

California Energy Commission
STAFF REPORT

DRAFT EVALUATION REPORT

**Application for Compliance Option for
Open Cell, Low-Density Spray Polyurethane Foam
(OcSPF) Insulation**

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CALIFORNIA ENERGY COMMISSION

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ABSTRACT

The Spray Polyurethane Foam Alliance (SPFA) has submitted an application and supporting information requesting approval of a compliance option for open-cell, low-density spray polyurethane foam (ocSPF) insulation. The application is consistent with the Compliance Options procedures in Section 10-109 of the Building Energy Efficiency Standards.

The SPFA seeks this Compliance Option application to allow this product type to receive compliance credit for Quality Insulation Installation (QII).

California Energy Commission staff believes the intent of the application is warranted and the general content of the SPFA proposed changes to compliance documentation is appropriate. Staff believes that compliance with the standards would be best served by developing a single comprehensive QII procedure covering both ocSPF and closed cell, medium density spray polyurethane foam (ccSPF) insulation. Staff recommends that a staff workshop be held to discuss the proposals that are included in this draft evaluation report.

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Introduction

On November 1, 2010, the California Energy Commission received an application and supporting information from representatives of the Spray Polyurethane Foam Alliance (SPFA) requesting approval of a compliance option for open-cell, low-density spray polyurethane foam (ocSPF) insulation. The application is consistent with the compliance options procedures in Section 10-109 (b) 4 of the Building Energy Efficiency Standards and those described in the *Compliance Options Approval Manual for the Building Energy Efficiency Standards: CEC-400-2005-007*.

SPFA seeks this compliance option application to allow ocSPF insulation to receive compliance credit for Quality Insulation Installation (QII). The SPFA application seeks approval to apply the same QII credit to ocSPF that is currently approved for closed-cell, medium-density spray polyurethane foam (ccSPF) insulation when installed and inspected through third-party verification to meet specified QII procedures.

Since ocSPF's thermal performance and installation processes are similar to that of ccSPF insulation, the SPFA has proposed a QII procedure for ocSPF insulation that is based on the current approved QII procedure for ccSPF insulation in JA7 of the Reference Appendices.

- SPFA's application does not require modifications to performance computer modeling nor does it propose modifications to the prescriptive packages.
- SPFA's application proposes to use the same R-value per inch for ocSPF that is currently allowed in compliance reference information.

The compliance option request from SPFA is supported by the following proposed compliance documents:

- A proposed QII installation procedure for ocSPF
- Editorial modifications to specific JA4 tables and their respective footnotes contained in the *2008 Reference Appendices*
- Editorial modifications to the *2008 Residential Compliance Manual*
- Modifications to the QII Installer (CF-6R) and HERS Rater (CF-4R) forms

Staff believes that compliance with the standards would be best served through developing a single comprehensive QII procedure covering both ocSPF and ccSPF product types.

Staff recommends that a staff workshop be held to address the proposed compliance option and documents in this draft evaluation report. Following public review staff will prepare its final evaluation and recommendations for approval to the Energy Commission.

Background

Effectiveness of Insulation

Research completed by the Energy Commission has found that typical home insulation installations have construction defect flaws that degrade thermal performance. Three categories of problems commonly occur when insulation is improperly installed:

- Insulation not in contact with the air barrier causes a “short circuit” of the insulation’s thermal resistance due to unconditioned air circulation between the insulation and the air barrier,
- Gaps and voids in the insulation leads to uninsulated portions of the building envelope and,
- Overly compressed insulation or insulation installed at less than prescribed levels degrades insulation performance. This can occur in entire cavities or around and under wiring, piping, and electrical and other service components.

Beginning with the *2005 Standards*, performance modeling of all insulation materials was changed to reflect these common installation defects, reducing expected thermal resistance of insulation assemblies by about 19 percent.

Insulation Installation Quality

To address these common installation defects and to encourage quality installation of insulation materials, a compliance credit was provided beginning with the *2005 Standards* for following quality installation procedures. The credit, available when using the performance approach to demonstrate compliance with the standards, requires verification by a third-party, certified Home Energy Rating System (HERS) rater. Specific verification procedures were adopted as part of the *Standards Reference Appendices*, and are known as High Quality Insulation Installation (QII) Procedures.

QII protocols were developed for the predominant insulation materials used in residential construction at the time: mineral fiber batts, blown-in mineral fiber, and cellulose loose fill material.

During the development of the *2008 Standards*, SPFA representatives worked with the Energy Commission to develop QII procedures for ccSPF insulation. QII procedures for ccSPF were adopted in the *2008 Standards* and included in the *2008 Reference Appendices; Appendix JA7 – Installation Procedures for Medium-Density, Closed-Cell Spray Polyurethane Foam (SPF)*.

Since the adoption of the *2008 Standards*, the SPFA has worked closely with its members and the Energy Commission to develop QII procedures for ocSPF insulation.

SPFA Compliance Option Application

The SPFA's application for a compliance option for residential buildings proposes to allow ocSPF insulation to receive compliance credit for Quality Insulation Installation (QII). Its application is supported by the following proposed compliance documents:

- A proposed QII installation procedure for ocSPF
- Editorial modifications to specific JA4 tables and their respective footnotes contained in the *2008 Reference Appendices*
- Editorial modifications to the *2008 Residential Compliance Manual*
- Modifications to the QII Installer (CF-6R) and HERS Rater (CF-4R) forms

Staff believes that compliance with the standards would be best served through the development of a single comprehensive QII procedure covering both ocSPF and ccSPF product types. This approach was discussed and agreed to by the SPFA and is presented in this draft evaluation report.

All information from the SPFA compliance option application is included in the attachments. In some cases, staff has modified the SPFA's proposed language to better address compliance needs.

Provided below is staff's summary of key aspects of each of the compliance documents that support the SPFA compliance option application.

- **Attachment 1: Alternative Quality Insulation Installation Procedures for Spray Polyurethane Foam (SPF) Insulation: Medium-Density Closed Cell and Low-Density Open Cell**
 - Staff and the SPFA acknowledge there are strong similarities in the procedures needed to provide quality installation and third-party verification for both ocSPF and ccSPF insulation. The proposed single QII document covering installation procedures for SPF insulation would be an alternative to the current procedure focused solely on ccSPF, which has been adopted by regulation in JA7 of the *2008 Reference Appendices*.
 - This procedure has been reorganized compared to the current JA7 procedures to identify more clearly key elements affecting installation and field verification. Additional criteria have also been added in Section 5 to ensure quality of the installation.
 - Section 3 provides a new R-value table for ocSPF insulation based on the prescribed R-3.6 per inch currently allowed in compliance reference information. Additional language has been added for ccSPF and ocSPF, recognizing that approved performance compliance software may specify other thicknesses to achieve a specific R-value used for compliance. Onsite field verification of installed thickness must always be completed. The HERS rater is required to check installed thickness using probes or similar devices at several locations within the building, and standard wall assemblies with 2x4 inch and 2x6 inch framing must be completely filled when ocSPF insulation is used.
 - Section 3 allows the average installed thickness of ocSPF to be used to determine the installed R-value, allowing up to 10 percent of the surface area to have small depressions

not less than 1 inch of the minimum thickness required to achieve the specified R-value on compliance documentation.

- Cautionary language has been added in Sections 5, 8 (d), and 9 (a & e) regarding insulation installation in unvented attics, including the amount of insulation required, the requirement to insulate gable ends, and the requirement to check for the safety of fuel-burning appliances when they are present in the attic area.

- **Attachment 2: 2008 Reference Appendices—Appendix JA4 – U-factor, C-factor, and Thermal Mass Data**

The values in Appendix JA4 are used for all residential and nonresidential compliance calculations: prescriptive, overall envelope, and building performance. Energy Commission approved compliance software may make adjustments to the table values using procedures described in this appendix. Under to Section 4.1.1 of Appendix JA4, information regarding the assembly tables in Appendix JA4 can be modified or new information included upon approval by the Energy Commission’s Executive Director.

- A new Section 4.1.7 is proposed to be added to this attachment to accompany the changes in the tables and their respective footnotes and to provide baseline performance guidance for SPF insulation, including descriptions of ccSPF and ocSPF insulation, their designated R-value per inch, and nominal thicknesses.
- Clarifications have been made to table descriptions, footnotes, and assumptions. No changes have been made to R-values or U-factors with one exception: *Table 4.3.3 – U-factors of Metal Framed Walls for Nonresidential Construction*, has been modified to include a low R-value (R-5) cavity insulation condition in combination with exterior continuous sheathing (R-12) to better account for combinations of insulating material being used in nonresidential construction.

- **Attachment 3: 2008 Residential Compliance Manual**

- Modifications to Chapter 3, Building Envelope Requirements, of the Residential Compliance Manual (RCM) are proposed to more clearly describe the performance characteristics of SPF insulation both for ccSPF and ocSPF. Modifications to Section 3.3.7 describe ocSPF’s allowance to receive the QII compliance credit upon verification by a HERS Rater should the Energy Commission approve the SPFA Compliance Option request. The RCM is not adopted by regulation. Staff makes periodic editorial changes to the RCM to help improve the information contained in this manual, and provides public notice of those updates when they are made available.

- **Attachment 4: Compliance Forms**

- The success of the requirements in the standards depends on enforcement and verification in the field. Inclusion of a QII compliance credit for ocSPF insulation necessitates modifying QII compliance forms to cover installation and field verification checklists for use at both the framing and insulation stages of insulation installation.

Conclusion

All information contained in the SPFA Compliance Option request is included in the attachments. In some cases staff has modified the SPFA's proposed language to better address compliance needs. This information is provided for discussion and review and covers each of the compliance documents that must be modified to support the SPFA application.

Energy Commission staff believes the intent of the application is warranted and the general content of the SPFA proposed changes to compliance documentation is appropriate. Staff recommends that a staff workshop be held to discuss the proposals which are included in staff's draft evaluation report.

ATTACHMENT 1

Staff proposed QII insulation installation procedures for open cell spray polyurethane foam (ocSPF), including approved procedures for closed cell polyurethane (ccSPF) foam of JA7 are noted below:

Alternative Quality Insulation Installation Procedures for Spray Polyurethane Foam (SPF) Insulation: Medium-Density Closed Cell and Low-Density Open Cell

1. Purpose

These procedures detail the installation and inspection protocols necessary to qualify for the allowed energy credit for High Quality Insulation Installation (QII) of spray polyurethane foam (SPF) insulation. These procedures must be field verified before the building construction permit is finalized in order to claim the QII energy compliance credit for SPF insulation.

The energy credit is available for low rise-residential buildings after verification is made by a certified Home Energy Rating System (HERS) rater. These procedures and energy credit apply to a wood or metal framed wall, floor, ceilings, and/or roof assemblies insulated with SPF insulation.

2. Scope

These procedures apply to two types of SPF used as building insulation: medium-density closed cell SPF (ccSPF) and low-density open cell SPF (ocSPF). Most often, the same procedures will apply to both ccSPF and ocSPF. However, in some construction situations the procedures will be different. Situations where the procedures are different are highlighted in a grey text box.

NOTE 1: High-rise residential, hotel/motel, and nonresidential buildings are required to follow these procedures when either type of SPF insulation is installed, and a certified HERS rater is required to verify compliance with these procedures.

NOTE 2: For ccSPF, these procedures or the procedures in JA7 of the Reference Appendices shall be used.

3. Thermal Specification

ccSPF

A spray applied polyurethane foam insulation having a closed cellular structure resulting in an installed nominal density of 2.0 ±0.5 pounds per cubic foot.

R-value: The total R-value shall be calculated based on the nominal required thickness of the insulation multiplied by an R-value of 5.8 per inch. Based on this calculation, the overall assembly U-factor shall be determined by selecting the assembly that matches the assembly type, framing configuration, and cavity insulation from the appropriate Reference Joint Appendix JA4 table. The thickness for the proposed required R-value of ccSPF insulation shall meet or exceed the thickness specified in Table 1 below.

Alternatively, the R-value of the installed insulation shall be based on the verified thickness at an R-value of 5.8 per inch. Approved compliance software shall make appropriate adjustments to account for the R-value and U-factor effects of the ccSPF assembly.

Nominal Thickness: ccSPF sprayed into framed cavities or on flat surfaces will expand with variable thicknesses, visibly appearing as undulations on the surface of the insulation. The average thickness of the foam insulation must meet or exceed the required R-value. Depressions in the foam insulation's surface shall not be greater than 1/2-inch of the required thickness at any given point of the surface area being insulated.

See the Certificate of Compliance for the minimum R-values required for compliance with the Standards.

ATTACHMENT 1

Table 1 Required Thickness of ccSPF Insulation to Achieve Given R-values

Equivalent R-Values for ccSPF insulation	11	13	15	19	21	22	25	30	38
Required thickness of ccSPF Insulation (inches)	2.00	2.25	2.75	3.50	3.75	4.00	4.50	5.25	6.75

ocSPF

A spray applied polyurethane foam insulation having an open cellular structure resulting in an installed nominal density of 0.4 to less than 1.5 pounds per cubic foot.

