attest to the declarations in this statement on the responsible person's behalf.
3. The constructed or installed features, materials, components or manufactured devices (the installation) identified on this Certificate of Installation conforms to all applicable codes and regulations and the installation conforms to the requirements given on the Certificate of Compliance, plans, and specifications approved by the enforcement agency.
4. I understand that a HERS rater will check the installation to verify compliance and if such checking determines the installation fails to comply, I am required to offer any necessary corrective action at no charge to the building owner.
5. I will ensure that a registered copy of this Certificate of Installation shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Installation is required to be included with the documentation the builder provides to the building owner at occupancy.

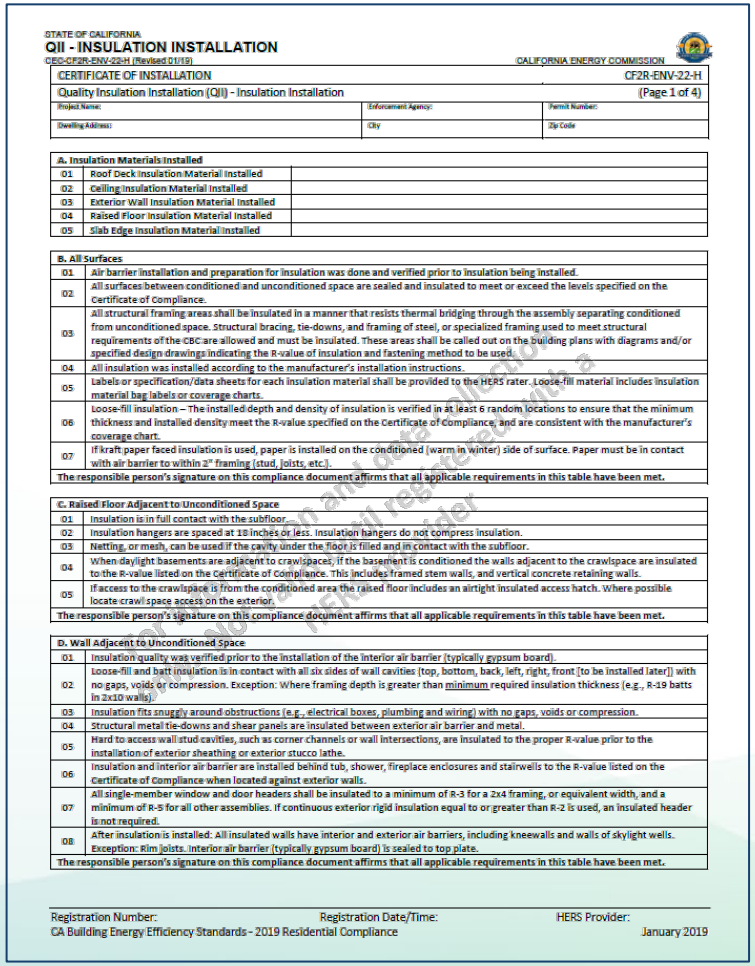
Responsible Builder/Installer Name:	Responsible Builder/Installer Signature:	
Company Name: (Installing Subcontractor or General Contractor or Builder/Owner)	Position With Company (Title):	
Address:	CSLB License:	
City/State/Zip:	Phone	Date Signed:
Third Party Quality Control Program (TPQCP) Status:	Name of TPQCP (if applicable):	

Quality Insulation Installation HERS Requirements

CF2R-ENV-22-H, CF3R-ENV-22-H

QII Checklist – Insulation Stage

A. Insulation materials installed
B. All surfaces
C. Raised floor
D. Wall
E. Ceiling
F. Ceiling insulation in vented attics
G. Insulation in unvented attics
H. Insulation in vented attic
I. Skylights and knee walls
J. Floors above garages
K. Cantilevered floors
L. Attached porches
M. Spray foam insulation



STATE OF CALIFORNIA
QII - INSULATION INSTALLATION
CEC-CF2R-ENV-22-H (Revised 01/19) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF INSTALLATION — CF2R-ENV-22-H
Quality Insulation Installation (QII) - Insulation Installation — (Page 1 of 4)

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

A. Insulation Materials Installed		
01	Roof Deck Insulation Material Installed	
02	Ceiling Insulation Material Installed	
03	Exterior Wall Insulation Material Installed	
04	Raised Floor Insulation Material Installed	
05	Slab Edge Insulation Material Installed	

B. All Surfaces	
01	Air barrier installation and preparation for insulation was done and verified prior to insulation being installed.
02	All surfaces between conditioned and unconditioned space are sealed and insulated to meet or exceed the levels specified on the Certificate of Compliance.
03	All structural framing areas shall be insulated in a manner that resists thermal bridging through the assembly separating conditioned from unconditioned space. Structural bracing, tie-downs, and framing of steel, or specialized framing used to meet structural requirements of the CBC are allowed and must be insulated. These areas shall be called out on the building plans with diagrams and/or specified design drawings indicating the R-value of insulation and fastening method to be used.
04	All insulation was installed according to the manufacturer's installation instructions.
05	Labels or specification/data sheets for each insulation material shall be provided to the HERS rater. Loose-fill material includes insulation material bag labels or coverage charts.
06	Loose-fill insulation – The installed depth and density of insulation is verified in at least 6 random locations to ensure that the minimum thickness and installed density meet the R-value specified on the Certificate of Compliance, and are consistent with the manufacturer's coverage chart.
07	If kraft paper faced insulation is used, paper is installed on the conditioned (warm in winter) side of surface. Paper must be in contact with air barrier to within 2" framing (stud, joists, etc.).
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

C. Raised Floor Adjacent to Unconditioned Space	
01	Insulation is in full contact with the subfloor.
02	Insulation hangers are spaced at 18 inches or less. Insulation hangers do not compress insulation.
03	Netting, or mesh, can be used if the cavity under the floor is filled and in contact with the subfloor.
04	When daylight basements are adjacent to crawlspaces, if the basement is conditioned the walls adjacent to the crawlspace are insulated to the R-value listed on the Certificate of Compliance. This includes framed stem walls, and vertical concrete retaining walls.
05	If access to the crawlspace is from the conditioned area the raised floor includes an airtight insulated access hatch. Where possible locate crawl space access on the exterior.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

D. Wall Adjacent to Unconditioned Space	
01	Insulation quality was verified prior to the installation of the interior air barrier (typically gypsum board).
02	Loose-fill and batt insulation is in contact with all six sides of wall cavities (top, bottom, back, left, right, front [to be installed later]) with no gaps, voids or compression. Exception: Where framing depth is greater than minimum required insulation thickness (e.g., R-19 batts in 2x10 walls).
03	Insulation fits snuggly around obstructions (e.g., electrical boxes, plumbing and wiring) with no gaps, voids or compression.
04	Structural metal tie-downs and shear panels are insulated between exterior air barrier and metal.
05	Hard to access wall stud cavities, such as corner channels or wall intersections, are insulated to the proper R-value prior to the installation of exterior sheathing or exterior stucco lathe.
06	Insulation and interior air barrier are installed behind tub, shower, fireplace enclosures and stairwells to the R-value listed on the Certificate of Compliance when located against exterior walls.
07	All single-member window and door headers shall be insulated to a minimum of R-3 for a 2x4 framing, or equivalent width, and a minimum of R-5 for all other assemblies. If continuous exterior rigid insulation equal to or greater than R-2 is used, an insulated header is not required.
08	After insulation is installed: All insulated walls have interior and exterior air barriers, including kneewalls and walls of skylight wells. Exception: Rim joists. Interior air barrier (typically gypsum board) is sealed to top plate.
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 - 2019 Residential Compliance January 2019

