

RESIDENTIAL ACM APPENDIX RH

Appendix RH – High Quality Insulation Installation Procedures

RH1. Purpose and Scope

ACM RH-2005 is a procedure for verifying the quality of insulation installation in low-rise residential buildings. A compliance credit is offered when this procedure is followed by the insulation installer and a qualified HERS rater. The procedure and credit applies to wood framed construction with wall stud cavities, ceilings, and roof assemblies insulated with mineral fiber or cellulose insulation in low-rise residential buildings.

RH2. Terminology

- Air Barrier** An air barrier is needed in all thermal envelope assemblies to prevent air movement. Insulation, other than foam, is not designed to stop air movement. For insulation installed horizontally, such as in an attic, the insulation must be in substantial contact with the assembly air barrier (usually the ceiling drywall) on one side for it to perform at its rated R-value. A wall or ceiling covering that has multiple leakage sites (such as 1 x 6 tongue and groove board ceilings) can not serve as an air barrier.
- Air-tight** 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 expansive or minimally expansive foam.
- Excessive Compression** Batt insulation may be compressed up to 50% at obstructions such as plumbing vents and in non-standard cavities, but compression of more than 50% in any dimension is excessive and shall not be allowed. Where obstructions would cause the insulation to be compressed greater than 50% insulation shall be cut to fit around the obstruction.
- Delaminated** Batts are often split or delaminated to fit around an obstruction. For example when an electrical wire runs through a wall cavity the insulation must still fill the area both in front of the wire and the area behind the wire. This is typically accomplished by delaminating the batt from one end and placing one side of the batt behind the wire and the other in front of the wire. The location of the delamination must coincide with the location of the obstruction. For example if the wire is one third of the distance from the front of the cavity the batt should be delaminated so that two thirds of the batt goes behind the wire and one third in front of the wire.
- Draft Stops** 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. 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.
- Friction Fit** Friction fit batts are commonly used. Friction fit batts have enough side-to-side frictional force to hold the batt in place without any other means of attachment.
- Gaps** A gap is an uninsulated area at the edge of or between batts. Gaps in insulation are avoidable and are not permitted.

Hard Covers Hard covers shall be installed above areas where there is a drop ceiling. For example a home with 10 ft ceilings may have an entry closet with a ceiling lowered to 8 ft. A hard cover (usually a piece of plywood) is installed at the 10 ft. level above the entry closet. Hard covers become part of the ceiling air barrier and shall be air-tight.

Inset Stapling In windy areas installers often staple the flanges of faced batts to the sides of the stud in order to assure that the insulation remains in place until covered with drywall, particularly on the wall between the house and the garage where there isn't any exterior sheathing to help keep the insulation in place. The void created by the flange inset shall not extend more than two inches from the stud on each side.

Net Free-Area 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.

Voids When batt insulation is pushed too far into a wall stud cavity a void is created between the front of the batt and the drywall. Batts shall be fully lofted and fill the cavity front-to-back. Small voids less than $\frac{3}{4}$ in. deep on the front or back of a batt shall be allowed as long as the total void area is not over 10% of the batt surface area. This definition shall not preclude the practice of inset stapling as long as the void created by the flange inset meets the specification in the definition of inset stapling. Improper spraying or blowing of insulation in ceilings and wall cavities can result in areas with insufficient insulation not meeting the specified installed density and R-value. Wall and cathedral ceiling cavity areas where cellulose insulation has fallen away shall be filled with insulation. Depressions in netting or material supporting blown insulation in walls and cathedral ceilings shall be filled with insulation.

RH3. Raised Floors and Floors Over Garages

- Batts shall be correctly sized to fit snugly at the sides and ends, but not be so large as to buckle.
- Batts shall be cut to fit properly without gaps. Insulation shall not be doubled-over or compressed.
- Insulation shall be in contact with an air barrier - usually the subfloor.
- On floors that are over garages, or where there is an air space between the insulation and the subfloor, the rim joist shall be insulated.
- Batts shall be cut to butt-fit around wiring and plumbing, or be split (delaminated) so that one layer can fit behind the wiring or plumbing, and one layer fit in front.
- If the insulation is faced, the facing shall be placed toward the living space and be in contact with the underside of the floor sheathing. Continuous support shall be provided to keep the facing in contact with the floor sheathing. Filling the entire cavity with insulation and providing support with netting at the bottom of the framing is one acceptable method.
- Insulation shall be properly supported to avoid gaps, voids, and compression.

RH4. Wall Insulation

RH4.1. Batt Installation

- Wall stud cavities shall be caulked or foamed to provide a substantially air-tight envelope to the outdoors, attic, garage and crawl space. Special attention shall be paid to plumbing and wiring penetrations through the top plates, electrical boxes that penetrate the sheathing, and the sheathing seal to the bottom plate.