R-value: The total R-value shall be calculated based on the nominal required thickness of the insulation multiplied by an R-value of 3.6 per inch. Based on this calculation, the overall assembly U-factor shall be determined by selecting the assembly that matches the assembly type, framing configuration, and cavity insulation from the appropriate Reference Joint Appendix JA4 table. The thickness for the proposed required R-value of ocSPF insulation shall meet or exceed the thickness specified in the table below.

Alternatively, the R-value of the installed insulation shall be based on the verified thickness at an R-value of 3.6 per inch. Approved compliance software shall make appropriate adjustments to account for the R-value and U-factor effects of the ocSPF assembly.

Nominal Thickness: ocSPF sprayed into framed cavities or on flat surfaces will expand with variable thicknesses, visibly appearing as undulations on the surface of the insulation. The average thickness of the foam insulation must meet or exceed the required R-value. Depressions in the foam insulation surface shall not be greater than 1-inch of the required thickness provided these depressions do not exceed 10% of the surface area being insulated.

Additional requirements for ocSPF: ocSPF foam insulation shall completely fill cavities of 2x4 and 2x6 inch framing.

See the Certificate of Compliance for the minimum R-values required for compliance with the Standards.

Table 2 Required Thickness of ocSPF Insulation to Achieve Given R-values

Equivalent R-Values for ocSPF insulation	11	13	15	19	21	22	25	30	38
Required thickness of ccSPF Insulation (inches)	3.0	3.5	4.2	5.3	5.8	6.1	6.9	8.3	10.6

4. Terminology

Continuous Air Barrier	<p>An air barrier is needed in all thermal envelope assemblies to prevent air movement. SPF insulation is designed to stop air movement so an additional air barrier is not required in areas where SPF insulation is applied.</p> <p><u>A combination of interconnected materials and assemblies joined and sealed together to provide a continuous air-tight boundary of the building envelope separating conditioned from unconditioned space. Insulation must be in substantial contact with the assembly air barrier on one side for it to perform at its rated R-value.</u></p> <p><u>Note: An air barrier is needed in all thermal envelope assemblies to prevent air movement between unconditioned/outside spaces and conditioned/inside spaces. ccSPF may serve as the air barrier in assemblies where it is installed.</u></p>
Air-tight	<p><u>Not permitting the passage of air either in or out of the building envelope.</u></p> <p><u>Note:</u> Thermal envelope assemblies (such as wall assemblies) shall be built to minimize air movement. Air movement can move unwanted heat and moisture through or into the assembly. For these procedures, air-tight shall be defined as an assembly or air barrier with all openings greater than 1/8 inch caulked, or sealed with minimally expansive foam.</p>

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Closed-Cell SPF	See Medium-Density SPF
Draft Stops	<p>Draft stops are installed to prevent air movement between wall cavities, other interstitial cavities and the attic. They are typically constructed of dimensional lumber blocking, drywall or plywood.</p> <p><u>A material, device or construction installed to prevent the movement of air within open spaces of concealed areas of building components such as crawl spaces, floor/ceiling assemblies, roof/ceiling assemblies and attics.</u></p> <p><u>Note:</u> Draft stops become part of the attic air barrier and shall be air-tight. Fire blocks constructed of porous insulation materials cannot serve as draft stops since they are not air tight. Draft stops become part of the attic air barrier and shall be air-tight.</p>
Gaps	<p>A gap is an <u>Uninsulated areas</u> at the edge of an insulated area or penetrations, <u>compressions or spaces within the plane of the insulation that reduce the insulation's contact with the air barrier.</u> Gaps in insulation are avoidable and are not permitted.</p>
Hard Covers	<p><u>Building materials, such as plywood or gypboard, which become part of the ceiling air barrier.</u></p> <p><u>Note:</u> Hard covers shall be installed above areas where there is a drop ceiling. For example, a home with 10ft ceilings may have an entry closet with a ceiling lowered to 8ft. In this case, a hard cover is installed at the 10ft level above the entry closet. Hard covers become part of the ceiling air barrier and shall be air-tight.</p>
Medium Density SPF	<p>A structural spray polyurethane foam (SPF) having a nominal density of 2.0 <u>+ 0.5</u> pounds per cubic foot.</p>
Minimally Expansive Foam	<p>A <u>single-component</u> polyurethane foam system typically formulated <u>in a handheld can</u> to <u>seal and</u> fill construction gaps and crevasses, <u>holes, and cracks</u> without distorting adjacent framing. Minimally expansive foam typically expands only 2 to 5 times its dispensed volume. <u>They are not used for insulation purposes, rather as agents for air sealing cracks and voids in opaque surfaces</u></p>
Net Free-Area	<p>The net free-area of a vent cover is equal to the total vent opening less the interference to air flow caused by the screen or louver. Screened or louvered vent opening covers are typically marked by the manufacturer with the "net free-area." For example a 22.5 in. by 3.5 in. eave vent screen with a total area of 78.75 square inches may have a net free-area of only 45 square inches.</p>
Nominal Thickness	<p>Medium-Density SPF insulation typically exhibits surface undulations due to the insulation's expansion in the cavity. SPF insulation thicknesses will, therefore, vary from point to point and from side to side of construction cavities (typically thickness will be greater at the perimeter of construction cavities where the SPF is filled onto framing members and thinner toward the center of the cavity). Since the R-value of the SPF insulation is measured by its thickness, it is important that the average thickness of the SPF insulation be sufficient to meet the requirements of the project. However, the minimum thickness at any given point should be no more than 1/2 inch less than the required thickness.</p>
Spray Polyurethane Foam (SPF)	<p>A foamed plastic insulation material formed by the reaction of an isocyanurate and a polyol that uses a blowing agent to develop a cellular structure when spray applied onto a substrate. SPF insulation is a two-component reactive system mixed at a spray gun or a single-component system that cures by exposure to humidity. SPF insulation can be formulated to have specific physical properties (i.e., density, compressive strength, fire resistance and R-value) appropriate for the application requirements.</p>

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<u>Voids & Air Spaces</u>	An uninsulated space within an enclosed building assembly created when the assembly has been insulated by partial filling of the framed cavity. The partial fill results in an air space (void) between the insulation surface and the assembly's cover or sheathing exterior or interior layers. Voids are permitted under this Procedure. (Contrast with the definition for Gaps.) <u>See Gaps.</u>
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5. Material General Requirements for Walls, Roof/Ceilings, and Floors

- The HERS rater shall verify that the manufacturer's nominal insulation thickness has been installed and certified and that all requirements determination on of the Certificate of Field Verification and Diagnostic Testing (CF-4R) have has been met.
- The HERS rater shall verify that SPF insulation is in substantial contact with the assembly air barrier, particularly when ccSPF insulation is being used to provide air barrier control.
- SPF insulation shall be applied by SPF applicators trained and experienced in the use and maintenance of high-pressure, plural-component equipment. SPF applicators shall be certified by the SPF insulation manufacturer for the application of SPF insulation systems.
- SPF insulation shall be spray-applied to fully adhere to assembly framing, floor and ceiling the joists, and other framing surfaces within the construction cavity. When multiple layers of SPF material are applied, each foam lift (i.e. spray application) shall have adhesion at substrate and foam interfaces. SPF insulation shall not exhibit areas that:
 - Have voids or gaps in the uniformity of the insulation
 - Are extremely soft or spongy for ccSPF
 - Show the presence of liquid
 - Have blistering between lifts
 - Show differences in coloration of adjacent foam layers
 - Indicate the presence of other materials between lifts
- SPF insulation shall be installed in conformance with the manufacturer's specifications, recommendations and temperature/humidity limitations.
- Substrates to which SPF insulation is applied shall be secure and free of surface moisture, frost, grease, oils, dirt, dust or other contaminants that would adversely affect SPF adhesion.
- SPF insulation shall meet all provisions of CBC, Title 24, Part 2 and be separated from occupied spaces by an approved thermal barrier, such as 0.5 inch gypsum wallboard or other approved material, or show equivalence through testing in accordance with California Building Code (CBC), Title 24, Part 2, Section 2603.
- In unvented attics where SPF insulation is used to insulate roof and attic surfaces, and fuel burning appliances are present (i.e., gas furnace, water heater), the HERS rater shall verify the appliance manufacturer's allowance for the equipment's use in unvented applications.
- Materials shall comply with flame spread index and smoke developed index requirements of CBC, Title 24, Part 2, Section 2603.5.4.
- Materials shall meet California Quality Standards for Insulating Material, Title 24, Part 12, Chapter 4, Article 3, and be listed in the California Department of Consumer Affairs Consumer Guide and Directory of Certified Insulating Materials.
- ~~The HERS rater shall verify that the manufacturer's nominal insulation thickness has been installed and certified that determination on the Certificate of Field Verification and Diagnostic Testing (CF-4R).~~

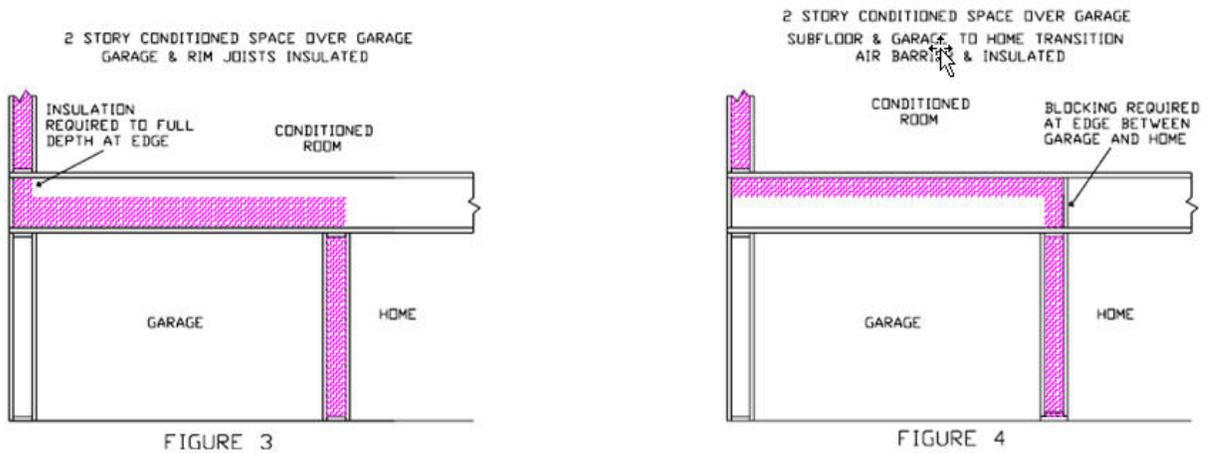
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6. Raised Floors and Floors Over Garages

- a. Raised Floors
 - o SPF insulation shall be spray-applied to fully adhere to the bottom side of the floor sheathing, and
 - o SPF insulation installation shall uniformly cover the cavity side-to-side and end-to-end top-to-bottom.
- b. Floors Over Garages

~~Two Story Homes with Conditioned Space over the Garage~~

The floor over the garage shall be insulated by spraying SPF insulation to fully adhere to the subfloor of the conditioned space. The garage and the adjacent conditioned space (house) shall be insulated up to the subfloor including any gaps between the header and the floor joist and should be fully air tight. SPF insulation shall cover any gaps between the header and the floor joist.

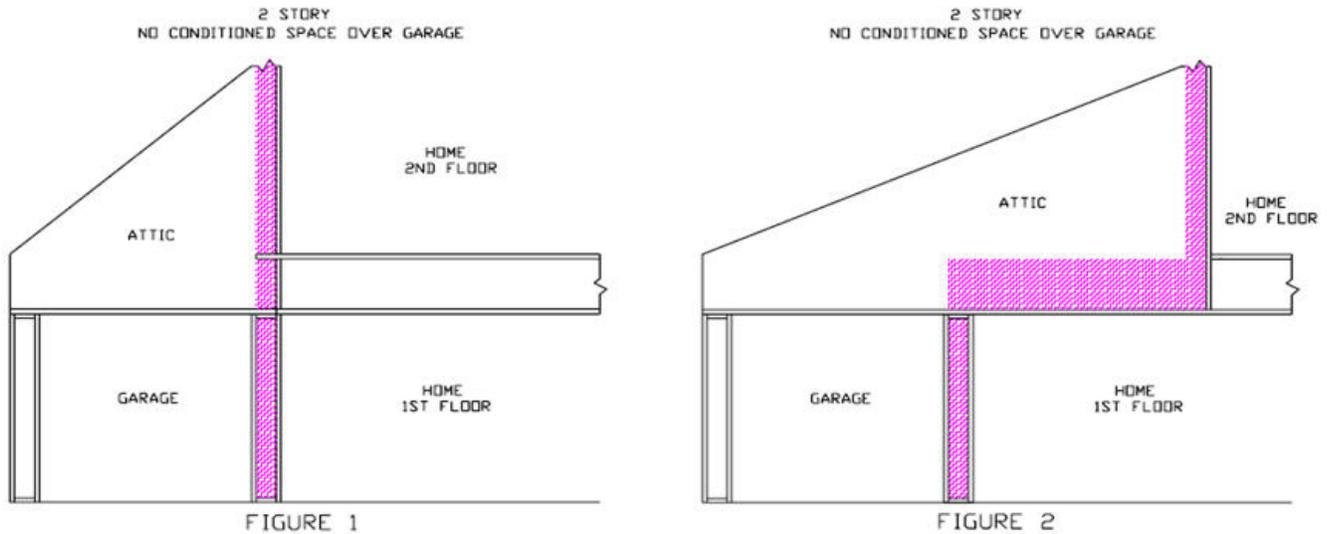


~~Two Story Homes with No Conditioned Space over the Garage~~

The band joist where the garage transitions to an attic above conditioned space shall have an air barrier installed in contact with the edge of the attic insulation with no gaps. ~~SPF insulation may serve as the air barrier as long as there are no gaps.~~

ccSPF insulation may serve as the air barrier.