Quality Insulation Installation HERS Requirements

RA3.5

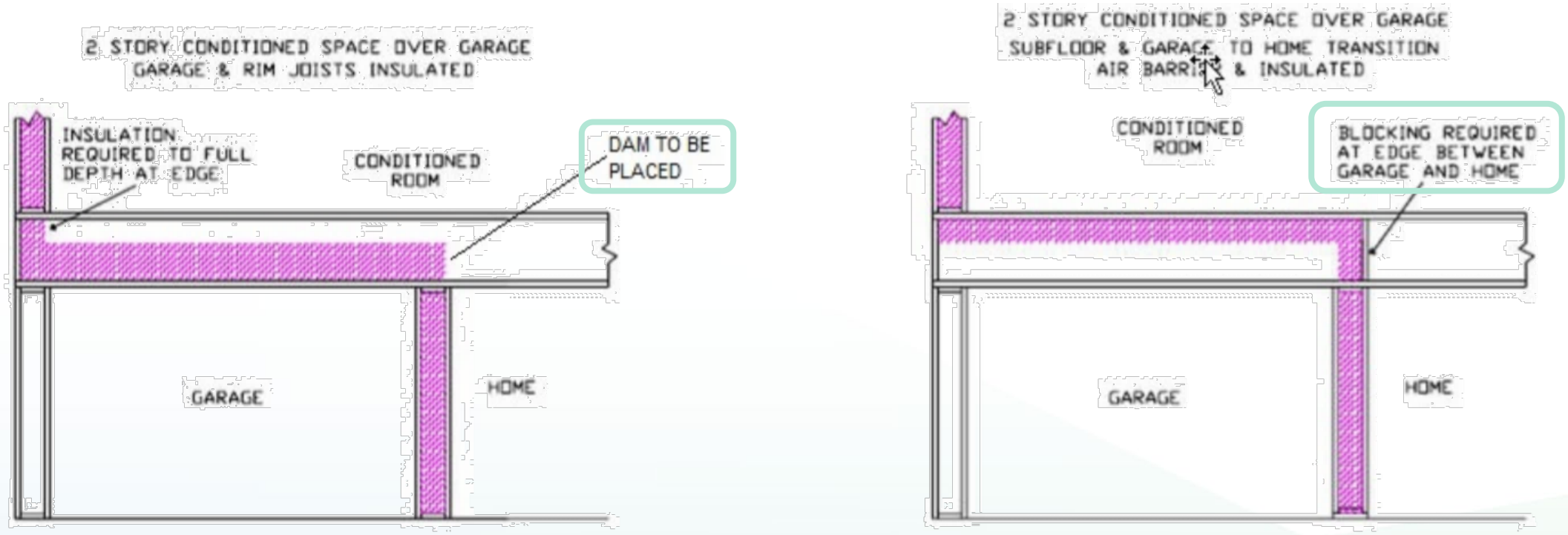


Figure RA3.5-1 Homes with Conditioned Space Over Garage – Batt and Blanket Insulation

Quality Insulation Installation HERS Requirements

RA3.5

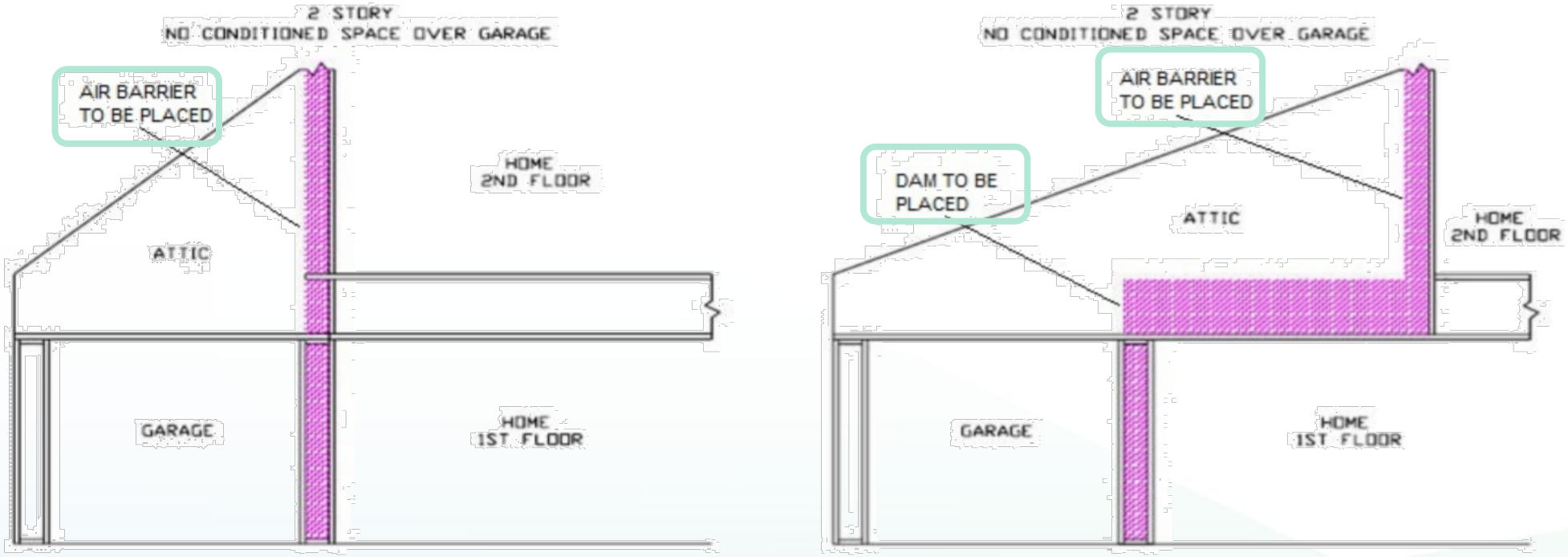


Figure RA3.5-2 Homes with No Conditioned Space Over Garage – Batt and Blanket Insulation

Quality Insulation Installation HERS Requirements

Single-family Compliance Manual

Figure 3-46: Wood-Framed Wall, 2x6 @ 24" oc, AWF With Three-Stud corners

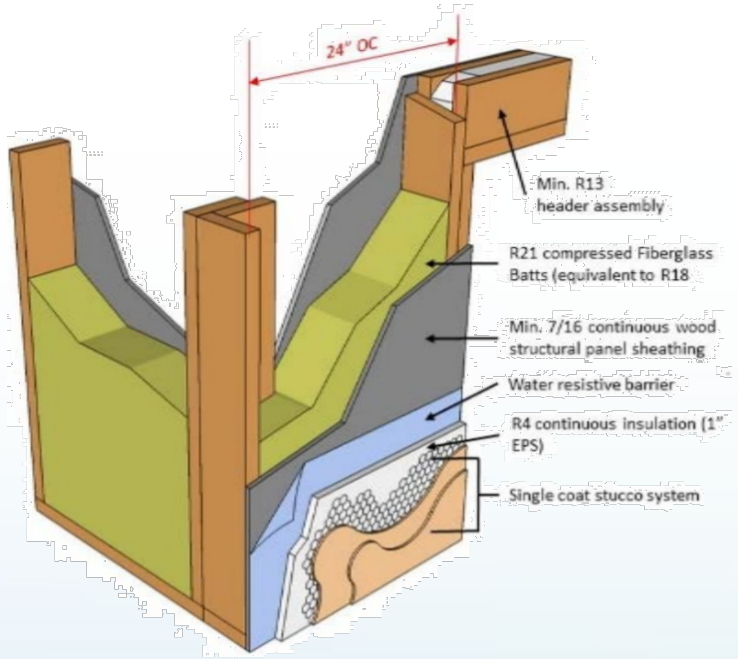
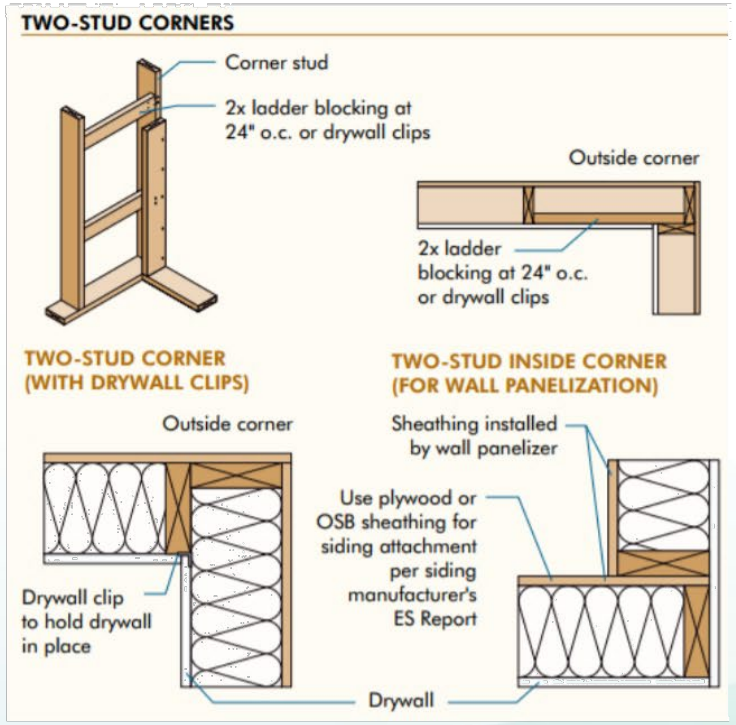
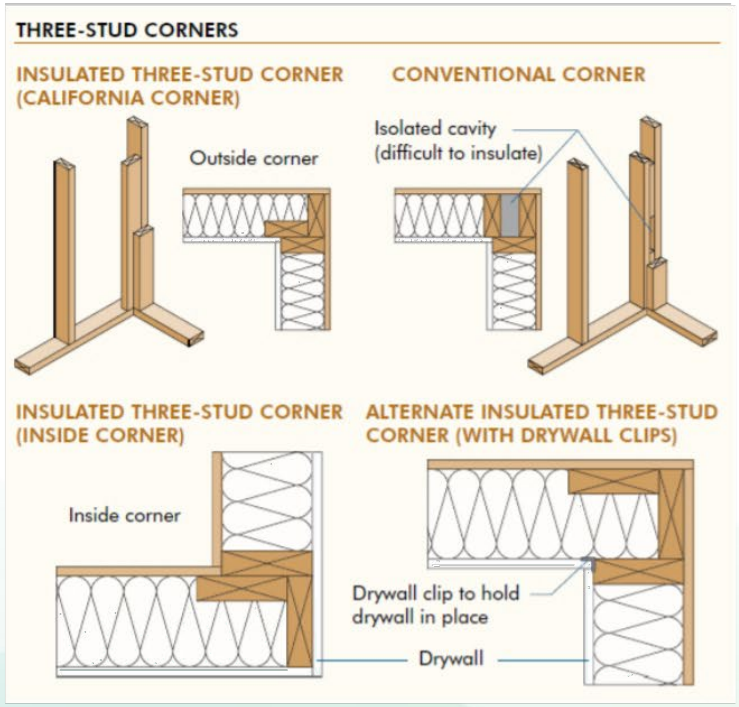