- Installation shall uniformly fill the cavity side-to-side, top-to-bottom, and front-to-back.
- The batt shall be friction fitted into the cavity unless another support method is used
- Batt insulation shall be installed to fill the cavity and be in contact with the sheathing on the back and the wallboard on the front - no gaps or voids.
- Batts with flanges that are inset stapled to the side of the stud must be flush with the face of the cavity (or protrude beyond) except for the portion that is less than two inches from the edge of the stud.
- Non-standard-width cavities shall be filled with batt insulation snugly fitted into the space without excessive compression.
- Batt insulation shall be cut to butt-fit around wiring and plumbing, or be split (delaminated) so that one layer can fit behind the wiring or plumbing, and one layer fit in front.

RH4.2 Narrow-Framed Cavities

- Non-standard width cavities shall be filled by batt insulation cut to snugly fit into the space.
- Narrow spaces (two inches or less) at windows, between studs at the building's 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 expansive or minimally expansive foam.

RH4.3 Special Situations

RH4.3.1 Installations Prior to Exterior Sheathing or Lath

- Hard to access wall stud cavities such as: corner channels, wall intersections, and behind tub/shower enclosures shall be insulated to the proper R-value. This may have to be done prior to the installation of the exterior sheathing or the stucco lath.

RH4.3.2 Obstructions

- Insulation shall be cut to fit around wiring and plumbing without compression.
- Insulation shall be placed between the sheathing and the rear of electrical boxes and phone boxes.
- 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, as much insulation as possible shall be placed between the pipe and the outside (without excessive compression), and no insulation shall be placed between the pipe and the inside.

RH4.3.3 Rim Joists

- All rim-joists shall be insulated to the same R-Value as the adjacent walls.
- The insulation shall be installed without gaps or excessive compression.

RH4.3.4 Kneewalls and Skylight Shafts

- All kneewalls and skylight shafts shall be insulated to a minimum of R-19.
- The insulation shall be installed without gaps and with minimal compression.
- For steel-framed kneewalls and skylight shafts, external surfaces of steel studs ~~must~~ shall be covered with batts or rigid foam unless otherwise specified on the CF-1R using correct U-factors from Joint Appendix IV, Table IV-11 (or U-factors approved by the CEC Executive Director) and documented by a form 3R generated by EZFRAME.
- The house side of the insulation shall be in contact with the drywall or other wall finish.
- The insulation shall be supported so that it will not fall down by either fitting to the framing, stapling in place with minimal compression, or using other support such as netting.

RH4.3.5 HVAC/Plumbing Closet

- 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.

RH4.3.6 Loose Fill Wall Insulation

- Wall stud cavities shall be caulked or foamed to provide a substantially air-tight envelope to the outdoors, attic, garage and crawl space. Special attention shall be paid to plumbing and wiring penetrations through the top plates, electrical boxes that penetrate the sheathing, and the sheathing seal to the bottom plate.
- Installation shall uniformly fill the cavity side-to-side, top-to-bottom, and front-to-back.
- Loose fill insulation shall be installed to fill the cavity and be in contact with the sheathing on the back and the wallboard on the front - no gaps or voids.
- Loose fill wall insulation shall be installed to fit around wiring, plumbing, and other obstructions.
- The installer shall certify on forms CF-6R and IC-1 that the manufacturer's minimum weight-per-square-foot requirement has been met.

RH5. Ceiling and Roof Insulation**RH5.1 Batt Insulation****RH5.1.1 General Requirements**

- Batts shall be correctly sized to fit snugly at the sides and ends.
- Batts shall be installed so that they will be in contact with the air barrier.
- Where necessary, batts shall be cut to fit properly - there shall be no gaps, nor shall the insulation be doubled-over or compressed.
- When batts are cut to fit a non-standard cavity, they shall be snugly fitted to fill the cavity without excessive compression.
- Batts shall be cut to butt-fit around wiring and plumbing, or be split (delaminated) so that one layer can fit behind the wiring or plumbing, and one layer fit in front.
- For batts that are taller than the trusses, full-width batts shall be used so that they expand to touch each other over the trusses.
- 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 hard covers or draft stops are missing or incomplete, they shall be completed before insulation is installed.
- Required eave ventilation shall not be obstructed - the net free-ventilation area of the eave vent shall be maintained.
- Eave vent baffles shall be installed to prevent air movement under or into the batt.
- Insulation shall cover all recessed lighting fixtures. If the fixtures are not rated for insulation contact (IC) and air tight, the fixtures shall either be replaced or eliminated.
- All recessed light fixtures that penetrate the ceiling shall be IC and air tight (AT) rated and shall be sealed with a gasket or caulk between the housing and the ceiling.

RH5.1.2 Special Situations**RH5.1.2.1 Rafter Ceilings**

- An air space shall be maintained between the insulation and roof sheathing if required by California Building Code section 1505.3.
- Facings and insulation shall be kept away from combustion appliance flues in accordance with flue manufacturers' installation instructions or labels on the flue.

RH5.1.2.2 HVAC Platform

- Appropriate batt insulation shall be placed below any plywood platform or cat-walks for HVAC equipment installation and access
- Batts shall be installed so that they will be in contact with the air barrier.

RH5.1.2.3 Attic Access

- Permanently attach rigid foam or a batt of insulation to the access door using adhesive or mechanical fastener.