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7. Wall Insulation

a. SPF Application

- In wall cavities, SPF insulation shall be applied to provide an air-tight envelope to the outdoors, attic, garage and crawl space. and between adjoining cavity surfaces of conditioned and unconditioned space, such as: attic, garage, and crawl space. Special attention shall be paid to plumbing and wiring penetrations through the top plates and bottom plate framing, and electrical boxes that penetrate the sheathing and the sheathing seal to the top and bottom plate framing.
- ~~SPF insulation installation shall uniformly cover the cavity side-to-side and top-to-bottom. An air space may be left between the surface of the Medium-Density SPF insulation and the interior sheathing/drywall provided the appropriate thickness of SPF insulation has been applied to achieve the specified R-value and the SPF insulation is installed to cover and form an air barrier on the framing at the top, bottom and sides of each cavity.~~
- SPF insulation installation shall uniformly cover the cavity side-to-side and end-to-end and shall be installed to cover and form an air barrier on the framing at the top, bottom and sides of each cavity.

Additional requirement for ocSPF: An air space may be left between the surface of SPF insulation and the interior finish sheathing/drywall in framed wall cavities provided the appropriate thickness of SPF insulation has been applied to achieve the specified R-value. ocSPF insulation must fill the cavity of 2x4 and 2x6 inch framing.

b. Narrow-Framed Cavities

- Non-standard width cavities shall be filled with SPF insulation at a depth consistent with the SPF thickness required to achieve the specified R-value.
- Narrow spaces (2 inches or less) at windows and door jambs shall be filled with minimally expansive foam sealing material.
- Narrow spaces (2 inches or less), such as between studs at the building corners and at the intersections of partition walls, shall be filled with batt insulation snugly fitted into the space (without excessive compression), loose fill insulation, or minimally expansive foam.

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8. Special Situations

- a. Installations Prior to Exterior Sheathing or Lath
 - o Hard to access wall stud cavities such as corner channels, wall intersections, and behind tub/shower enclosures shall be insulated to the required R-value. This may have to be done prior to the installation of the tub/shower or the exterior sheathing or stucco lath.
- b. Obstructions and Wall Penetrations
 - o SPF insulation shall be applied to fully seal around wiring and plumbing.
 - o SPF insulation shall be applied to fully seal between the sheathing and the rear of electrical boxes and phone boxes.
 - o In cold climates, where water pipes may freeze (Climate Zones 14 and 16), pipes shall have at least two-thirds of the insulation between the water pipe and the outside. If the pipe is near the outside exterior finish assembly layers, as much insulation as possible shall be placed between the pipe and the ~~outside exterior sheathing or stucco lath~~ assembly material.
- c. Rim Joists
 - o All rim-joists shall be insulated to the same R-value as the adjacent walls.
 - o The insulation shall be installed without gaps or voids.
- d. Kneewalls, ~~and~~ Skylight Shafts and Gable Ends
 - o All kneewalls and skylight shafts shall be insulated to a minimum of R-19 ~~or a higher level as specified in the compliance documentation~~.
 - o In unvented attics, where SPF is applied directly to the underside of the roof deck, all gable ends shall be insulated to the same R-value as the exterior walls and as specified in the compliance documentation.
 - o In unvented attics, where SPF is applied directly to the underside of the roof deck, it is not necessary to insulate kneewalls.
 - o The SPF insulation shall be installed without gaps or voids.
 - o ~~The interior side of the SPF insulation is not required to be in contact with the drywall or other wall finishes.~~
 - o The SPF insulation shall be fully adhered and self-supporting so that it will remain in place.

Additional requirement for ocSPF: An air space may be left between the surface of SPF insulation and the interior finish sheathing/drywall in framed wall cavities, provided the appropriate thickness of SPF insulation has been applied to achieve the specified R-value. ocSPF insulation must fill the cavity of 2x4 and 2x6 inch framing.

- e. HVAC/Plumbing Closet
 - o Walls of interior closets for HVAC and/or water heating equipment that require combustion air venting, shall be insulated to the same R-value as the exterior walls as specified in the compliance documentation.

9. Ceiling and Roof Insulation

- a. General Requirements
 - o SPF insulation shall be applied to fully adhere to the substrate (ceiling or roof deck).
 - o

ATTACHMENT 1

- ~~○ SPF insulation shall be spray-applied to fully adhere to the substrate (roof deck or ceiling).~~
 - SPF insulation shall be applied to fully adhere to the joist and other framing faces to form a complete air seal within the construction cavity.
 - ~~○ SPF insulation shall be installed in a continuous and fully adhered manner to form an air barrier.~~
 - SPF insulation shall be spray-applied to fully adhere to and seal around wiring and plumbing.
 - Hard covers or draft stops shall be placed over all drop ceiling areas and interior wall cavities to keep insulation in place and stop air movement. ~~If h~~Hard covers or draft stops are missing or incomplete, they shall be in place before insulation is installed.
 - In vented attics, required eave ventilation shall not be obstructed; the net free-ventilation area of the eave vent shall be maintained.
 - In unvented attics where SPF is applied directly to the underside of the roof deck, all gable end areas shall be insulated to the same R-value as the walls and as specified on compliance documentation. It is not necessary to place hard covers over drop ceilings and interior wall cavities in this situation.
 - All recessed light fixtures that penetrate the ceiling shall be IC rated and air tight rated and shall be sealed with a gasket or caulk between the housing and the ceiling.
 - SPF insulation shall not be applied directly to recessed lighting fixtures. Recessed light fixtures must be either insulated by methods other than SPF (such as mineral fiber) with CBC approved materials (i.e., mineral fiber) or enclosed in a box fabricated from ½-inch plywood, 18 gauge sheet metal, 1/4-inch hard board, or drywall or other approved materials. The exterior of the box may then be insulated with SPF. ~~If the f~~ixtures that are not air tight or and not rated for insulation contact (IC), the fixtures shall either be replaced or eliminated removed and/or replaced.
 - ~~○ All recessed light fixtures that penetrate the ceiling shall be IC rated and air tight rated and shall be sealed with a gasket or caulk between the housing and the ceiling.~~
- b. Enclosed Rafter Ceilings
- SPF insulation shall be kept away from combustion appliance flues in accordance with flue manufacturers' installation instructions or labels on the flue for clearance.
 - Prior to installation, verify that the building official permits SPF insulation directly applied to the underside of the roof deck and/or allows unvented rafter spaces.
- c. HVAC Platform
- ~~○ A minimum of 3 inches of SPF insulation shall be placed below any plywood platform or cat-walks installed in vented attics for HVAC equipment and access to assure that the overall assembly meets the required values listed in the compliance documentation.~~
 - ~~○ SPF insulation shall be installed in a continuous and fully adhered manner to form an air barrier.~~
- Additional requirements for SPF:** A minimum of 3 inches of ccSPF insulation or 5.3 inches of ocSPF shall be placed below any plywood platform or cat-walk access ways installed in vented attics for HVAC equipment or other needs. The overall assembly R-value shall meet the required values specified in the compliance documentation.
- d. Attic Access
- ~~○ Apply a minimum of 3 inches of SPF insulation to the access door or permanently attach rigid foam with adhesive or mechanical fastener to assure that the overall assembly meets the required values specified in the Compliance Documentation.~~

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Additional requirements for SPF: Apply a minimum of 3 inches of ccSPF or 5.3 inches of ocSPF insulation to the access door assuring good adhesion to the door surface. Alternatively, permanently attach rigid foam or batt insulation with adhesive or mechanical fastener. The overall assembly R-value shall meet the required values specified in the compliance documentation.

e. Attics and Cathedral Ceilings

- Prior to installation verify that the building official in your area permits SPF insulation directly applied to the underside of the roof.
- In vented and unvented conditioned attics where entry is made for the service of utilities, SPF applied in direct contact with the underside of the roof deck shall be protected from ignition in accordance with CBC Section 2603.
- ~~In cathedral ceilings where restricted spaces do not allow entry, SPF insulation does not require protection from ignition.~~
- In unvented attics, where SPF is applied directly to the underside of the roof deck, all gable ends shall be insulated to the same R-value as the exterior walls and as specified in the compliance documentation.
- In unvented attics where SPF insulation is used to insulate roof and attic surfaces, and fuel burning appliances are present (i.e., gas furnace, water heater), the HERS rater shall verify the appliance manufacturer's allowance for the equipment's use in unvented applications.

10. **JA7.8 Materials**

- ~~Materials shall comply with the CBC (including, but not limited to, Chapter 26) and installed to meet all applicable fire codes.~~
- ~~Materials shall meet California Quality Standards for Insulating Material, Title 24, Part 12, Chapter 4, Article 3, and be listed in the California Department of Consumer Affairs Consumer Guide and Directory of Certified Insulating Materials.~~
- ~~Materials shall comply with flame spread index and smoke developed index requirements of CBC Section 2603.5.4.~~
- ~~Materials shall be installed according to manufacturer specifications and instructions.~~

11. **R-value Measurement Equipment**

Probes for Medium Density SPF: Insulation thickness measurements shall be accurate to within $\pm 1/8$ inch. A probe or a measuring device shall be left with the compliance information for use by HERS Raters to verify adequate insulation levels. Probes capable of penetrating the full thickness of Medium Density SPF insulation with measurements marked by 1/8 inch increments shall be used by HERS Raters to verify proper thickness of insulation has been applied. The probes shall be designed to cause minimal damage to the insulation. HERS Raters shall measure in at least 6 random locations on various walls or ceilings to insure thickness levels specified on the Certificate of Compliance, CF-1R and CR-6R have been met.

- HERS Raters shall measure in at least 6 random locations on walls, roof/ceilings and floors (i.e., 6 measurements per opaque surface type: wall, roof/ceiling or floor) to ensure thickness levels specified on the Certificate of Compliance, CF-1R and CR-6R have been met. Measurement areas shall include low and high areas of the undulating SPF surface.
- Probes for inspection of installed thickness of SPF insulation: Measurement probes, gauges or devices shall be used by the HERS rater to verify that proper thickness of insulation has been applied. The insulation thickness shall be verified by using a probe, gauge or device capable of measuring the installed thickness. A pointed measurement probe or other gauge or device, capable of penetrating the full thickness of the insulation, shall be used having measurements marked by eighth inch increments. Insulation thickness measurement probes and gauges or devices shall be accurate to within $\pm 1/8$ inch.

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- A probe, gauge or a measuring device shall be left with the compliance information for use by the HERS rater to verify adequate insulation levels. Insulation thickness probes shall be designed to cause minimal damage to the insulation.

12. ~~JA7.10 R-Value and U-Value Specifications~~

Insulation values shall be based on the following.

For Medium Density SPF insulation the total R-value shall be calculated based on the nominal required thickness of the insulation multiplied by an R-value of 5.8 per inch. Based on this calculation for Medium Density SPF insulation, the overall assembly U-factor shall be determined by selecting the assembly that matches the assembly type, framing configuration, and cavity insulation from the appropriate Reference Joint Appendix JA4 table. The thickness for the proposed required R-value of the SPF insulation shall meet or exceed the thickness specified in Table JA7.1 below.

Table JA7.1: Required thickness of SPF Insulation to Achieve Particular R-values

Equivalent R-Values for standard SPF insulation	11	13	15	19	21	22	25	30	38
Required thickness of Medium-Density SPF Insulation (inches)	2.00	2.25	2.75	3.50	2.75	4.00	4.50	5.25	6.75

Certificates

- All provisions of Residential Appendix RA2 shall be met. An Insulation Certificate (CF-6R) signed by the SPF applicator ~~shall be provided~~ that states that the installation is consistent with the plans and specifications for which the building permit was issued shall be provided. The certificate shall also state the installing company name, insulation manufacturer's name and material identification, and that the labeled installed nominal thickness ~~as specified in JA7.9~~, and installed R-value for Medium-Density SPF insulation meets those specified in Section 3, Thermal Specification. The SPF applicator shall also attach a manufacturer's coverage chart or Specification Sheet with insulation coverage information for every insulation material used.