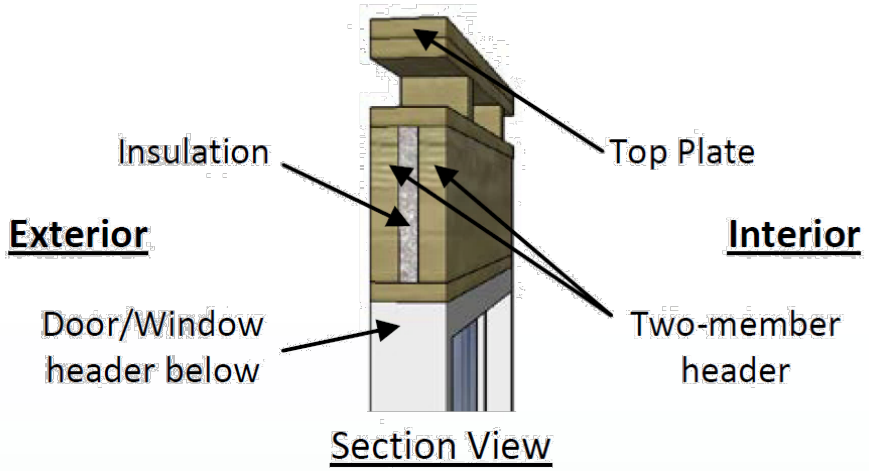
Figure 3-47: Advanced Framing Corners

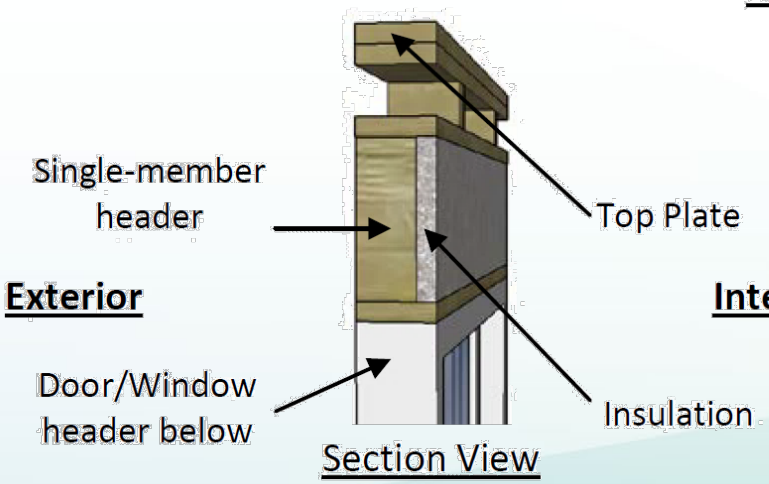


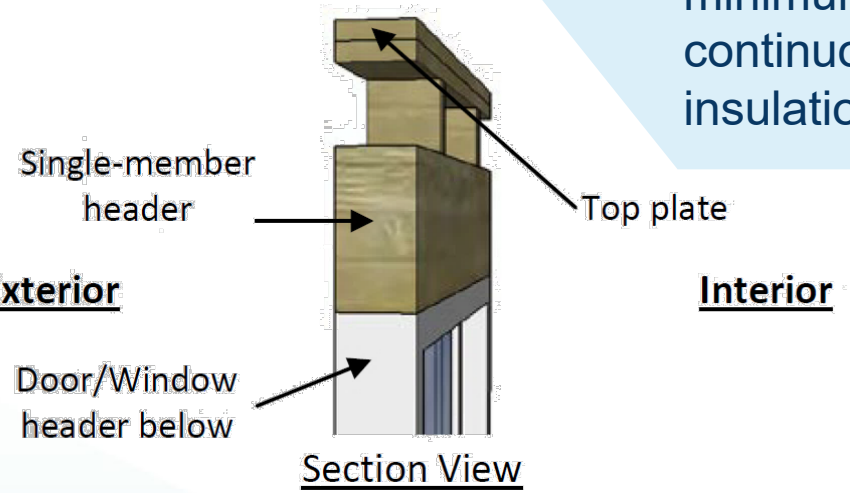


Quality Insulation Installation HERS Requirements

Single-family







Full width headers minimum R-2 continuous insulation

A. Insulation Materials Installed		
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05	If access to the crawlspace is from the conditioned area the raised floor includes an airtight insulated access hatch. Where possible locate crawl space access on the exterior.
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D. Wall Adjacent to Unconditioned Space	
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02	Loose-fill and batt insulation is in contact with all six sides of wall cavities (top, bottom, back, left, right, front [to be installed later]) with no gaps, voids or compression. Exception: Where framing depth is greater than minimum required insulation thickness (e.g., R-19 batts in 2x10 walls).
03	Insulation fits snuggly around obstructions (e.g., electrical boxes, plumbing and wiring) with no gaps, voids or compression.
04	Structural metal tie-downs and shear panels are insulated between exterior air barrier and metal.
05	Hard to access wall stud cavities, such as corner channels or wall intersections, are insulated to the proper R-value prior to the installation of exterior sheathing or exterior stucco lathe.
06	Insulation and interior air barrier are installed behind tub, shower, fireplace enclosures and stairwells to the R-value listed on the Certificate of Compliance when located against exterior walls.
07	All single-member window and door headers shall be insulated to a minimum of R-3 for a 2x4 framing, or equivalent width, and a minimum of R-5 for all other assemblies. If continuous exterior rigid insulation equal to or greater than R-2 is used, an insulated header is not required.
08	After insulation is installed: All insulated walls have interior and exterior air barriers, including kneewalls and walls of skylight wells. Exception: Rim joists. Interior air barrier (typically gypsum board) is sealed to top plate.
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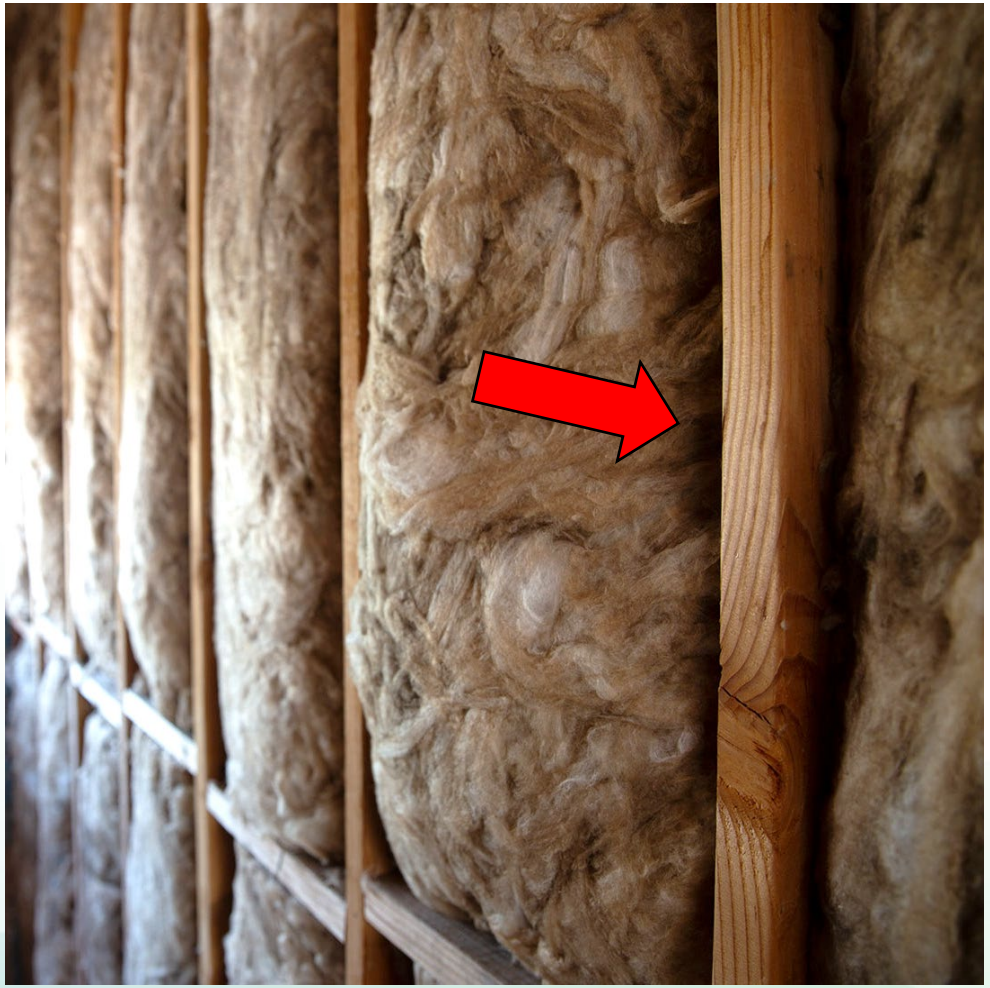



ACH T&G - Type II - UL ER11812-01 U-53


JM
Johns Manville
Altura 42
42X60

E. Ceiling Adjacent to Unconditioned Space	
01	Insulation extends to the outside surface of the exterior wall.
02	Insulation is in direct contact with the ceiling air barrier so there are no gaps, voids or compression.
03	Chimneys and flues (except zero clearance) have a sheet metal collar at the ceiling level to prevent contact with the insulation. The collar is at least as tall as the depth of the insulation. There is a minimum 1" clearance between the collar and the chimney/flue for double wall vent, and 6" for single wall vent, unless manufacturer's instructions require otherwise. The collar is sealed to the ceiling with high temperature sealant to prevent air leakage. The insulation is in contact with the sheet metal collar.
04	Recessed can lights penetrating the ceiling air barrier are covered with insulation to the depth needed to meet the ceiling R-value specified on the Certificate of Compliance.
05	External surfaces of steel studs, steel-framed kneewalls, skylight shafts, and gable ends are covered with insulation.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

F. Ceiling Insulation in Vented Attics	
01	Required eave ventilation shall not be obstructed. The net-free ventilation area of the eave vent is maintained.
02	Eave vent baffles and dams are installed to prevent air movement under or into the ceiling insulation.
03	Attic access is insulated to the same R-value required by the Certificate of Compliance for ceiling insulation and the insulation is permanently attached using adhesive or mechanical fasteners.
04	Attic access must have a dam around the access to at least the same depth as the insulation.
05	Attic rulers specified to the installed loose-fill material (brand and type) are installed and evenly distributed throughout the attic to verify depth (one ruler for every 250 ft^2). The rulers are clearly readable and scaled to read inches of insulation and the R-value installed.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

G. Insulation in Unvented Attics	
01	The roof sheathing is the air barrier and is sealed to prevent air movement to the outside.
02	Insulation is in full contact with the air barrier (roof sheathing).
03	If insulated using air permeable insulation, gable end walls are sealed and insulated the same as exterior walls, including interior air barrier.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

H. Insulation in Vented Attics (High Performance Vented Attics)	
01	Insulation is in full contact with roof sheathing and firmly supported to prevent sagging.
02	Batt insulation between roof trusses is acceptable with minimal gaps and voids caused by roof truss members.
03	Insulation is not required on gable end walls.
