

Source: California Energy Commission



When the performance method is used, credit is offered for increasing thermal mass in buildings. This procedure is automated in Energy Commission-approved computer compliance software. See Section 3.6 for the performance method.

### 3.5.8 Quality Insulation Installation (QII) RA 3.5

Prescriptive Requirements (Table 150.1-A and Table 150.1-B)

The prescriptive requirements shown in Table 150.1-A and Table 150.1-B call for QII in all climate zones for new construction and additions greater than 700 square feet, except low-rise multifamily buildings in Climate Zone 7.

All insulation shall be installed properly throughout the building. A third-party HERS Rater is required to verify the integrity of the installed insulation. The installer shall provide evidence to the HERS Rater using compliance documentation that all insulation specified is installed to meet specified R-values and assembly U-factors.

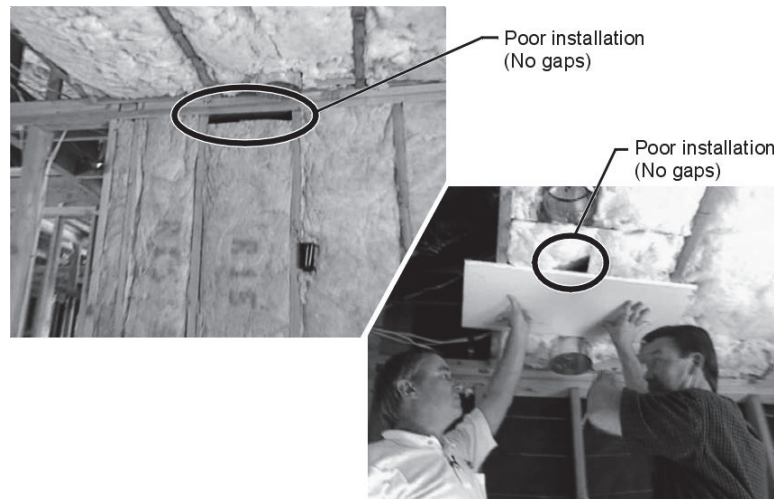
To meet QII, two primary installation criteria must be adhered to and they both must be field-verified by a HERS Rater. They include air sealing of the building enclosure (including walls, ceiling/roof, and floors), as well as proper installation of insulation. Refer to Reference Appendices RA3.5 for more details.



**Many residential insulation installations have flaws that degrade thermal performance. Four problems are generally responsible for this degradation:**

1. There is an inadequate air barrier in the building envelope or holes and gaps within the air barrier system that inhibit the ability to limit air leakage.
2. Insulation is not in contact with the air barrier, creating air spaces that short-circuit the thermal break of the insulation when the air barrier is not limiting air leakage properly.
3. The insulation has voids or gaps, resulting in portions of the construction assembly that are not properly insulated and, therefore, have less thermal resistance than other portions of the assembly (Figure 3-34).
4. The insulation is compressed, creating a gap near the air barrier and/or reducing the thickness of the insulation.

**Figure 3-34: Examples of Poor Quality Insulation Installation**



Source: California Energy Commission

QII requires third-party HERS inspection to verify that an air barrier and insulation are installed correctly to eliminate or reduce common problems associated with poor installation. Guidance for QII is provided in Residential Appendix RA3.5. QII applies to framed and nonframed assemblies. Residential construction may incorporate multiple frame types, for example, using a combination of nonframed walls with a framed roof/ceiling. Likewise, multiple insulation materials often are used.

**Framed Assemblies**

Framed assemblies include wood and steel construction insulated with batts of mineral fiber, mineral and natural wool, or cellulose; loose-fill insulation of mineral fiber, mineral and natural wool, cellulose, or spray polyurethane foam (SPF). Rigid board insulation may be used on the exterior or interior of framed or nonframed assemblies.

**Nonframed Assemblies**

Nonframed assemblies include structural insulated panels (SIP), insulated concrete forms (ICF), and mass walls of masonry, concrete and concrete sandwich panels, log walls, and straw bale.