13. Certificates and Availability

- All provisions of Residential Appendix RA2 shall be met. The CF-6R with complete information, signed by the SPF applicator, and a measuring probe or similar device shall be available at the building site for the HERS rater's verification inspection. Note: The HERS rater shall not verify compliance credit without these completed forms.

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Staff proposed modifications to Appendix JA4 are noted below by section:

2008 REFERENCE APPENDICES

Appendix JA4 – U-factor, C-factor, and Thermal Mass Data

- Change 1:

4.1.7 R-values and U-factors for Spray Polyurethane Foam (SPF) Insulation: Medium-Density Closed Cell and Light-Density Open Cell

These procedures apply to two types of SPF used as building insulation: medium-density closed cell SPF (ccSPF) and low-density open cell SPF (ocSPF).

- **ccSPF**

A spray applied polyurethane foam insulation having a closed cellular structure resulting in an installed nominal density of 2.0 ±0.5 pounds per cubic foot.

R-value: The total R-value shall be calculated based on the nominal required thickness of the insulation multiplied by an R-value of 5.8 per inch. Based on this calculation, the overall assembly U-factor shall be determined by selecting the assembly that matches the assembly type, framing configuration, and cavity insulation from the appropriate Reference Joint Appendix JA4 table. The thickness for the proposed required R-value of ccSPF insulation shall meet or exceed the thickness specified in Table 1 below.

Alternatively, the R-value of the installed insulation shall be based on the verified thickness at an R-value of 5.8 per inch. Approved compliance software shall make appropriate adjustments to account for the R-value and U-factor effects of the ccSPF assembly.

Nominal Thickness: ccSPF sprayed into framed cavities or on flat surfaces will expand with variable thicknesses, visibly appearing as undulations on the surface of the insulation. The average thickness of the foam insulation must meet or exceed the required R-value. Depressions in the foam insulation's surface shall not be greater than 1/2-inch less of the required thickness at any given point of the surface area being insulated.

Table 4.1.7a Required Thickness of ccSPF Insulation to Achieve Given R-values

<u>Equivalent R-Values for ccSPF insulation</u>	<u>11</u>	<u>13</u>	<u>15</u>	<u>19</u>	<u>21</u>	<u>22</u>	<u>25</u>	<u>30</u>	<u>38</u>
<u>Required thickness of ccSPF Insulation (inches)</u>	<u>2.00</u>	<u>2.25</u>	<u>2.75</u>	<u>3.50</u>	<u>3.75</u>	<u>4.00</u>	<u>4.50</u>	<u>5.25</u>	<u>6.75</u>

NOTE: ccSPF insulation installed in High-rise residential, hotel/motel, and nonresidential buildings is required to have a HERS Rater verify the installation following the procedures of JA7 of the Reference Appendices or those specified in *Alternative Quality Insulation Installation Procedures for Spray Polyurethane Foam (SPF) Insulation: Medium-Density Closed Cell and Low-Density Open Cell.*

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- **ocSPF**

A spray applied polyurethane foam insulation having an open cellular structure resulting in an installed nominal density of 0.4 to less than 1.5 pounds per cubic foot.

R-value: The total R-value shall be calculated based on the nominal required thickness of the insulation multiplied by an R-value of 3.6 per inch. Based on this calculation, the overall assembly U-factor shall be determined by selecting the assembly that matches the assembly type, framing configuration, and cavity insulation from the appropriate Reference Joint Appendix JA4 table. The thickness for the proposed required R-value of ocSPF insulation shall meet or exceed the thickness specified in the table below.

Alternatively, the R-value of the installed insulation shall be based on the verified thickness at an R-value of 3.6 per inch. Approved compliance software shall make appropriate adjustments to account for the R-value and U-factor effects of the ocSPF assembly.

Nominal Thickness: ocSPF sprayed into framed cavities or on flat surfaces will expand with variable thicknesses, visibly appearing as undulations on the surface of the insulation. The average thickness of the foam insulation must meet or exceed the required R-value. Depressions in the foam insulation surface shall not be greater than 1-inch less of the required thickness provided these depressions do not exceed 10% of the surface area being insulated.

Table 4.1.7b Required Thickness of ocSPF Insulation to Achieve Given R-values

<u>Equivalent R-Values for ocSPF insulation</u>	<u>11</u>	<u>13</u>	<u>15</u>	<u>19</u>	<u>21</u>	<u>22</u>	<u>25</u>	<u>30</u>	<u>38</u>
<u>Required thickness of ocSPF Insulation (inches)</u>	<u>3.0</u>	<u>3.5</u>	<u>4.2</u>	<u>5.3</u>	<u>5.8</u>	<u>6.1</u>	<u>6.9</u>	<u>8.3</u>	<u>10.6</u>

NOTE: ocSPF foam insulation shall completely fill cavities of 2x4 and 2x6 inch framing.

- **Change 2:**

Table 4.2.2 – U-factors of Wood Framed Rafter Roofs

16 inch OC	2x4	20	0.074	0.064	0.057	0.051	0.049	0.046	0.043	0.036
<u>Loose-fill mineral fiber, ocSPF</u>	2x6	21	0.052	0.047	0.043	0.040	0.038	0.037	0.034	0.030
<u>Sprayed Foam or Cellulose Insulation^{2,5}</u>	2x8	22	0.041	0.038	0.035	0.033	0.032	0.031	0.029	0.026
	2x10	23	0.033	0.031	0.029	0.028	0.027	0.026	0.025	0.023
	2x12	24	0.028	0.027	0.025	0.024	0.023	0.023	0.022	0.020
24 inch OC	2x4	44	0.071	0.062	0.055	0.050	0.047	0.045	0.042	0.036
<u>Loose-fill mineral fiber, ocSPF</u>	2x6	45	0.050	0.045	0.042	0.038	0.037	0.036	0.033	0.029
<u>Sprayed Foam or Cellulose Insulation^{2,5}</u>	2x8	46	0.039	0.036	0.034	0.032	0.031	0.030	0.028	0.025
	2x10	47	0.032	0.030	0.028	0.027	0.026	0.025	0.024	0.022
	2x12	48	0.026	0.025	0.024	0.022	0.022	0.022	0.021	0.019

Notes:

- This assembly is only allowed where ventilation is provided between the bottom of the roof deck and the top of the insulation meeting CBC requirements or with enforcement agency officials approval of rafter attic assemblies with no ventilation air spaces.
- Loose-fill mineral fiber, ocSPF or cellulose insulation shall fill the entire cavity. Cellulose shall have a binder to prevent sagging. Verify that the building official in your area permits this construction, since there is no ventilation layer. Alternatively, ocSPF may use the procedure described in JA4, Section 4.1.7.

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This table contains thermal performance data (U-factors) for wood framed rafter roofs. This is a common construction in low-rise residential buildings and in Type V nonresidential buildings. The rafters may be either flat or in a sloped application. Insulation is typically installed between the rafters. With this construction, the insulation is in contact with the ceiling and there is typically a one-inch air gap above the insulation so that moisture can be vented. Whether there is an air space above the insulation depends on local climate conditions and may not be required in some building permit jurisdictions. ~~The ventilation space requirement would have to be waived by the building official for the case of cellulose insulation or foamed plastic, since the entire cavity would be filled.~~ Filling the entire cavity of framed rafter assemblies with loose-fill mineral fiber, cellulose, or ocSPF requires prior approval by the local building official.

Assumptions: These data are calculated using the parallel path method documented in the 2005 ASHRAE Handbook of Fundamentals. These calculations assume an exterior air film of R-0.17, asphalt shingles of R-0.44 (AR02), building paper of R-0.06 (BP01), ½ inch of wood based sheathing (Custom), continuous insulation (optional), the insulation / framing layer with an air space of R-0.76 or R-0.80 (except for loose-fill mineral fiber, cellulose, ccSPF, and ocSPF foamed plastic), 1/2 inch gypsum of R-0.45 (GP01), and an interior air film (heat flow up diagonally) of R-0.62. The continuous insulation may also be located at the ceiling, between the drywall and the framing. The framing percentage is assumed to be 10 percent for 16 inch OC and 7 percent for 24 inch. OC. The thickness of framing members is assumed to be the actual size of 3.50, 5.50, 7.25, 9.25, and 11.25 inches for 2x4, 2x6, 2x8, 2x10, and 2x12 nominal sizes. High-density batt insulation is assumed to be 8.5 inch thick for R-30 and 10.5 inch thick for R-38. The R-value of sprayed foam and cellulose insulation is assumed to be R-3.6 per inch.

- **Change 3:**

Table 4.2.5 – U-factors of Metal Framed Rafter Roofs

16 inch OC	2x6	17	0.099	0.083	0.071	0.062	0.058	0.055	0.050	0.041
<u>Loose-fill mineral fiber, ocSPF</u>	2x8	18	0.087	0.074	0.065	0.057	0.054	0.051	0.047	0.039
<u>ocSPF</u>	2x10	19	0.077	0.067	0.059	0.053	0.050	0.048	0.044	0.037
<u>Sprayed Foam or Cellulose Insulation^{2,5}</u>	2x12	20	0.069	0.061	0.054	0.049	0.047	0.044	0.041	0.035
	2x14	21	0.064	0.057	0.051	0.046	0.044	0.042	0.039	0.034
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24 inch OC	2x6	38	0.081	0.070	0.061	0.055	0.052	0.049	0.045	0.038
<u>Loose-fill mineral fiber, ocSPF</u>	2x8	39	0.070	0.061	0.055	0.049	0.047	0.045	0.041	0.035
<u>ocSPF</u>	2x10	40	0.061	0.054	0.049	0.045	0.043	0.041	0.038	0.033
<u>Sprayed Foam or Cellulose Insulation^{2,5}</u>	2x12	41	0.054	0.049	0.044	0.041	0.039	0.038	0.035	0.031
	2x14	42	0.049	0.045	0.041	0.038	0.036	0.035	0.033	0.029

Notes:

2. This assembly is only allowed where ventilation is provided between the bottom of the roof deck and the top of the insulation meeting CBC requirements or with enforcement agency officials approval of rafter attic assemblies with no ventilation air spaces.
5. Loose-fill mineral fiber, ocSPF foamed plastic or cellulose insulation shall fill the entire cavity. Cellulose shall have a binder to prevent sagging. Verify that the building official in your area permits this construction, since there is no ventilation layer. Alternatively, ocSPF may use the procedure described in JA4, Section 4.1.7.

This table contains pre-calculated U-factors for metal-framed rafter roofs where the ceiling is the air barrier. This construction assembly is similar to that covered by Table 4.2.2 except that metal framing members are substituted for the wood-framing members. The rafters may be either flat or in a sloped application. Insulation is typically installed between the rafters. With this

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construction, the insulation is in contact with the ceiling and there is typically a one-inch air gap above the insulation so that moisture can be vented. Whether or not there is an air space above the insulation depends on local climate conditions and may not be required in some building permit jurisdictions. The building official will need to waive the air gap requirement to allow the use of cellulose insulation or sprayed foam. Filling the entire cavity of framed rafter assemblies with loose-fill mineral fiber, cellulose, or ocSPF requires prior approval by the local building official.

- **Change 4:**

Table 4.3.1 – U-factors of Wood Framed Walls

16 inch OC	2x4	14	0.103	0.085	0.073	0.064	0.060	0.056	0.051	0.042
<u>Loose-fill mineral fiber, ocSPF</u>	2x6	15	0.071	0.062	0.055	0.050	0.047	0.045	0.042	0.036
<u>Loose-fill mineral fiber, ocSPF</u>	2x8	16	0.056	0.050	0.046	0.042	0.040	0.039	0.036	0.031
<u>Foamed Plastic or Cellulose Insulation³</u>	2x10	17	0.045	0.041	0.038	0.035	0.034	0.033	0.031	0.028
	2x12	18	0.038	0.035	0.033	0.031	0.030	0.029	0.028	0.025
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24 inch OC	2x4	32	0.099	0.083	0.071	0.062	0.058	0.055	0.050	0.041
<u>Loose-fill mineral fiber, ocSPF</u>	2x6	33	0.069	0.059	0.054	0.049	0.047	0.044	0.041	0.035
<u>Loose-fill mineral fiber, ocSPF</u>	2x8	34	0.054	0.049	0.044	0.041	0.039	0.038	0.035	0.031
<u>Foamed Plastic or Cellulose Insulation³</u>	2x10	35	0.044	0.040	0.037	0.035	0.034	0.033	0.031	0.027
	2x12	36	0.036	0.034	0.031	0.030	0.029	0.028	0.026	0.024

Notes:

5. Loose-fill mineral fiber, ocSPF Foamed plastic or cellulose insulation shall fill the entire cavity. Cellulose shall have a binder to prevent sagging. Alternatively, ocSPF may use the procedure described in JA4, Section 4.1.7.