04	Required roof deck insulation over any conditioned space, or HVAC ducts, is installed on the entire attic roof deck; even over unconditioned spaces (e.g., garage, covered porch). Roof deck of attic over unconditioned space without HVAC ducts and separated from other attics by a sealed air barrier do not need to be insulated.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

I. Special Requirements for Skylight Shafts and Attic Knee Walls	
01	Insulation must meet all the requirements for walls and insulation is in contact with the air barrier on all six sides unless SPF is used.
02	Insulation shall be in full contact with the interior wall finish. Batt insulation must be cut to fit around 2x4's that are laid flat.
03	Skylight shafts and attic knee walls shall be completely enclosed by vertical and horizontal framing, including horizontal plates at the top and bottom of the insulation.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

J. Special Requirements for Floors Above Garages	
01	If the air barrier is at the perimeter of the garage below the conditioned subfloor, then the insulation may be placed on the garage ceiling. The perimeter of the subfloor must also be insulated.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

K. Special Requirements for Cantilevered Floors	
01	Sealed blocking shall be installed between joists where the wall rim joist would have been located in the absence of a cantilever. Insulation shall be placed on both sides of the block.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

L. Special Requirements for Attached Porches	
01	Exterior wall at the intersection of the porch roof is fully insulated above, below and behind the roof line.
02	Where truss framing is used, airtight blocking is used at the top and bottom of each wall/roof section and is insulated.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

M. Special Requirements for SPF Insulation	
01	Installed product meets the claimed R-value per inch. Non-standard values are supported by an ICC Evaluation Service Report (ESR) number (e.g., ESR-xxxx) and documented on the CF2R-ENV-03. Non-standard values are anything greater than R-5.8/inch for closed cell and R-3.6/inch for open cell.
02	Installed thickness meets the required R-value from the Certificate of Compliance. Verified in at least 6 random places for each surface type: floors, walls, and ceilings.
03	Insulation is spray applied to fully adhere to structural assembly framing, floor and ceiling joists, and other framing surfaces within the construction cavity.
04	If multiple layers are applied, each foam lift (e.g., spray application) adheres to the substrate and foam interfaces.
05	Closed cell SPF: In areas where an air barrier is required the foam is at least 2" thick.
06	Open cell SPF: In areas where an air barrier is required the foam is at least 5.5" thick.
07	Open cell SPF: Depressions in the foam insulation surface are not greater than 1/2" of the required thickness provided these depressions do not exceed 10% of the surface area being insulated.
08	Open cell SPF: Insulation completely fills cavities of 2x4 framing.
09	SPF insulation is not applied directly to recessed lighting fixtures unless specifically allowed by manufacturer's instructions. When not allowed, can lights are: A. Covered with a minimum of 1.5" of mineral fiber insulation; or B. Enclosed in a manufacturer's approved box fabricated from an approved material, such as 18 gauge sheet metal or ½" gypsum board.
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.	

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Installation documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Documentation Author Company Name:	Date Signed:
Address:	CEA/HERS Certification Identification (If applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Installation is true and correct.
2. I am either: a) a responsible person eligible under Division 3 of the Business and Professions Code in the applicable classification to accept responsibility for the system design, construction, or installation of features, materials, components, or manufactured devices for the scope of work identified on this Certificate of Installation and attest to the declarations in this statement, or b) I am an authorized representative of the responsible person and attest to the declarations in this statement on the responsible person's behalf.
3. The constructed or installed features, materials, components or manufactured devices (the installation) identified on this Certificate of Installation conforms to all applicable codes and regulations and the installation conforms to the requirements given on the Certificate of Compliance, plans, and specifications approved by the enforcement agency.
4. I understand that a HERS rater will check the installation to verify compliance and if such checking determines the installation fails to comply, I am required to offer any necessary corrective action at no charge to the building owner.
5. I will ensure that a registered copy of this Certificate of Installation shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Installation is required to be included with the documentation the builder provides to the building owner at occupancy.