### Tips for Implementing QII

Applies to all Insulation	QII applies to the whole building - roof/ceilings, walls, and floors - and requires field verification by a third-party HERS Rater.
Slab Edge Insulation	If slab edge insulation is installed, then the integrity of the slab edge insulation must also be field-verified in addition to the air barrier and insulation system for walls and the roof/ceiling.
Various Insulation Types	Combinations of insulation types (hybrid systems) are allowed.
Air Barriers	An air barrier shall be installed for the entire envelope.
Additions	QII is prescriptively required for additions to existing buildings more than 700 square feet. Refer to Chapter 9 for additional information specific to additions.
Alterations	Compliance credit is allowed for alterations to existing buildings where the "existing, plus addition, plus alteration" approach is used, but credit will only apply to new surfaces in the new zone.
Insulated Headers	<p>Headers shall meet one of the following criteria for QII:</p> <ol style="list-style-type: none"> <li>Two-member header with insulation in between. The header and insulation must fill the wall cavity. There are prefabricated products available that meet this assembly. Example: a 2x4 wall with two 2x nominal headers, or a 2x6 wall with a 4x nominal header and a 2x nominal header. Insulation is required to fill the wall cavity and must be installed between the headers.</li> <li>Two-member header, less than the wall width, with insulation on the interior face. The header and insulation must fill the wall cavity. Example: a 2x6 wall with two 2x nominal headers. Insulation is required to fill the wall cavity and must be installed to the interior face of the wall.</li> <li>Single-member header, less than the wall width, with insulation on the interior face. The header and insulation must fill the wall cavity. Example: a 2x4 wall with a 3-1/8-inch-wide header, or 2x6 wall with a 4x nominal header. Insulation is required to fill the wall cavity and must be installed to the interior face of the wall.</li> <li>Single-member header, same width as wall. The header must fill the wall cavity. Example: a 2x4 wall with a 4x nominal header or a 2x6 wall with a 6x nominal header. No additional insulation is required because the header fills the cavity.</li> </ol>
Panel Box Headers	Wood structural panel box headers may also be used as load-bearing headers in exterior wall construction, when built in accordance with 2015 CRC Figure R602.7.3 and Table R602.7.3.
Structural Bracing, Tie-Downs, Steel Structural Framing	<p>Metal bracing, tie-downs, or steel structural framing can be used to connect to wood framing for structural or seismic purposes, and comply with QII if:</p> <ol style="list-style-type: none"> <li>Metal bracing, tie-downs, or steel structural framing is identified on the structural plans.</li> <li>Insulation is installed in a manner that minimizes the thermal bridging through the structural framing assembly.</li> <li>Insulation fills the entire cavity and/or adheres to all six sides and ends of structural assemblies that separate conditioned from unconditioned space.</li> </ol>

	d. The structural portions of assemblies are airtight.
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**QII in the Compliance Modeling Software.** QII is not a mandatory requirement; therefore, when using the performance approach, QII may be traded off with other efficiency measures. The compliance modeling software assumes QII and full insulation effectiveness in the standard design. The compliance modeling software automatically reduces the effectiveness of insulation for the proposed design in projects that do not pursue QII. The effect of a poorly installed air barrier system and envelope insulation results in higher wall heat loss and heat gain than standard R-value and U-factor calculations would indicate. Similar increases in heat loss and heat gain are experienced for roof/ceilings where construction and installation flaws are present. The reduction in effectiveness reflects standard industry installation practices and allows for full insulation credit to be taken for HERS verified quality insulation installation.

**3.5.8.1 Air Barrier RA3.5.2**

An air barrier shall be installed enclosing the entire building. The air barrier must be installed in a continuous manner across all components of framed and nonframed envelope assemblies. The installer shall provide evidence with compliance documentation that the air barrier system meets one or more of the air barrier requirements. More detailed explanation is provided in RA3.5. Documentation for the air barrier includes product data sheets and manufacturer specifications and installation guidelines.



For QII, a third-party HERS Rater is required to verify that the air barrier has been installed properly and is integral with the insulation being used throughout the building.



**Continuous Air Barrier Requirements**

A combination of interconnected materials and assemblies are joined and sealed together to provide a continuous barrier to air leakage through the building envelope separating conditioned from unconditioned space, or adjoining conditioned spaces of different occupancies or uses. An air barrier must meet one of the following:

1. Using materials that have an air permeance not exceeding 0.004 cfm/ft<sup>2</sup> under a pressure differential of 0.3 in. w.g. (1.57 psf) (0.02 L/s.m<sup>2</sup> at 75 pa) when tested in accordance with ASTM E2178.
2. Using assemblies of materials and components that have an average air leakage not to exceed 0.04 cfm/ft<sup>2</sup> under a pressure differential of 0.3 in. w.g (1.57 psf) (0.2 L/s.m<sup>2</sup> at 75 pa) when tested in accordance with ASTM E2357, ASTM E1677, ASTM E1680 or ASTM E283.
3. Testing the completed building and demonstrating that the air leakage rate of the building envelope does not exceed 0.40 cfm/ft<sup>2</sup> at a pressure differential of 0.3 in