Assumptions: Values in this table were calculated using the parallel heat flow calculation method, documented in the 2005 ASHRAE Handbook of Fundamentals. The construction assembly assumes an exterior air film of R-0.17, a 7/8 inch layer of stucco of R-0.18 (SC01), building paper of R-0.06 (BP01), continuous insulation (if any), the cavity insulation / framing layer, ½ inch gypsum board of R-0.45 (GP01), and an interior air film 0.68. The framing factor is assumed to be 25 percent for 16 inch stud spacing and 22 percent for 24 inch spacing. Loose-fill mineral fiber, ocSPF Foam plastic and cellulose insulation are assumed to entirely fill the cavity and have a thermal resistance of R-3.6 per inch. Actual cavity depth is 3.5 inch for 2x4, 5.5 inch for 2x6, 7.25 inch for 2x8, 9.25 inch for 2x10, and 11.25 inch for 2x12. High density R-30 insulation is assumed to be 8.5 inch thick batt and R-38 is assumed to be 10.5 inch thick.

- **Change 5:**

Table 4.3.3 – U-factors of Metal Framed Walls for Nonresidential Construction

Spacing	Cavity Insulation R-Value:	Nominal Framing Size	Rated R-value of Continuous Insulation ²									
			R-0	R-2	R-4	R-6	R-7	R-8	R-10	R-12	R-14	
			A	B	C	D	E	F	G	H	H _E	
16 in. OC	None	Any	1	0.458	0.239	0.162	0.122	0.109	0.098	0.082	<u>0.072</u>	0.062
	<u>R-5</u>	<u>2x4</u>	<u>1A</u>	<u>0.351</u>	<u>0.206</u>	<u>0.146</u>	<u>0.113</u>	<u>0.102</u>	<u>0.092</u>	<u>0.078</u>	<u>0.067</u>	<u>0.059</u>
	R-11	2x4	2	0.244	0.155	0.118	0.096	0.087	0.080	0.069	<u>0.062</u>	0.054
	R-13	2x4	3	0.217	0.151	0.116	0.094	0.086	0.079	0.068	<u>0.060</u>	0.054
	R-15	2x4	4	0.211	0.148	0.114	0.093	0.085	0.078	0.068	<u>0.060</u>	0.053

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R-19	2x6	5	0.183	0.134	0.106	0.087	0.080	0.074	0.065	<u>0.057</u>	0.051
R-21 ¹	2x6	6	0.178	0.131	0.104	0.086	0.079	0.073	0.064	<u>0.057</u>	0.051
R-19	2x8	7	0.164	0.123	0.099	0.083	0.076	0.071	0.062	<u>0.055</u>	0.050
R-22	2x8	8	0.160	0.121	0.098	0.082	0.075	0.070	0.062	<u>0.055</u>	0.049
R-25	2x8	9	0.158	0.120	0.097	0.081	0.075	0.070	0.061	<u>0.055</u>	0.049
R-30 ¹	2x8	10	0.157	0.119	0.096	0.081	0.075	0.070	0.061	<u>0.054</u>	0.049
R-30	2x10	11	0.140	0.109	0.090	0.076	0.071	0.066	0.058	<u>0.052</u>	0.047
R-38 ¹	2x10	12	0.139	0.109	0.089	0.076	0.070	0.066	0.058	<u>0.052</u>	0.047
R-38	2 x 12	13	0.124	0.099	0.083	0.071	0.066	0.062	0.055	<u>0.050</u>	0.045
<u>Loose-fill mineral fiber, ocSPF</u>	2 x 4	14	0.218	0.152	0.116	0.094	0.086	0.079	0.069	<u>0.060</u>	0.054
<u>Foamed Plastic or Cellulose Insulation</u> ³	2 x 6	15	0.179	0.132	0.104	0.086	0.079	0.074	0.064	<u>0.057</u>	0.051
	2 x 8	16	0.157	0.119	0.096	0.081	0.075	0.070	0.061	<u>0.054</u>	0.049
	2 x 10	17	0.138	0.108	0.089	0.075	0.070	0.066	0.058	<u>0.052</u>	0.047
	2 x 12	18	0.123	0.099	0.082	0.071	0.066	0.062	0.055	<u>0.050</u>	0.045
24 in. OC	None	Any	24	0.455	0.238	0.161	0.122	0.109	0.098	<u>0.072</u>	0.062
	<u>R-5</u>	<u>2x4</u>	<u>24A</u>	<u>0.333</u>	<u>0.200</u>	<u>0.143</u>	<u>0.111</u>	<u>0.100</u>	<u>0.091</u>	<u>0.077</u>	<u>0.067</u>
										<u>0.059</u>	
R-11	2x4	25	0.210	0.148	0.114	0.093	0.085	0.078	0.068	<u>0.060</u>	0.053
R-13	2x4	26	0.203	0.144	0.112	0.092	0.084	0.077	0.067	<u>0.059</u>	0.053
R-15	2x4	27	0.197	0.141	0.110	0.090	0.083	0.076	0.066	<u>0.059</u>	0.052
R-19	2x6	28	0.164	0.123	0.099	0.083	0.076	0.071	0.062	<u>0.055</u>	0.050
R-21 ¹	2x6	29	0.161	0.122	0.098	0.082	0.076	0.070	0.062	<u>0.055</u>	0.049
R-19	2x8	30	0.153	0.117	0.095	0.080	0.074	0.069	0.060	<u>0.054</u>	0.049
R-22	2x8	21	0.149	0.115	0.093	0.079	0.073	0.068	0.060	<u>0.053</u>	0.048
R-25	2x8	32	0.147	0.114	0.093	0.078	0.072	0.068	0.060	<u>0.053</u>	0.048
R-30 ¹	2x8	33	0.146	0.113	0.092	0.078	0.072	0.067	0.059	<u>0.053</u>	0.048
R-30	2x10	34	0.130	0.103	0.086	0.073	0.068	0.064	0.057	<u>0.051</u>	0.046
R-38 ¹	2x10	35	0.128	0.102	0.085	0.072	0.068	0.063	0.056	<u>0.050</u>	0.046
R-38	2 x 12	36	0.115	0.093	0.079	0.068	0.064	0.060	0.053	<u>0.048</u>	0.044
<u>Loose-fill mineral fiber, ocSPF</u>	2 x 4	37	0.204	0.145	0.112	0.092	0.084	0.078	0.067	<u>0.059</u>	0.053
<u>Foamed Plastic or Cellulose Insulation</u> ³	2 x 6	38	0.167	0.125	0.100	0.083	0.077	0.071	0.063	<u>0.056</u>	0.050
	2 x 8	39	0.146	0.113	0.092	0.078	0.072	0.067	0.059	<u>0.053</u>	0.048
	2 x 10	40	0.128	0.102	0.085	0.072	0.068	0.063	0.056	<u>0.050</u>	0.046
	2 x 12	41	0.114	0.093	0.078	0.068	0.063	0.060	0.053	<u>0.048</u>	0.044

Notes

3. Loose-fill mineral fiber, ocSPF Foamed plastic and cellulose insulation shall fill the entire cavity. Cellulose shall have a binder to prevent sagging.

Assumptions: Values in this table were calculated using the zone calculation method. The construction assembly assumes an exterior air film of R-0.17, a 7/8 inch layer of stucco of R-0.18, building paper of R-0.06 (BP01), continuous insulation (if any), the insulation / framing layer, 1/2 inch gypsum of R-0.45 gypsum board (GP01), and an interior air film 0.68. The steel framing is assumed to be 0.0747 inch thick with a 15 percent knock out. The framing factor is assumed to be 25 percent for 16 inch stud spacing and 22 percent for 24 inch spacing. The EZFrame internal default framing percentages are 15 percent for 16 inch stud spacing and 12 percent for 24 inch spacing. To account for the increased wall framing percentage the frame spacing input to the EZ Frame program is reduced to 13.218 inches for 16 inch stud spacing and 15.231 inches for 24 inch stud spacing. Loose-fill mineral fiber, ocSPF Foam plastic and cellulose insulation are assumed to entirely fill the cavity and have a thermal resistance of R-3.6 per inch. Actual cavity depth is 3.5 inch for 2x4, 5.5 inch for 2x6, 7.25 inch for 2x8, 9.25 inch for

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2x10, and 11.25 inch for 2x12. High density R-30 insulation is assumed to be 8.5 inch thick batt and R-38 is assumed to be 10.5 inch thick.

- **Change 6:**

Table 4.3.4 – U-factors of Metal Framed Walls for Residential Construction

16 inch OC	2 x 4	14	0.177	0.131	0.104	0.094	0.086	0.079
<u>Loose-fill mineral fiber, ocSPF</u>	2 x 6	15	0.152	0.119	0.095	0.087	0.080	0.074
<u>Foamed Plastic or Cellulose Insulation³</u>	2 x 8	16	0.121	0.098	0.082	0.076	0.070	0.066
	2 x 10	17	0.105	0.087	0.074	0.069	0.064	0.060
	2 x 12	18	0.092	0.077	0.067	0.063	0.059	0.056
24 inch OC	2 x 4	37	0.182	0.133	0.105	0.095	0.087	0.080
<u>Loose-fill mineral fiber, ocSPF</u>	2 x 6	38	0.146	0.112	0.092	0.084	0.078	0.072
<u>Foamed Plastic or Cellulose Insulation³</u>	2 x 8	39	0.121	0.097	0.081	0.075	0.070	0.066
	2 x 10	40	0.101	0.084	0.072	0.067	0.063	0.059
	2 x 12	41	0.087	0.074	0.064	0.060	0.057	0.054

Notes:

3. Loose-fill mineral fiber, ocSPF Foamed plastic and cellulose insulation shall fill the entire cavity. Cellulose shall have a binder to prevent sagging.

Assumptions: Values in this table were calculated using the zone calculation method. The construction assembly assumes an exterior air film of R-0.17, a 7/8 inch layer of siding or stucco averaging R-0.18, building paper of R-0.06 (BP01), continuous insulation (if any), the insulation / framing insulation layer, 1/2 inch gypsum of R-0.45 gypsum board (GP01), and an interior air film 0.68. The framing factor is assumed to be 25 percent for 16 inch stud spacing and 22 percent for 24 inch spacing. To account for the increased wall framing percentage, the frame spacing input to the EZ Frame program is reduced to 13.218 inches for 16 inch stud spacing and 15.231 inches for 24 inch stud spacing. The stud web thickness is assumed to be 0.038 inches, which is a 50/50 mix of 18 gauge and 20 gauge C-channel studs. This value was confirmed to be representative of low-rise residential construction by polling several California-based light-gauge steel structural engineers and light-gauge steel framers. Loose-fill mineral fiber, ocSPF Foam plastic and cellulose insulation are assumed to entirely fill the cavity and have a thermal resistance of R-3.6 per inch. Actual cavity depth is 3.5 inch for 2x4, 5.5 inch for 2x6, 8 inch for 2x8, 10 inch for 2x10, and 12 inches for 2x12. High density R-30 insulation is assumed to be 8.5 inch thick batt and R-38 is assumed to be 10.5 inches thick.

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Staff proposed modifications to the Residential Compliance Manual are noted below by section:

2008 RESIDENTIAL COMPLIANCE MANUAL

3 Building Envelope Requirements

3.3.2 Ceiling/Roof Insulation

Construction Practice

Ventilation

Where ceiling insulation is installed next to eave or soffit vents, a rigid baffle should be installed at the top plate to direct ventilation air up and over the ceiling insulation. See Figure 3-9. The baffle should extend beyond the height of the ceiling insulation and should have sufficient clearance between the baffle and roof deck at the top. There are a number of acceptable methods for maintaining ventilation air, including pre-formed baffles made of either paper or plastic. In some cases, plywood baffles are used.

The California Building Code (CBC) requires a minimum vent area to be provided in roofs with attics, including enclosed rafter roofs creating cathedral or vaulted ceilings. Check with the local building jurisdiction to determine which of the two CBC ventilation requirements are to be followed:

- CBC, Title 24, Part 2, Vol. 1, Section 1203.2 requires that the net free ventilating area shall not be less than 1/300 of the area of the space ventilated.
- CBC, Title 24, Part 2, Vol. 2.5, Section R806.2 requires that the net free ventilating area shall not be less than 1/150 of the area of the space ventilated ~~4 ft² for each 150 ft² of attic floor area.~~ This ratio may be reduced to 1/300 ~~to 300~~ if a ceiling vapor retarder is installed ~~present or if high (for example, ridge or gable vents) and low (soffit vents) attic ventilation is used.~~

In either situation, a minimum of 50% of the ventilators must be located in the upper portion of the space being ventilated at least 3 feet above eave or cornice vents.