Responsible Builder/Installer Name:	Responsible Builder/Installer Signature:	
Company Name: (Installing Subcontractor or General Contractor or Builder/Owner)	Position With Company (Title):	
Address:	CSLB License:	
City/State/Zip:	Phone	Date Signed:
Third Party Quality Control Program (TPQCP) Status:	Name of TPQCP (if applicable):	

Roofing Products
Single-Family

Administrative § 10-113

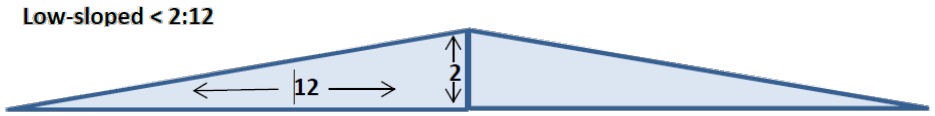
Mandatory § 110.8(i)

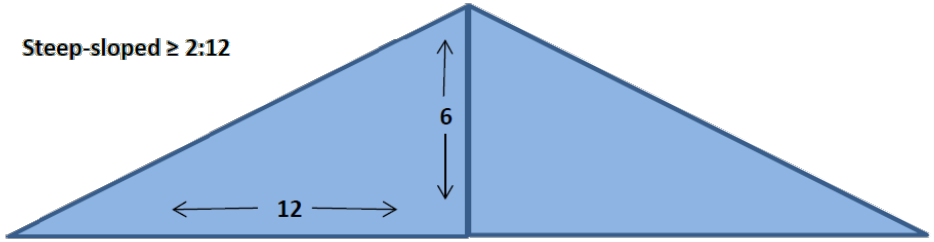
Prescriptive § 150.1(c)

Additions and Alterations § 150.2(a-b)

Roof Definitions

All buildings § 100.1





Low-sloped - rise to run less than 2:12

Steep-sloped - rise to run of 2:12 or greater

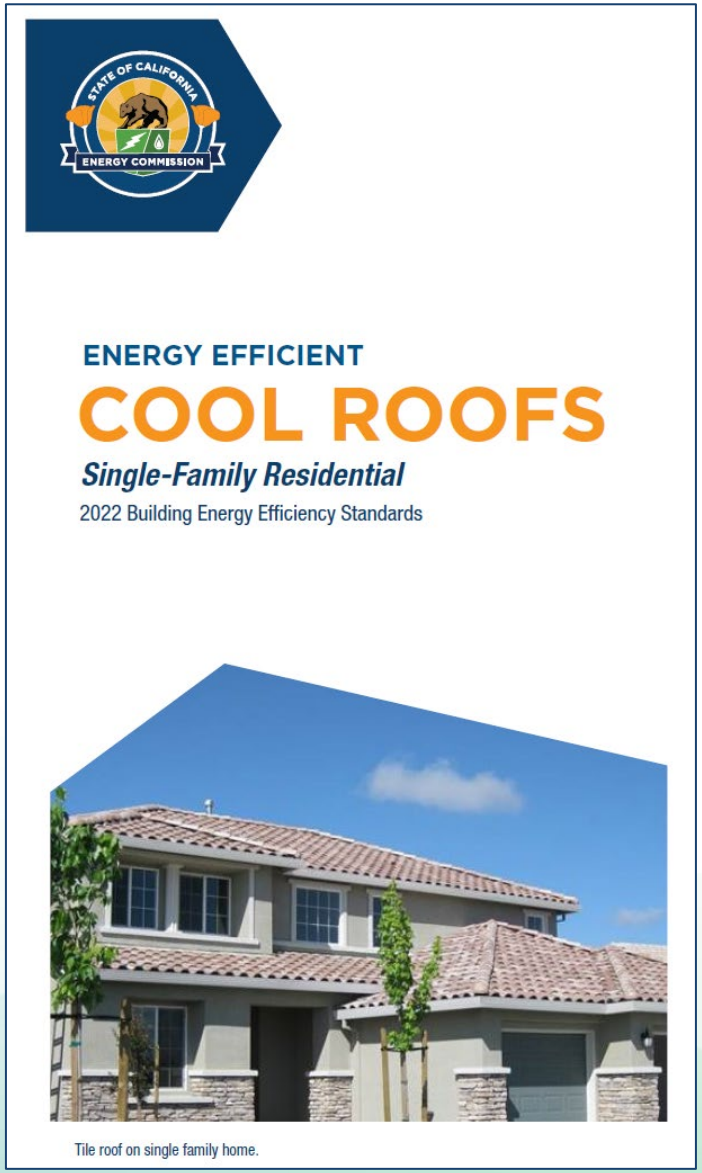
Solar reflectance (SR) - ability to reflect solar energy from the sun back into the atmosphere

Thermal emittance (TE) - the ability to release heat that has been absorbed

Solar reflectance index (SRI) - combines SR three-year aged value and TE in an equation

Single-Family Cool Roof Brochure

- Cool roofs reflect more sunlight and absorb less heat
- Roofing products must meet minimum solar reflectance and thermal emittance values for Energy Code compliance
- Higher values equal cooler roofs



Roofing Products Administrative Regulations

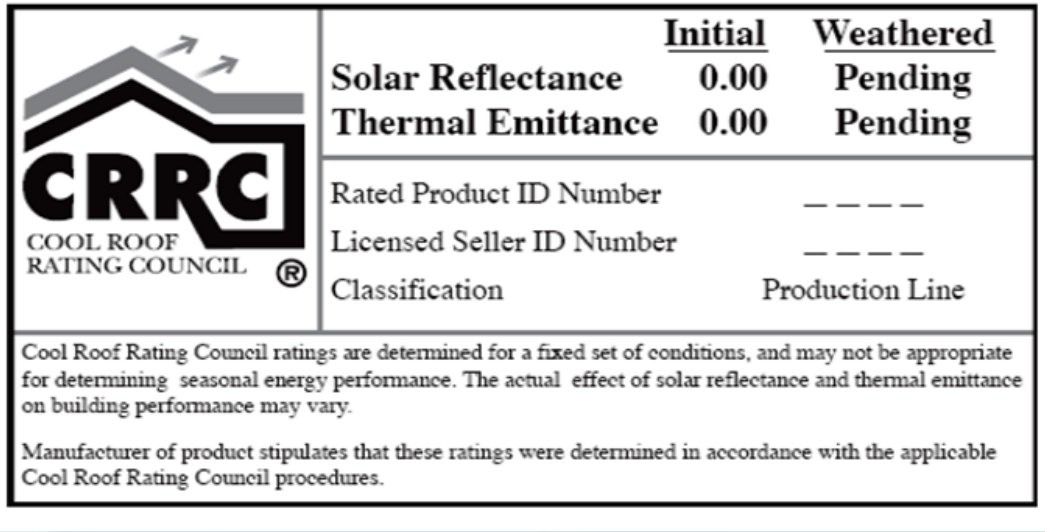
All buildings § 10-113

Certification requirements

- Cool Roof Rating Council (CRRC) is responsible for certifying

Labeling requirements

- Solar reflectance and thermal emittance must be listed



CRRC
COOL ROOF RATING COUNCIL ®

	Initial	Weathered
Solar Reflectance	0.00	Pending
Thermal Emittance	0.00	Pending

Rated Product ID Number	_ _ _ _
Licensed Seller ID Number	_ _ _ _
Classification	Production Line

Cool Roof Rating Council ratings are determined for a fixed set of conditions, and may not be appropriate for determining seasonal energy performance. The actual effect of solar reflectance and thermal emittance on building performance may vary.

Manufacturer of product stipulates that these ratings were determined in accordance with the applicable Cool Roof Rating Council procedures.

Roofing Products Mandatory Requirements

All buildings § 110.8(i)

Roofing products

- Meet aged solar reflectance and thermal emittance thresholds
- Certified and labeled per § 10-113
- CEC default values for non-certified products
- SRI may be used as alternative to aged SR and TE values
  - SRI worksheet
  - Allows for initial SR when aged SR is not available
- Liquid-applied roof coatings to meet Table 110.8-C for coverage and thickness requirements

Roofing Products Prescriptive Requirements

Single-family § 150.1(c)11, Table 150.1-A

Roofing products

- Meet aged SR and TE per Table 150.1-A or meet SRI
  - Steep-sloped roofs in climate zones 10-15
    - Minimum aged solar reflectance of 0.20
    - Minimum thermal emittance of 0.75
    - Minimum solar reflectance index of 16
  - Low-sloped roofs in climate zones 13 and 15
    - Minimum aged solar reflectance of 0.63
    - Minimum thermal emittance of 0.75
    - Minimum solar reflectance index of 75

Roofing Products Prescriptive Requirements

Single-family Table 150.1-A

- Roofing product

	Climate Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Low-Sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.63	NR	0.63	NR
Low-Sloped	Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	NR	0.75	NR
Steep-Sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.20	0.20	0.20	0.20	0.20	0.20	NR
Steep-Sloped	Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	0.75	0.75	0.75	NR

Roofing Products Additions Prescriptive Requirements

Single-family § 150.2(a)

Roofing products meet prescriptive requirements in § 150.1(c)11

- Exception for additions of 300 square feet or less

Existing house

Addition

Roof Alterations Prescriptive Requirements

Single-family § 150.2(b)1I

Updated for 2022

Roof replacements 50% or more

- Expands climates zones for cool roofs

Roof Type	Climate Zone	Minimum Three-Year Aged Solar Reflectance	Minimum Thermal Emittance	Minimum SRI
Steep-sloped	4, 8-15	0.20	0.75	16
Low-sloped	4, 6-15	0.63	0.75	75

Roof Alterations Prescriptive Requirements

Single-family § 150.2(b)1Ii-ii

Updated for 2022

Exceptions for steep-sloped roofs

- Ceiling insulation at least R-38 or U-factor 0.025
- Radiant barrier per Section 150.1(c)2
- No ducts in attic in climate zones 2, 4, 9, 10, 12 and 14
- Continuous insulation at roof deck R-2 or greater
- Roof area covered by building integrated photovoltaic panels or building integrated solar thermal panels
- Roof constructions with weight of at least 25 pounds per ft^2

Roof Alterations Prescriptive Requirements

Single-family § 150.2(b)1Iiia, Table 150.2-B

Updated for 2022

Exceptions for low-sloped roofs

- Insulation trade-off for low-sloped roofs per Table 150.2-B
- Roof area covered by building integrated photovoltaic panels or building integrated solar thermal panels
- Roof constructions with weight of at least 25 pounds per ft^2

Table 150.2-B Aged Solar Reflectance Insulation Trade-Off

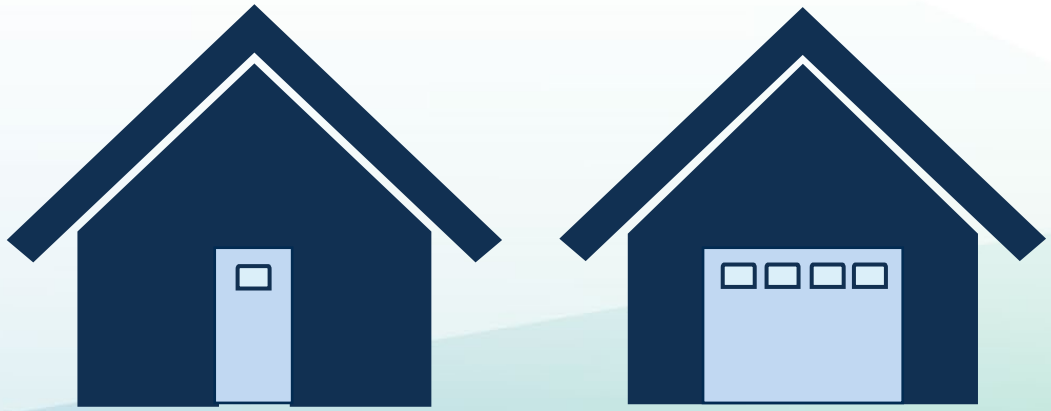
Minimum Aged Solar Reflectance	Roof Deck Continuous Insulation R-value (Climate Zones 6-7)	Roof Deck Continuous Insulation R-value (Climate Zones 2, 4, & 8-15)
0.60	2	16
0.55	4	18
0.50	6	20
0.45	8	22
No Requirement	10	24

Test Your Knowledge

Does an alteration to the roof of an unconditioned detached garage trigger cool roof requirements?

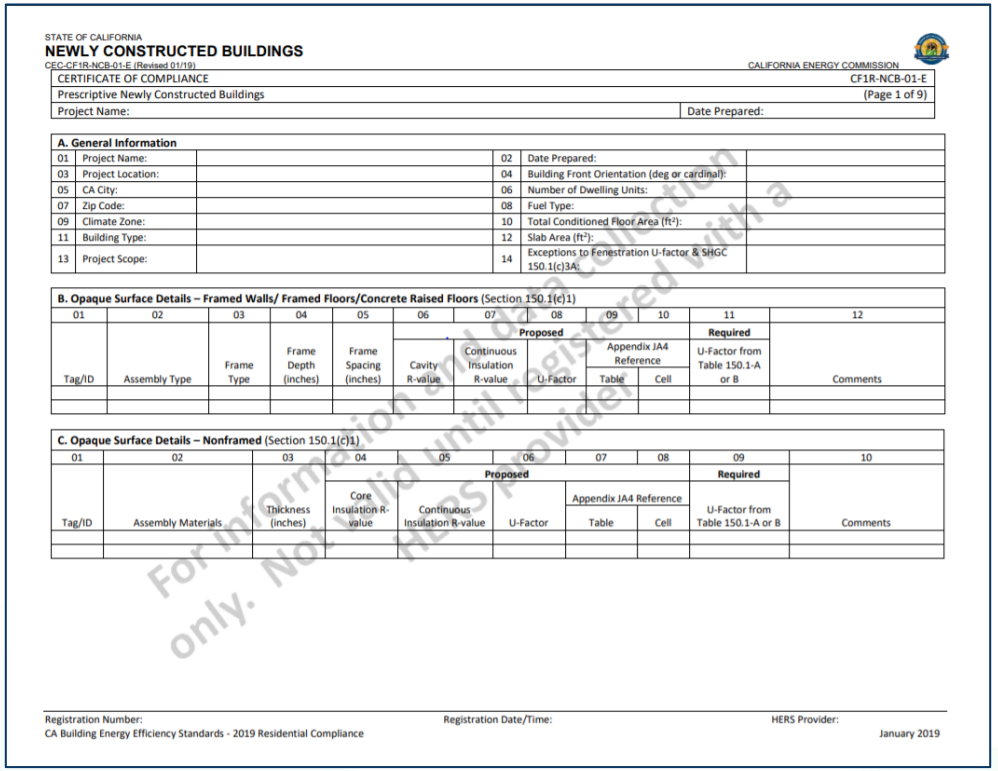
No, alterations to the roof of an unconditioned detached garage do not trigger cool roof requirements

- Building envelope requirements usually do not apply to unconditioned buildings



Plans Examiners

- Verify required roof product values
  - Certain climate zones
  - SRI worksheet
- Verify CF1R values match plans



STATE OF CALIFORNIA
NEWLY CONSTRUCTED BUILDINGS
CEC-CF1R-NCB-01-E (Revised 01/19) — CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE	CF1R-NCB-01-E
Prescriptive Newly Constructed Buildings	(Page 1 of 9)
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 (ft²):	
11	Building Type:		12	Slab Area (ft²):	
13	Project Scope:		14	Exceptions to Fenestration U-factor & SHGC 150.1(c)3A:	

B. Opaque Surface Details – Framed Walls/ Framed Floors/Concrete Raised Floors (Section 150.1(c)1)

01	02	03	04	05	06	07	08	09	10	11	12
					Proposed					Required	
Tag/ID	Assembly Type	Frame Type	Frame Depth (inches)	Frame Spacing (inches)	Cavity R-value	Continuous Insulation R-value	U-Factor	Appendix JA4 Reference: Table	Appendix JA4 Reference: Cell	U-Factor from Table 150.1-A or B	Comments

C. Opaque Surface Details – Nonframed (Section 150.1(c)1)

01	02	03	04	05	06	07	08	09	10
			Proposed					Required	
Tag/ID	Assembly Materials	Thickness (inches)	Core Insulation R-value	Continuous Insulation R-value	U-Factor	Appendix JA4 Reference: Table	Appendix JA4 Reference: Cell	U-Factor from Table 150.1-A or B	Comments

For information and data collection only. Not valid until registered with a HERS provider.