Ventilating openings are typically covered with corrosion resistant wire cloth screening or similar mesh material. When part of the vent area is blocked by meshes or louvers, the resulting "net free area" of the vent must be considered when meeting ventilation requirements.

Unvented Attic Assemblies

Attic ventilation is the traditional way of controlling temperature and moisture in an attic. In an unvented attic assembly insulation is applied directly at the roofline of the building, either above or below the structural roof sheathing, and is tied into the insulation located in the walls so that the roof system becomes part of the insulated building enclosure. For this case, the thermal boundary of the building results in an unconditioned attic space between the ceiling gypsum and the insulated roof above.

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The provisions of CBC, Title 24, Part 2, Vol. 2.5, Section R806.4 describes conditions for insulation placed at the roof of the building as opposed to on top of the horizontal ceiling. Unvented attic assemblies are allowed provided that:

- Air-impermeable insulation is used below and in direct contact with the underside of the roof sheathing, or
- Air-permeable insulation is used below and in direct contact with the underside of the roof sheathing and rigid board or sheet insulation of at least R-4 is used above the roof sheathing, or
- Air-impermeable insulation is used below and in direct contact with the underside of the roof sheathing and an additional layer of air-permeable insulation is installed directly under the air-impermeable insulation.

Check with the local building jurisdiction to determine their specific requirements for unvented attic conditions.

Wood Rafter Constructions

Ventilating solid rafter spaces is more difficult than ventilating attics because each framing cavity requires its own vent openings. However, the requirement for ventilation is at the discretion of the local building official. It is common practice with loose-fill mineral fiber and cellulose insulation, for instance, to completely fill the cavity so that there is no ventilation at all. Also, if spray polyurethane foam (SPF) is used, it is applied to the underside of the roof deck leaving no ventilation space. With batt and loose-fill mineral fiber insulation, it is possible to ventilate above the insulation using eave baffles, ridge vents, and careful installation.

3.3.7 Compliance Options

Quality Insulation Installation

Examples of poorly installed insulation are shown in Figure 3-19.

With the performance method, designers and contractors can get credit for correctly installing insulation to eliminate or reduce the problems described above. Reference Residential Appendix RA3.5 contains a procedure for verifying the quality of mineral fiber and cellulose insulation installation in low-rise residential buildings. Credit for installation of medium density closed cell spray polyurethane foam (ccSPF) in residential and nonresidential buildings is given when the required installation procedures described in Reference Joint Appendix JA7 are followed. An alternative installation procedure may be followed that covers both ccSPF and open-cell spray polyurethane foam (ocSPF)-- Alternative Quality Insulation Installation Procedures for Spray Polyurethane Foam (SPF) Insulation: Medium-Density Closed Cell and Low-Density Open Cell. Through the performance approach, a compliance credit is offered when this procedure is followed by the insulation installer and verified by a qualified HERS rater.

The procedure and credit apply to wood-framed construction with wall stud cavities, ceilings, floors, and roof assemblies insulated with mineral fiber or cellulose insulation in low-rise residential buildings. ~~The procedure does not allow any credits for floor assemblies.~~ The procedures and credit for ccSPF and ocSPF apply to wood and metal-framed construction with wall stud cavities, ceilings, floors, and roof assemblies in low-

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rise residential buildings; those for ccSPF also apply to nonresidential buildings but no energy credit can be taken. The ceiling/roof constructions are presented in Reference Joint Appendix JA4, Tables 4.2.1, and 4.2.2, 4.2.5; and the wall assemblies presented in Tables 4.3.1, 4.3.3 and 4.3.4; and the floor assemblies are presented in Tables 4.4.1, 4.4.2, 4.4.4 and 4.4.5.

The credit does not apply to other construction assemblies listed in Reference Joint Appendix JA4, including ~~metal-framed walls and ceiling/roof assemblies and SIPS, straw bale, or log construction.~~ For non-wood framed assemblies, approved computer programs do not modify the thermal performance of the building envelope component as described above.

Sprayed Wall Insulation

Sprayed wall insulation can be an effective way to deal with the irregularities of wall and ceiling cavities, especially the spaces around pipes, electric cables, junction boxes, and other equipment that is embedded in cavities. There are several types of sprayed insulation, including cellulose (see Figure 3-20), loose-fill mineral fiber (fiberglass) and spray polyurethane foam (SPF). Cellulose is basically paper that has been treated for flame- and insect-resistance. The product is similar to the loose fill cellulose that is commonly used in attic insulation retrofits, but for walls it is mixed with a water- and starch-based binder. The binder causes the insulation to stick to the surfaces of the wall cavity. Excess insulation that extends past the wall cavity is scraped off with a special tool and recycled into the hopper with the fresh insulation.

Loose fill fiberglass insulation

Loose fill fiberglass insulation is made up of small glass fibers. The product is similar to loose fill fiberglass that is commonly used in attics, but for walls it can be installed behind a netting fabric or mixed with water based adhesive. The adhesive causes the insulation to adhere to surfaces of the wall cavity. Excess insulation that extends past the wall cavity is scraped off and recycled. ~~Loose fill fiberglass insulation shall use batt insulation assembly U-factors listed in Reference Joint Appendix JA4. See Reference Residential Appendix RA3.5.5.2 for more Quality Insulation Installation (QII) requirements.~~

Spray Polyurethane Foam (SPF)

Spray polyurethane foam insulation is a foamed plastic formed by the combination of chemicals and a blowing agent applied using a spray gun. SPF insulation is spray applied to fully adhere to the joist and other framing faces to form a complete air seal within the construction cavities.

There are two types of SPF insulation: medium density, or closed cell (ccSPF), and low density, or open cell (ocSPF) insulation. They have different insulating properties, and compliance requirements as described below:

- ccSPF Medium density, closed cell SPF has been assigned an R-value of 5.8 per inch for compliance purposes and a nominal density of 2.0 ±0.5 pounds per cubic foot (pcf).
- ocSPF has been assigned an R-value of 3.6 per inch for compliance purposes and a nominal density of 0.4 to 1.4 pounds per cubic foot (pcf).

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~~Medium density ccSPF~~ must be applied following the procedures detailed in Reference Joint Appendix JA7 or those of: *Alternative Quality Insulation Installation Procedures for Spray Polyurethane Foam (SPF) Insulation: Medium-Density Closed Cell and Low-Density Open Cell.* The insulation shall be installed at the average thickness required to achieve the specified R-value of the assembly documented on the CF-1R. The installation thickness applied to meet these R-values levels shall be documented on the Installation Certificate (CF-6R). The nominal thickness of the SPF insulation shall be such that: (1) the average thickness shall be equal to or greater than that required to meet the design R-value of the assembly, and (2) the minimum tested thickness shall be no more than ½ inch less than the required thickness for the R-value.

~~ccSPF Medium density~~ is not required to fill the cavity. The insulation thickness shall be verified by using probes capable of penetrating the full thickness of the insulation with measurements marked by eighth inch increments. Measurements shall be accurate to within ±1/8 inch. The probes shall be used by HERS Raters to verify that proper thickness of insulation has been applied.

A compliance credit for quality insulation installation (QII) is available for ccSPF insulation when the required procedures detailed in Reference Joint Appendix JA7 are followed or those of: *Alternative Quality Insulation Installation Procedures for Spray Polyurethane Foam (SPF) Insulation: Medium-Density Closed Cell and Light-Density Open Cell.* Installation must be and verified by a qualified HERS rater. The credit only applies to low rise-residential buildings. The procedure and credit applies to wood or metal framed wall, ceiling, floor, and/or roof assemblies insulated with ccSPF insulation. Review Section 3.3.2 of this document, Appendix JA4, Section 4.1.7 of the Reference Appendices, or see Reference Residential Appendix RA3.5 for more discussion of Quality Insulation Installation (QII).

~~ocSPF Low density SPF open cell~~ insulation has an R-value of 3.6 per inch and a density of 0.45 to 1.4 pcf. ~~lbs/ft².~~ Low density, open cell ocSPF insulation is sprayed into the cavity then expands to fill the cavity. Excess insulation is removed with a special tool. Low density SPF insulation shall use spray insulation assembly U-factors listed in Reference Joint Appendix JA4. No quality insulation installation compliance credit is allowed for low density SPF insulation. ocSPF is required to fill the cavity of 2x4 and 2x6 framing.

Measurement probes, gauges or devices shall be used by the HERS rater to verify that proper thickness of insulation has been applied. A pointed measurement probe or other gauge or device, capable of penetrating the full thickness of the insulation, shall be used having measurements marked by eighth inch increments. Insulation thickness measurement probes, gauges or devices shall be accurate to within ±1/8 inch.

A compliance credit for quality insulation installation (QII) is available for ocSPF insulation when the required procedures are followed detailed in: *Alternative Quality Insulation Installation Procedures for Spray Polyurethane Foam (SPF) Insulation: Medium-Density Closed Cell and Low-Density Open Cell.* Installation must be verified by a qualified HERS rater. The credit only applies to low rise-residential buildings. The procedure and credit applies to wood or metal framed wall, ceiling, floor, and/or roof assemblies insulated with ocSPF insulation. Review Section 3.3.2 of this document, Appendix JA4, Section 4.1.7 of the Reference Appendices, or see Reference Residential Appendix RA3.5 for more discussion of Quality Insulation Installation (QII).

The general method for calculating and using R-values and U-factors for SPF sprayed insulation is ~~are~~ provided in Reference Joint Appendix JA4, Section 4.1.7 and ~~(Tables~~

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4.2.2, and 4.2.5 for roof/ceilings; 4.3.1, 4.3.3, and 4.3.4) for walls, and 4.4.1, 4.4.2, 4.4.4 and 4.4.5 for floors. These apply to for both framed walls (wood or metal framed assemblies.) as well as for rafter roofs (wood or metal). The thermal performance of loose-fill mineral fiber, cellulose and ocSPF foamed plastic is similar, and one set of data is provided for both. In some cases, the data in Reference Joint Appendix JA4 assumes that the cavity of rafter roof constructions can be completely filled (no ventilation). Check with the building official in your area to verify that this method of insulation installation is acceptable.

ATTACHMENT 4

Staff proposed modifications to Compliance Forms are noted below by specific form:

Compliance Forms

Quality Insulation Installation (QII) - Framing Stage Checklist (CF-4R-ENV-21)

✓ FLOOR AIR BARRIER			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All gaps in the raised floor to unconditioned space or to outside larger than 1/8" filled with foam or caulk. (NA if SPF)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All openings on a second floor including under a tub where the drain penetrates the floor is sealed
Yes	No	NA	
✓ WALLS AIR BARRIER			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All gaps in wall exterior sheathing to unconditioned space or to outside larger than 1/8" filled with foam or caulk. (NA if SPF <u>used in cavity</u>)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	No gaps in <u>exterior sheathing</u> against the garage, attic, or covered patio. All gaps larger than 1/8" filled with foam or caulk. (NA if SPF <u>used in cavity</u>)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All gaps in Rim-joists in interior and exterior walls to the outside including holes drilled for electrical and plumbing larger than 1/8" filled with foam or caulk. (NA if SPF)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Rope caulk, foam gasket, or caulking bead around the entire sole plate of the home
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All gaps around the windows are caulked or foamed (stuffing with fiberglass not acceptable)
Yes	No	NA	
✓ ATTIC INSPECTION			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Attic rulers appropriate to the material installed evenly throughout the attic to verify depth. (NA if SPF or batt)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Square foot of attic _____ / 250 = _____ minimum number of rulers installed. Must round up. Number of rulers actually installed _____ (NA if SPF or batt)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ALL rulers visible from attic access. (NA if SPF or batt)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Eave vents baffles installed at all eave vents to prevent air movement under or into insulation. (NA if SPF <u>in cavity</u>)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Area of eave vent baffle is the same or larger than the net free-ventilation area of the eave vent. (NA if SPF)
Yes	No	NA	
✓ CEILING AIR BARRIER			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All draft stops in place to form a continuous ceiling air barrier no gaps larger than 1/8". (NA if SPF)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All drops covered with hard covers. Gaps around or in the hard cover larger than 1/8" filled with foam or caulk. (NA if SPF).
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All recessed light fixtures in non conditioned space IC and air tight (AT)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All recessed light fixtures are sealed with a gasket or caulk between the housing and the ceiling
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Openings around flue shafts fully sealed with solid blocking or flashing and any remaining gaps sealed with fire-rated caulk or sealant.
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Piping shafts openings fully sealed and caulked
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Penetrations from wiring in interior walls, electrical boxes, fire alarms etc. sealed with caulk or sealant
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All duct chases, fireplace chases, and double walls sealed air tight at the ceiling level. All gaps into shafts larger than 1/8" filled with foam or caulk. Special attention paid to ducts entering shafts from ceiling.
Yes	No	NA	
✓ GARAGE ROOF/CEILING AIR BARRIER FOR TWO STORIES (no conditioned space over garage)			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Air barrier installed at joists in garage to house transition (between floors). No gaps larger than 1/8". If <u>cc</u> SPF used then air barrier installed gaps not required to be filled. (NA if <u>SPF or conditioned space over garage</u>)
Yes	No	NA	
✓ GARAGE ROOF/CEILING AIR BARRIER FOR TWO STORIES (conditioned space over garage)			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If insulation is to be installed at subfloor then subfloor has no gaps over 1/8". Air barrier installed at joists in garage to house transition (between floors). (NA if <u>cc</u> SPF <u>or no conditioned space over garage</u>)
Yes	No	NA	

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<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	If insulation is to be installed at ceiling of garage then ceiling and joists to the outside have no gaps over 1/8". (NA if ccSPF or no conditioned space over garage.)
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Quality Insulation Installation (QII) - Insulation Stage Checklist (CF-4R-ENV-22)

FLOOR INSULATION			
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	All floor joist cavity insulation installed to uniformly fit the cavity side-to-side and end-to-end. (NA if floors slab on grade).
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	Insulation in full contact with the subfloor, NO gaps. (NA if floors are slab on grade).
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	Insulation in contact with air barrier on all five sides. (ends, sides, back). NA if floors are slab on grade.
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	Batts cut to fit around wiring and plumbing, or split (delaminated). (NA if loose fill, SPF, or slab on grade).
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	Batt insulation has continuous support. (NA if loose fill, SPF, or slab on grade).
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	Insulation R-value same or greater that listed on CF-1R.
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	SPF insulation properly adhered to avoid gaps.
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	SPF (Spray Polyurethane Foam Medium Density) insulation the average thickness is equal to or greater than that listed on the CF-1R, and For ccSPF the minimum thickness shall be no more than 1/2 inch less than the required thickness for the R-value. For ccSPF the minimum thickness shall be no more than 1 inch less than the required thickness for the R-value. (NA for other forms of insulation).
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	SPF list the required floor cavity R-value from CF-1R, R-_____. List tested average depth of insulation _____ in X 5.8 R-value/inch for ccSPF or 3.6 R-value/inch for ocSPF = _____ R-value. This is the installed R-value and must be equal to or greater than listed on CF-1R (NA for other forms of insulation)
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	Measure thickness of insulation in 6 random measurements. Must be within 1/2 inch of the required depth.

✓ WALL INSULATION			
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	Standard depth cavities insulation fills cavity and touches air barrier on all six sides. (ocSPF shall fill cavity of 2x4 and 2x6; NA if ccSPF used and meets the required R-value).
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	All double walls and bump-outs, the insulation fills the cavity or additional air barrier installed so that the insulation fills the cavity. Insulation touches all six sides. (NA if SPF used and meets the required R-value).
<input type="checkbox"/> Yes	<input type="checkbox"/> No		Behind tub/shower, walls under stairs, and fireplace, insulation touches air barrier on five sides. Not required to fill the space. Cavity required to be air tight.
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	BATTS , not a single void/depression deeper than 3/4" in ANY stud bay. (NA if loose fill mineral fiber, cellulose or SPF insulation)
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	BATTS , voids/depressions less than 3/4" allowed as long as the area is not greater than 10% of the surface area for each stud bay. (NA if loose fill or SPF).
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	Loose Fill mineral fiber and cellulose , no gaps or voids of any depth allowed. (NA if batts or SPF).
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	SPF :- Depressions in the foam insulation's surface of ccSPF shall not be greater than 1/2-inch less than the required thickness at any given point of the surface area being insulated. Depressions in the foam insulation surface ocSPF shall not be greater than 1-inch less than the required thickness provided these depressions do not exceed 10% of the surface area being insulated.
<input type="checkbox"/> Yes	<input type="checkbox"/> No		Any gaps between studs or insulation larger than 1/8" must be filled with insulation or foam.
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	All Rim-joists to the outside insulated.
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	Special attention must be paid to corner channels, wall intersections, and behind tub/shower enclosures insulated to proper R-Value.
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	All skylight shafts and attic kneewalls insulated with minimum R-19.
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	Insulation in full contact with drywall or wall finish of skylight shafts and attic kneewalls.
<input type="checkbox"/> Yes	<input type="checkbox"/> No		Wall insulation same or better than what is listed on the CF-1R.
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	SPF insulation properly adhered to avoid gaps, and provide an air seal
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	SPF (Spray Polyurethane Foam Medium Density) insulation the average thickness is equal to or greater than that listed on the CF-1R, and For ccSPF the minimum thickness shall be no more than 1/2 inch less than the required thickness for the R-value. For ccSPF the minimum thickness shall be no more than 1 inch less than the required thickness for the R-value. (NA for other forms of insulation).

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<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SPF list the required floor cavity R-value from CF-1R, R-_____. List tested average depth of insulation _____ in X 5.8 R-value/inch for ccSPF or 3.6 R-value/inch for ocSPF = _____ R-value. This is the installed R-value and must be equal to or greater than listed on CF-1R (NA for other forms of insulation)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Measure thickness of insulation in 6 random measurements. Must be within ½ inch of the required depth
✓ ROOF/CEILING INSULATION			
<input type="checkbox"/>	<input type="checkbox"/>		BATTS there must not be a single gap/void/depression deeper than ¾". (NA if loose fill <u>mineral fiber, cellulose</u> or SPF insulation).
<input type="checkbox"/>	<input type="checkbox"/>		BATTS voids/depressions less than 3/4" allowed as long as the area is not greater than 10% of the surface area for each stud bay. (NA if loose fill or SPF).
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	NO gaps or voids allowed for loose fill and SPF. (NA if batts).
<input type="checkbox"/>	<input type="checkbox"/>		All ceiling insulation installed to uniformly fit the cavity side-to-side and end-to-end.
<input type="checkbox"/>	<input type="checkbox"/>		Insulation in full contact with the ceiling, NO gaps.
<input type="checkbox"/>	<input type="checkbox"/>		Insulation in contact with air barrier on all five sides.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Batts cut to fit around wiring and plumbing, or split (delaminated). (NA for loose fill or SPF).
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Batts taller than the trusses must expand so that they touch each other over the trusses. (NA for loose fill or SPF).
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SPF the average thickness is equal to or greater than that listed on the CF-1R. <u>For ccSPF insulation</u> and the minimum thickness shall be no more than ½ inch less than the required thickness for the R-value. <u>For ocSPF the minimum thickness shall be no more than 1 inch less than the required thickness for the R-value.</u> (NA if loose fill or batts).
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Insulation fully fills cavity below any plywood platform or cat-walk. If <u>ccSPF</u> used then minimum 3 inches. <u>If ocSPF used then minimum 5.3 inches.</u> (NA if no platforms or cat-walks)
<input type="checkbox"/>	<input type="checkbox"/>		Attic access gasketed
<input type="checkbox"/>	<input type="checkbox"/>		Attic access insulated with rigid foam or batt insulation using adhesive or mechanical fastener. R-value same as ceiling R-value listed on CF-1R
<input type="checkbox"/>	<input type="checkbox"/>		Recessed light fixtures <u>shall be</u> covered full depth with insulation. <u>If SPF used then other forms of insulation used to cover or enclosed in a box fabricated from ½-inch plywood, 18 ga. sheet metal, 1/4-inch hard board or drywall</u> <u>SPF insulation shall not be applied directly to recessed lighting fixtures and left exposed. Recessed light fixtures insulated with SPF insulation shall be protected from ignition by a combination of one or more of the following methods: (1) be covered with a minimum of 1.5 inches of mineral fiber insulation, or (2) be enclosed in a box fabricated from 1/4 inch plywood, 18 gauge metal, 3/8inch hard board or gypboard. The exterior of the box may then be insulated with SPF provided: (1) the SPF insulation is covered with an approved ignition barrier coating tested and supported by an ICC Evaluation Services Report (ESR) or code compliance research report approved by the local agency; or (2) the exposed condition of the SPF insulation is supported by testing with an ICC ESR or research report approved by the local agency.</u>
<input type="checkbox"/>	<input type="checkbox"/>		<u>Roof/ceiling/Wall</u> insulation same or better than what is listed on the CF-1R. <u>In ventilated attics kneewalls and skylights shall be insulated to a minimum of R-19.</u> <u>In unvented attics with insulation placed directly below the structural roof sheathing or above the structural roof sheathing all gable ends shall be insulated; it is not necessary to insulate kneewalls.</u> <u>SPF insulation shall be protected from ignition by: (1) covering with an approved ignition barrier coating tested and supported by an ICC Evaluation Services Report (ESR) or code compliance research report approved by the local agency; or (2) the exposed condition of the SPF insulation is supported by testing with an ICC ESR or research report approved by the local agency.</u>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Loose Fill <u>mineral fiber or cellulose</u> insulation at proper depth – insulation rulers visible and indicating proper depth and R-value for blown in insulation. (NA for batts or SPF).
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Loose Fill <u>mineral fiber or cellulose</u> insulation uniformly covers the entire ceiling (or roof) area from outside of all exterior walls. (NA for batts or SPF).
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Loose-fill mineral fiber or cellulose insulation meets or exceeds manufacturer's minimum weight and thickness requirement for the target R-value. Target R-value _____ Manufacturer's minimum required weight for the target R-value _____ (pounds-per-square foot). Sample weight _____ (pounds per square foot).
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Manufacturer's minimum required thickness at time of installation _____ (inches) Manufacturer's minimum required settled thickness _____ (inches). Number of days since loose-fill insulation was installed _____ (days). At the time of installation, the insulation shall

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			be greater than or equal to the manufacturer's minimum initial insulation thickness. If the HERS rater does not verify the insulation at the time of installation, and if the loose-fill insulation has been in place less than seven days the thickness shall be greater than the manufacturer's minimum required thickness at the time of installation less 1/2 inch to account for settling. If the insulation has been in place for seven days or longer the insulation thickness shall be greater than or equal to the manufacturer's minimum required settled thickness. Minimum thickness measured (inches).
✓ GARAGE ROOF/CEILING INSULATION FOR TWO STORIES(no conditioned space over garage)			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Insulation installed at joists against the air barrier in the garage to house transition (between floors). All wall insulation requirements above must be met. (NA if conditioned space over garage).
Yes	No	NA	
✓ GARAGE ROOF/CEILING INSULATION FOR TWO STORIES(conditioned space over garage)			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If insulation is to be installed at subfloor then the insulation must also be installed at joists against the air barrier in the garage to house transition (between floors). All ceiling and wall insulation requirements above must be met. (NA if no conditioned space over garage).
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If insulation is to be installed at ceiling of garage then the joists to the outside must be insulated and all the insulation requirements listed above must be met. (NA if no conditioned space over garage).
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SPF insulation properly adhered -to avoid gaps, and provide an air seal if ocSPF .
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SPF (Spray Polyurethane Foam Medium Density) insulation the average thickness is equal to or greater than that listed on the CF-1R. For ccSPF and the minimum thickness shall be no more than 1/2 inch less than the required thickness for the R-value. For ocSPF the minimum thickness shall be no more than 1 inch less than the required thickness for the R-value. NA for other forms of insulation).
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SPF list the required floor cavity R-value from CF-1R, R- _____. List tested average depth of insulation _____ in X 5.8 R-value/inch for ccSPF or 3.6 R-value/inch for ocSPF = _____ R-value. T -this is the installed R-value and must be equal to or greater than listed on CF-1R (NA for other forms of insulation)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Measure thickness of insulation in 6 random measurements. Must be within 1/2 inch of the required depth
Yes	No	NA	

Quality Insulation Installation (QII) - Framing Stage Checklist (CF-6R-ENV-21-HERS)

✓ FLOOR AIR BARRIER			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All gaps in the raised floor to unconditioned space or to outside larger than 1/8" filled with foam or caulk. (NA if SPF)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All openings on a second floor including under a tub where the drain penetrates the floor are sealed
Yes	No	NA	
✓ WALLS AIR BARRIER			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All gaps in wall exterior sheathing to unconditioned space or to outside larger than 1/8" filled with foam or caulk. (NA if SPF)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	No gaps in sheathing against the garage, attic, or covered patio. All gaps larger than 1/8" filled with foam or caulk. (NA if SPF)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All gaps in Rim-joists in interior and exterior walls to the outside including holes drilled for electrical and plumbing larger than 1/8" filled with foam or caulk. (NA if SPF)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Rope caulk, foam gasket, or caulking bead around the entire sole plate of the home
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All gaps around the windows are caulked or foamed (stuffing with fiberglass not acceptable)
Yes	No	NA	
✓ ATTIC INSPECTION			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Attic rulers appropriate to the material installed evenly throughout the attic to verify depth. (NA if SPF or batt)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Attic area (sqft) _____ ÷ 250 = _____ minimum number of rulers installed. Must round up. Number of rulers actually installed _____ (NA if SPF or batt)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ALL rulers visible from attic access. (NA if SPF or batt)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Eave vents baffles installed at all eave vents to prevent air movement under or into insulation. (NA if SPF in cavity)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Area of eave vent baffle is the same or larger than the net free-ventilation area of the eave vent. (NA if SPF)
Yes	No	NA	
✓ CEILING AIR BARRIER			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All draft stops in place to form a continuous ceiling air barrier no gaps larger than 1/8". (NA if SPF)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All drops covered with hard covers. Gaps around or in the hard cover larger than 1/8" filled with foam or caulk. (NA if SPF).
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All recessed light fixtures in non conditioned space are IC rated and air tight (AT)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All recessed light fixtures are sealed with a gasket or caulk between the housing and the ceiling
Yes	No	NA	