Registration Number: — Registration Date/Time: — HERS Provider:
CA Building Energy Efficiency Standards - 2019 Residential Compliance — January 2019

OPAQUE SURFACES

01	02	03	04	05	06	07	08
Name	Zone	Construction	Azimuth	Orientation	Gross Area (ft^2)	Window and Door Area (ft2)	Tilt (deg)
Right Wall	ADU	R-21+R-5 Wall	180	Right	216	64	90
Ceiling Below Attic	ADU	R-38 Ceiling	n/a	n/a	816	n/a	n/a
Floor Over Crawlspace	ADU	R-19 Crawlspace	n/a	n/a	816	n/a	n/a

ATTIC

01	02	03	04	05	06	07	08
Name	Construction	Type	Roof Rise (x in 12)	Roof Reflectance	Roof Emittance	Radiant Barrier	Cool Roof
Attic	Tile Roof +R-19 BRD	Ventilated	5	0.2	0.75	No	Yes

FENESTRATION / GLAZING

01	02	03	04	05	06	07	08	09	10	11	12	13	14
Name	Type	Surface	Orientation	Azimuth	Width (ft)	Height (ft)	Mult.	Area (ft^2)	U-factor	U-factor Source	SHGC	SHGC Source	Exterior Shading
Window 1	Window	Front Wall	Front	270			1	20	0.3	NFRC	0.23	NFRC	Bug Screen
Glazed Door 1	Window	Front Wall	Front	270			1	20	0.53	Table 110.6-A	0.65	Table 110.6-B	Bug Screen
Window 2	Window	Front Wall	Front	270			1	20	0.3	NFRC	0.23	NFRC	Bug Screen
Window 3	Window	Rear Wall	Back	90			1	20	0.3	NFRC	0.23	NFRC	Bug Screen
Window 4	Window	Rear Wall	Back	90			1	4	0.3	NFRC	0.23	NFRC	Bug Screen
Window 5	Window	Rear Wall	Back	90			1	9	0.3	NFRC	0.23	NFRC	Bug Screen
Window 6	Window	Right Wall	Right	180			1	24	0.3	NFRC	0.23	NFRC	Bug Screen
Window 7	Window	Right Wall	Right	180			1	40	0.3	NFRC	0.23	NFRC	Bug Screen

Field Inspectors

CRRC
COOL ROOF RATING COUNCIL ®

	Initial	Weathered
Solar Reflectance	0.20	Pending
Thermal Emittance	0.75	Pending
Rated Product ID Number		_ _ _ _
Licensed Seller ID Number		_ _ _ _
Classification		Production Line

Cool Roof Rating Council ratings are determined for a fixed set of conditions, and may not be appropriate for determining seasonal energy performance. The actual effect of solar reflectance and thermal emittance on building performance may vary.

Manufacturer of product stipulates that these ratings were determined in accordance with the applicable Cool Roof Rating Council procedures.

At rough frame verify

- Cool roof in certain climate zones

At final verify

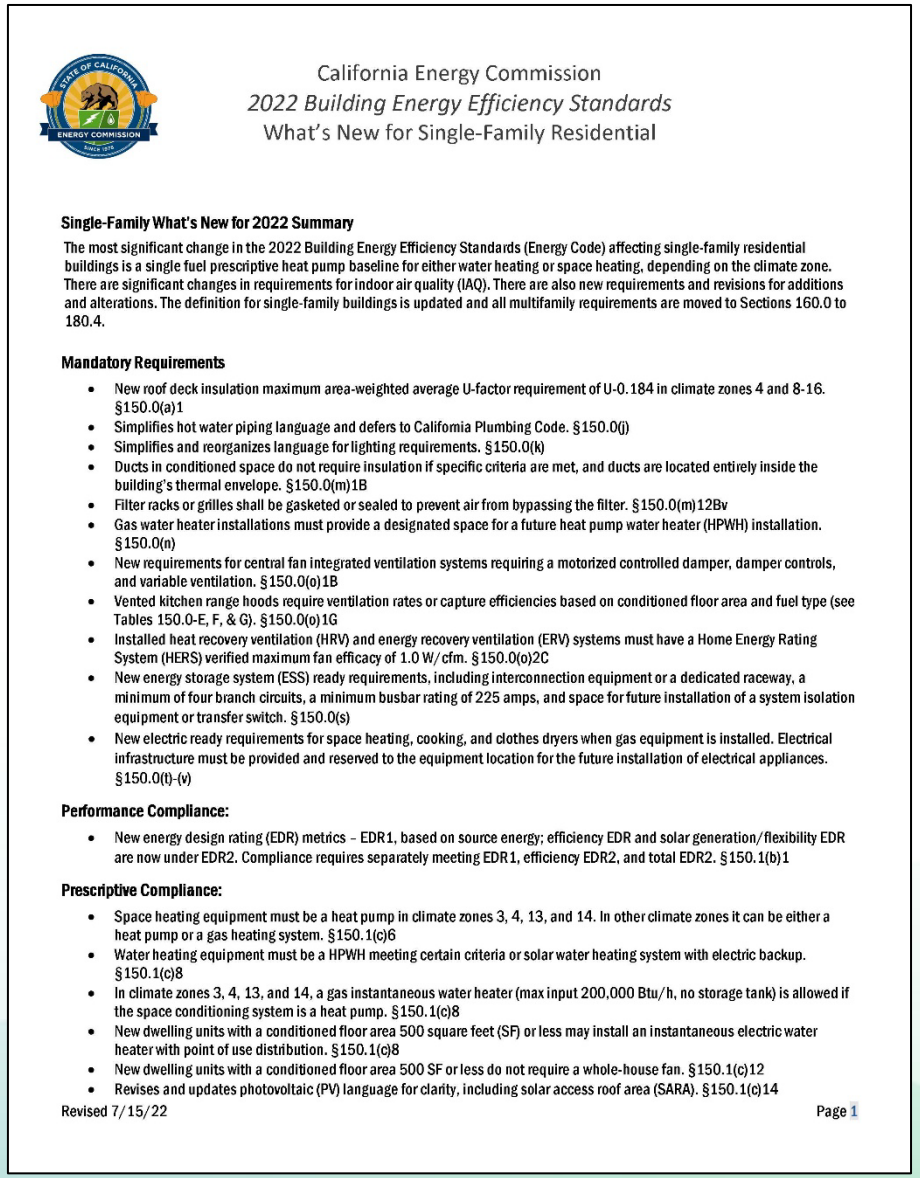
- CF2R installation forms
- Registered with HERS provider
  - Not required for roof only alterations
  - Request project status report (PSR)

Resources

Single-family Changes

What's New for Single-family

- Summary of significant changes
- Code references
- Mandatory requirements summary is also available
- Download from the Online Resource Center



California Energy Commission
2022 Building Energy Efficiency Standards
What's New for Single-Family Residential

Single-Family What's New for 2022 Summary

The most significant change in the 2022 Building Energy Efficiency Standards (Energy Code) affecting single-family residential buildings is a single fuel prescriptive heat pump baseline for either water heating or space heating, depending on the climate zone. There are significant changes in requirements for indoor air quality (IAQ). There are also new requirements and revisions for additions and alterations. The definition for single-family buildings is updated and all multifamily requirements are moved to Sections 160.0 to 180.4.

Mandatory Requirements

- New roof deck insulation maximum area-weighted average U-factor requirement of U-0.184 in climate zones 4 and 8-16. §150.0(a)1
- Simplifies hot water piping language and defers to California Plumbing Code. §150.0(j)
- Simplifies and reorganizes language for lighting requirements. §150.0(k)
- Ducts in conditioned space do not require insulation if specific criteria are met, and ducts are located entirely inside the building's thermal envelope. §150.0(m)1B
- Filter racks or grilles shall be gasketed or sealed to prevent air from bypassing the filter. §150.0(m)12Bv
- Gas water heater installations must provide a designated space for a future heat pump water heater (HPWH) installation. §150.0(n)
- New requirements for central fan integrated ventilation systems requiring a motorized controlled damper, damper controls, and variable ventilation. §150.0(o)1B
- Vented kitchen range hoods require ventilation rates or capture efficiencies based on conditioned floor area and fuel type (see Tables 150.0-E, F, & G). §150.0(o)1G
- Installed heat recovery ventilation (HRV) and energy recovery ventilation (ERV) systems must have a Home Energy Rating System (HERS) verified maximum fan efficacy of 1.0 W/cfm. §150.0(o)2C
- New energy storage system (ESS) ready requirements, including interconnection equipment or a dedicated raceway, a minimum of four branch circuits, a minimum busbar rating of 225 amps, and space for future installation of a system isolation equipment or transfer switch. §150.0(s)
- New electric ready requirements for space heating, cooking, and clothes dryers when gas equipment is installed. Electrical infrastructure must be provided and reserved to the equipment location for the future installation of electrical appliances. §150.0(t)-(v)

Performance Compliance:

- New energy design rating (EDR) metrics – EDR1, based on source energy; efficiency EDR and solar generation/flexibility EDR are now under EDR2. Compliance requires separately meeting EDR1, efficiency EDR2, and total EDR2. §150.1(b)1

Prescriptive Compliance:

- Space heating equipment must be a heat pump in climate zones 3, 4, 13, and 14. In other climate zones it can be either a heat pump or a gas heating system. §150.1(c)6
- Water heating equipment must be a HPWH meeting certain criteria or solar water heating system with electric backup. §150.1(c)8
- In climate zones 3, 4, 13, and 14, a gas instantaneous water heater (max input 200,000 Btu/h, no storage tank) is allowed if the space conditioning system is a heat pump. §150.1(c)8
- New dwelling units with a conditioned floor area 500 square feet (SF) or less may install an instantaneous electric water heater with point of use distribution. §150.1(c)8
- New dwelling units with a conditioned floor area 500 SF or less do not require a whole-house fan. §150.1(c)12
- Revises and updates photovoltaic (PV) language for clarity, including solar access roof area (SARA). §150.1(c)14

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Online Resource Center

www.energy.ca.gov/orc

Handouts
- Fact sheets
- Guides

Tools
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- Blueprint newsletter

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- Internal resources
- External resources

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HERS Program information

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- Newly constructed buildings
- Additions
- Alterations of residential and nonresidential buildings
- California whole-house home energy ratings
- HERS building performance contractors

CHEERS

- Newly constructed buildings
- Additions
- Alterations of residential and nonresidential buildings

Blueprint Newsletter

Energy Code quarterly newsletter

- Updates
- Clarifications
- Frequently asked questions

Issue 144 | October - December 2023

BLUEPRINT

CALIFORNIA ENERGY COMMISSION

EFFICIENCY DIVISION

In This Issue

For additional help with the Energy Code, see Energy Code Ace's **online offerings** of trainings, tools, and resources.

2025 Energy Code Update: Draft Regulations

The **2025 Energy Code** will improve upon the 2022 Energy Code by updating energy efficiency standards for newly constructed buildings, additions, and alterations to existing buildings, consistent with state and federal law. During pre-rulemaking California Energy Commission (CEC) staff evaluated proposed revisions to the 2025 Energy Code and prepared draft regulations (known as **Express Terms**). During the rulemaking in 2024, the CEC will have 45-day and 15-day public comments periods. The final 2025 Energy Code language will be proposed for adoption after the public comment periods in 2024 for an anticipated publication in 2025, with an effective date of January 1, 2026.

Summary of Staff Proposed Changes

- Introduces heat pump standards for existing single-family homes and for designated types of existing nonresidential buildings
- Updates heat pump standards for newly constructed single-family, multifamily, and designated types of nonresidential building
- Updates photovoltaic system standards for newly constructed buildings
- Updates energy storage standards for high-rise multifamily, nonresidential, and hotel and motel buildings
- Increases envelope efficiency standards
- Increases space conditioning system efficiency and control standards
- Improves indoor air quality requirements for multifamily buildings
- Improves efficiency standards for multifamily domestic water heating systems
- Establishes electric-ready requirements for multifamily domestic water heating systems
- Simplifies standards for multifamily buildings
- Increases efficiency requirements for pool and spa water heating systems

1

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  - Appliances
  - Blueprint
  - Building Standards
- Respond to confirmation email

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Energy Code Hotline

Monday through Friday

- 8:00 a.m. to 12:00 p.m.
- 1:00 p.m. to 4:30 p.m.

Call

- 800-772-3300 in CA
- 916-654-5106 outside CA

Email

- Title24@energy.ca.gov

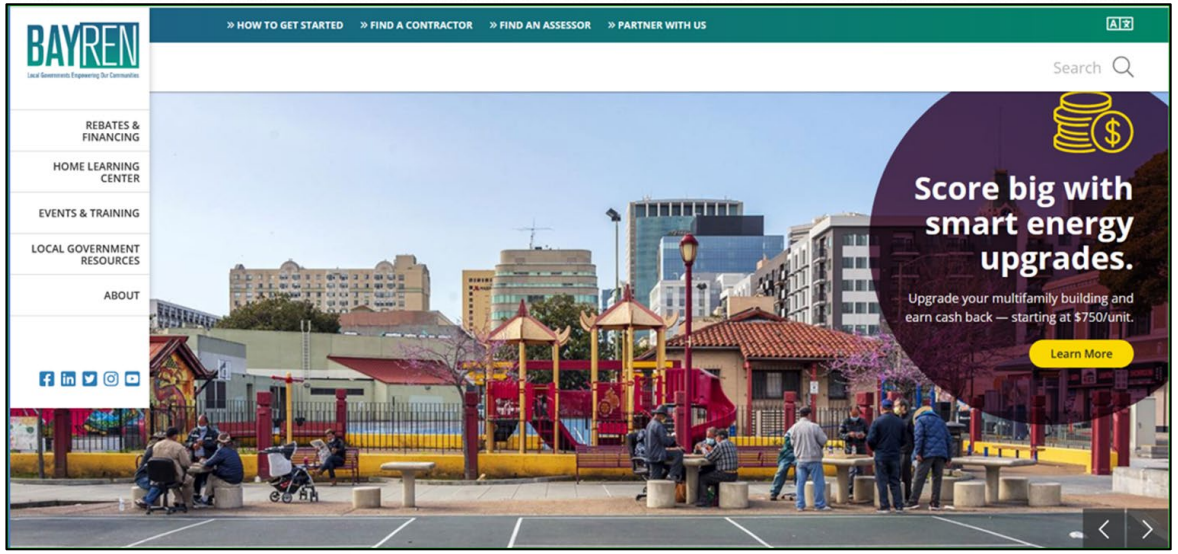
Compliance Software Support

Email

- Nonresidential and multifamily software
  - CBECC@energy.ca.gov
- Single-family residential software
  - CBECC.Res@energy.ca.gov

Energy Code Ace

Local RENs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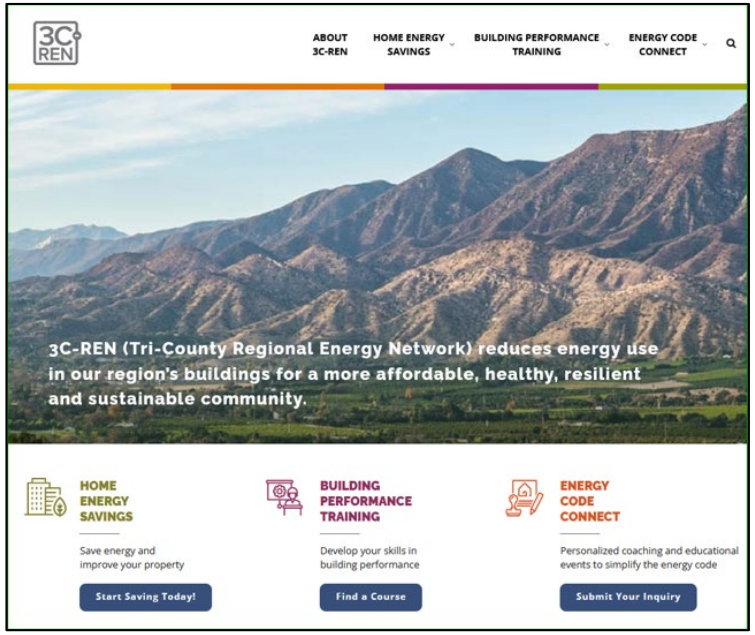
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Whether you're a homeowner, multifamily property owner or manager, business owner, or public agency representative, the Southern California Regional Energy Network (SoCalREN), a service of the County of Los Angeles, can help you take advantage of a wide variety of energy efficiency opportunities that can help you save energy and money. Learn more by visiting the program of your choice below, and feel free to contact us with any questions.

New Resource Hub

Homeowners and renters

- Information about water and space heating, cooking, EV charging, incentives

Contractors

- Information about training, tools, incentives

Local government representatives

- Information about model policies, permitting, training, incentives

Links on the Building and Home Energy Resource Hub

Thank you