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Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>		Openings around flue shafts fully sealed with solid blocking or flashing and any remaining gaps sealed with fire-rated caulk or sealant.
Yes	No		
<input type="checkbox"/>	<input type="checkbox"/>		Piping shaft openings fully sealed and caulked
Yes	No		
<input type="checkbox"/>	<input type="checkbox"/>		Penetrations from wiring in interior walls, electrical boxes, fire alarms etc. sealed with caulk or sealant
Yes	No		
<input type="checkbox"/>	<input type="checkbox"/>		All duct chases, fireplace chases, and double walls sealed air tight at the ceiling level. All gaps into shafts larger than 1/8" filled with foam or caulk. Special attention paid to ducts entering shafts from ceiling.
Yes	No		
✓ GARAGE /CEILING AIR BARRIER FOR TWO STORIES (no conditioned space over garage)			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Air barrier installed at joists in garage to house transition (between floors). No gaps larger than 1/8" allowed. Use of ccSPF satisfies the requirement to seal the gaps.
Yes	No	NA	
✓ GARAGE /CEILING AIR BARRIER FOR TWO STORIES (conditioned space over garage)			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If insulation is to be installed at subfloor then subfloor has no gaps over 1/8". Air barrier installed at joists in garage to house transition (between floors). Use of ccSPF satisfies the requirement to seal the gaps.
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If insulation is to be installed at ceiling of garage then ceiling and joists to the outside have no gaps over 1/8". (NA if ccSPF or no conditioned space over garage-)
Yes	No	NA	

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Quality Insulation Installation (QII) - Insulation Stage Checklist (CF-6R-ENV-22-HERS)

Insulation Stage Checklist ✓ FLOOR INSULATION			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All floor joist cavity insulation installed to uniformly fit the cavity side-to-side and end-to-end. (NA if floors slab on grade).
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Insulation in full contact with the subfloor, NO gaps. (NA if floors are slab on grade).
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Insulation in contact with air barrier on all five sides. (ends, sides, back). NA if floors are slab on grade.
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Batts cut to fit around wiring and plumbing, or split (delaminated). (NA if loose fill, SPF, or slab on grade).
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Batt insulation has continuous support. (NA if loose fill, SPF, or slab on grade).
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SPF (Spray Polyurethane Foam Medium Density) insulation the average thickness is equal to or greater than that listed on the CF-1R. <u>For ccSPF and the minimum thickness shall be no more than ½ inch less than the required thickness for the R-value. For ocSPF the minimum thickness shall be no more than 1 inch less than the required thickness for the R-value.</u> (NA for other forms of insulation).
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Insulation R-value same or greater than listed on the CF-1R.
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SPF insulation properly adhered to avoid gaps.
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	For SPF list the required floor cavity R-value from CF-1R, R=____ List tested average depth of insulation (inches) ____ X 5.8 (R-value/inch for medium density ccSPF <u>or 3.6 R-value/inch for ocSPF</u>) = ____ (R-value). This is the installed R-value and must be equal to or greater than listed on CF-1R (NA for other forms of insulation).
Yes	No	NA	
✓ WALL INSULATION			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Standard depth cavities insulation fills cavity and touches air barrier on all six sides. (<u>ocSPF shall fill cavity of 2x4 and 2x6.</u> (NA if ccSPF used and meets the required R-value).
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All double walls and bump-outs, the insulation fills the cavity or additional air barrier installed so that the insulation fills the cavity. Insulation touches all six sides. (NA if SPF used and meets the required R-value).
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Behind tub/shower, walls under stairs, and fireplace, insulation touches air barrier on five sides. Not required to fill the space. Cavity required to be air tight.
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	BATTS , not a single void/depression deeper than ¾" in ANY stud bay. (NA if loose fill <u>mineral fiber, cellulose or SPF insulation</u>)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	BATTS , voids/depressions less than 3/4" allowed as long as the area is not greater than 10% of the surface area for each stud bay. (NA if loose fill or SPF).
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Loose Fill <u>mineral fiber and cellulose</u> no gaps or voids of any depth allowed. (NA if batts or SPF).
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SPF insulation properly adhered -to avoid gaps.
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SPF: Depressions in the foam insulation's surface of ccSPF shall not be greater than 1/2-inch less than the required thickness at any given point of the surface area being insulated. Depressions in the foam insulation surface ocSPF shall not be greater than 1-inch less than the required thickness provided these depressions do not exceed 10% of the surface area being insulated.
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Any gaps between studs or insulation larger than 1/8" must be filled with insulation or foam.
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All Rim-joists to the outside insulated. (NA if no Rim-joists)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Special attention must be paid to corner channels, wall intersections, and behind tub/shower enclosures insulated to proper R-Value.
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All skylight shafts and attic kneewalls insulated with minimum R-19.
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Insulation in full contact with drywall or wall finishes of skylight shafts and attic kneewalls.
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Wall insulation same or better than what is listed on the CF-1R.
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SPF list the required wall cavity R-value from CF-1R, R=____. List tested average depth of insulation (inch) ____ X 5.8 (R-value/inch for medium density ccSPF <u>or 3.6 R-value/inch for ocSPF</u>) = ____ (R-value) This is the installed R-value and must be equal to or greater than listed on CF-1R (NA for other forms of insulation)
Yes	No	NA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	SPF (Spray Polyurethane Foam Medium Density) insulation the average thickness is equal to or greater than that listed on the CF-1R. <u>For ccSPF and the minimum thickness shall be no more than ½ inch less than the required thickness for the R-value. For ocSPF the minimum thickness shall be no more than 1 inch less than the required thickness for the R-value.</u> (NA for other forms of insulation)
Yes	No	NA	
✓ ROOF/CEILING INSULATION			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	BATTS there must not be a single gap/void/depression deeper than ¾". (NA if loose fill <u>mineral fiber, cellulose or SPF insulation</u>).
Yes	No	NA	

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<input type="checkbox"/> Yes	<input type="checkbox"/> No		BATTS voids/depressions less than 3/4" allowed as long as the area is not greater than 10% of the surface area for each stud bay. (NA if loose fill or SPF).
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	NO gaps or voids allowed for loose fill and SPF. (NA if batts).
<input type="checkbox"/> Yes	<input type="checkbox"/> No		All ceiling insulation installed to uniformly fit the cavity side-to-side and end-to-end.
<input type="checkbox"/> Yes	<input type="checkbox"/> No		Insulation in full contact with the ceiling, NO gaps.
<input type="checkbox"/> Yes	<input type="checkbox"/> No		Insulation in contact with air barrier on all five sides.
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	Batts cut to fit around wiring and plumbing, or split (delaminated). (NA for loose fill or SPF).
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	Batts taller than the trusses must expand so that they touch each other over the trusses. (NA for loose fill or SPF).
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	SPF insulation properly adhered to avoid gaps, and provide an air seal <u>if ocSPF</u> (NA for other forms of insulation)
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	Insulation fully fills cavity below any plywood platform or cat-walk. If <u>ccSPF</u> used then minimum 3 inches. <u>If ocSPF used then minimum 5.3 inches.</u> (NA if no platforms or cat-walks)
<input type="checkbox"/> Yes	<input type="checkbox"/> No		Attic access gasketed
<input type="checkbox"/> Yes	<input type="checkbox"/> No		Attic access insulated with rigid foam or batt insulation using adhesive or mechanical fastener. R-value same as ceiling R-value listed on CF-1R
<input type="checkbox"/> Yes	<input type="checkbox"/> No		Recessed light fixtures covered full depth with insulation. If SPF used then other forms of insulation used to cover or enclosed in a box fabricated from 1/2-inch plywood, 18 ga. sheet metal, 1/4-inch hard board or drywall <u>-SPF insulation shall not be applied directly to recessed lighting fixtures and left exposed. Recessed light fixtures insulated with SPF insulation shall be protected from ignition by a combination of one or more of the following methods: (1) be covered with a minimum of 1.5 inches of mineral fiber insulation, or (2) be enclosed in a box fabricated from 1/4 inch plywood, 18 gauge metal, 3/8inch hard board or gypboard. The exterior of the box may then be insulated with SPF provided: (1) the SPF insulation is covered with an approved ignition barrier coating tested and supported by an ICC Evaluation Services Report (ESR) or code compliance research report approved by the local agency; or (2) the exposed condition of the SPF insulation is supported by testing with an ICC ESR or research report approved by the local agency.</u>
<input type="checkbox"/> Yes	<input type="checkbox"/> No		Roof/ <u>ceiling</u> insulation same or better than what is listed on the CF-1R. <u>In ventilated attics k,kneewalls and skylights shall be insulated to a minimum of R-19.</u> <u>In unvented attics with insulation placed directly below the structural roof sheathing or above the structural roof sheathing all gable ends shall be insulated; it is not necessary to insulate kneewalls.</u> <u>SPF insulation shall be protected from ignition by: (1) covering with an approved ignition barrier coating tested and supported by an ICC Evaluation Services Report (ESR) or code compliance research report approved by the local agency; or (2) the exposed condition of the SPF insulation is supported by testing with an ICC ESR or research report approved by the local agency.</u>
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	Loose Fill <u>mineral fiber or cellulose</u> insulation at proper depth – insulation rulers visible and indicating proper depth and R-value for blown in insulation. (NA for batts or SPF).
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	Loose Fill <u>mineral fiber or cellulose</u> insulation uniformly covers the entire ceiling (or roof) area from outside of all exterior walls. (NA for batts or SPF).
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	Loose-fill <u>mineral fiber or cellulose</u> insulation meets or exceeds manufacturer's minimum weight and thickness requirements for the target R-value. Target R-value. Manufacturer's minimum required weight for the target R-value (pounds-per-square-foot). Manufacturer's minimum required thickness at time of installation. Manufacturer's minimum required settled thickness. Note: To receive compliance credit the HERS rater shall verify that the manufacturer's minimum weight and thickness has been achieved for the target R-value. (NA for batts or SPF).
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	SPF list the required ceiling cavity R-value from CF-1R, R-____. List tested average depth of insulation ____ in X 5.8 R-value/inch for ccSPF or 3.6 R-value/inch for ocSPF = ____ R-value. T his is the installed R-value and must be equal to or greater than listed on CF-1R (NA for other forms of insulation)
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	SPF insulation shall not be applied directly to recessed lighting fixtures <u>and left exposed. Recessed light fixtures insulated with SPF insulation shall be protected from ignition by a combination of one or more of the following methods: (1) Recessed light fixtures must be covered with other forms of a minimum of 1.5 inches of mineral fiber insulation or insulation, or (2) be enclosed in a box fabricated from 1/4 inch plywood, 18 gauge metal, 3/8 inch hard board or gypboard</u> drywall . The exterior of the box may then be insulated with SPF <u>provided: (1) the SPF insulation is covered with an approved ignition barrier coating</u>

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			<u>tested and supported by an ICC Evaluation Services Report (ESR) or code compliance research report approved by the local agency; or (2) the exposed condition of the SPF insulation is supported by testing with an ICC ESR or research report approved by the local agency.</u>
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	SPF insulation the average thickness is equal to or greater than that listed on the CF-1R. <u>For ccSPF and the minimum thickness shall be no more than ½ inch less than the required thickness for the R-value. For ccSPF the minimum thickness shall be no more than 1 inch less than the required thickness for the R-value.</u> (NA for other forms of insulation)
✓ GARAGE ROOF/CEILING INSULATION FOR TWO STORIES (no conditioned space over garage)			
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	Insulation installed at joists against the air barrier in the garage to house transition. All wall insulation requirements above must be met. (NA if conditioned space over garage).
✓ GARAGE ROOF/CEILING INSULATION FOR TWO STORIES(conditioned space over garage)			
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	If insulation is to be installed at subfloor then the insulation must also be installed at joists against the air barrier in the garage to house transition. All ceiling and wall insulation requirements above must be met. (NA if no conditioned space over garage).
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> NA	If insulation is to be installed at ceiling of garage then the joists to the outside must be insulated and all the insulation requirements listed above must be met. (NA if no conditioned space over garage).