RH5.2. Loose-Fill Ceiling Insulation

RH5.2.1 General Requirements

- Baffles shall be placed at eaves or soffit vents to keep insulation from blocking eave ventilation. The required net free-ventilation shall be maintained.
- Eave vent baffles shall be installed to prevent air movement under or into the loose-fill insulation
- 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 hard covers or draft stops are missing or incomplete, they shall be completed before insulation is completed or the entire drop area shall be filled with loose-fill insulation level with the rest of the attic.
- Attic rulers appropriate to the material installed shall be evenly distributed throughout the attic to verify depth: one ruler for every 250 square feet and clearly readable from the attic access. The rulers shall be scaled to read inches of insulation and the R-value installed.
- Insulation shall be applied underneath and on both sides of obstructions such as cross-bracing and wiring.
- Insulation shall be applied all the way to the outer edge of the wall top plate.
- Insulation shall cover recessed lighting fixtures. If the fixtures are not rated for insulation contact (IC) and air tight, the fixtures shall either be replaced or eliminated.
- All recessed light fixtures that penetrate the ceiling shall be IC and air tight (AT) rated and shall be sealed with a gasket or caulk between the housing and the ceiling.
- Insulation shall be kept away from combustion appliance flues in accordance with flue manufacturer's installation instructions or labels on the flue.
- Insulation shall be blown to a uniform thickness throughout the attic with all areas meeting or exceeding the insulation manufacturer's minimum requirements for depth and weight-per-square-foot.
- The installer shall certify on forms CF-6R and IC-1 that the manufacturer's minimum weight-per-square-foot requirement has been met.
- The HERS rater shall verify that the manufacturer's minimum weight-per-square-foot requirement has been met for attics insulated with loose-fill mineral-fiber insulation. Verification shall be determined using the methods of the Insulation Contractor's Association of America (ICAA) Technical Bulletin #17 except that only one ~~One~~ sample shall be taken in the area that appears to have the least amount of insulation. The rater shall record the weight-per-square-foot of the sample on the CF-4R.
- The HERS rater shall verify that the manufacturer's minimum insulation thickness has been installed. For cellulose insulation this verification shall take into account the time that has elapsed since the

insulation was installed. At the time of installation, the insulation shall be greater than or equal to the manufacturer's minimum initial insulation thickness. If the HERS rater does not verify the insulation thickness at the time of installation, and if ~~if~~ the insulation has been in place less than seven days, the insulation thickness shall be greater than ~~within 1/2 inch of~~ the manufacturer's minimum required thickness at the time of installation ~~less 1/2 inch to account for settling (or greater)~~. 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 ~~(or greater) shall be in place.~~

RH5.2.2 Special Situations

RH5.2.2.1 Kneewalls and Skylight Shafts:

- Kneewalls and skylight shafts shall be insulated to a minimum of R-19. If loose fill insulation is used it shall be properly supported with netting or other support material.

RH5.2.2.2 HVAC Platform

- Pressure-fill the areas under any plywood platform or walks for HVAC equipment installation and access or verify that appropriate batt insulation has been installed.

RH5.2.2.3 Attic Access

- Permanently attach rigid foam or a batt of insulation to the access door using adhesive or mechanical fastener.

RH6. Materials

- Materials shall comply with Uniform Building Code (including, but not limited to, 1997 UBC Section 707) and installed to meet all applicable fire codes.
- Materials shall meet California Quality Standards for Insulating Material, Title 24, Chapter 4, Article 3, listed in the California Department of Consumer Affairs Consumer Guide and Directory of Certified Insulating Materials.
- Materials shall comply with flame spread rating and smoke density requirements of Sections 2602 and 707 of the Title 24, Part 2: all installations with exposed facings must use fire retardant facings which have been tested and certified not to exceed a flame spread of 25 and a smoke development rating of 450. Insulation facings that do not touch a ceiling, wall, or floor surface, and faced batts on the undersides of roofs with an air space between the ceiling and facing are considered exposed applications.
- Materials shall be installed according to manufacturer specifications and instructions.

RH7. Equipment

- Scales - The scales used to weigh density samples shall be accurate to within +/- 0.03 pounds. Scales shall be calibrated in accordance with manufacture's instructions.

RH8. R-Value and U-Value Specifications

See CF-1R for minimum R-value requirements; for non-standard assemblies, also see applicable form 3R.

RH9. Certificates

An Insulation Certificate (IC-1) signed by the insulation installer shall be provided that states that the installation is consistent with the plans and specifications for which the building permit was issued. The certificate shall also state the installing company name, insulation manufacturer's name and material identification, the installed R-value, and, in applications of loose-fill insulation, the minimum installed

weight-per-square-foot (or the minimum weight per cubic foot) consistent with the manufacturer's labeled installed-design-density for the desired R-Value, and the number of inches required to achieve the desired R-Value. The insulation installer shall also complete a form CF-6R and attach a bag label or a manufacturer's coverage chart for every insulation material used.

RH10. Certificate Availability

The Insulation Certificate (IC-1) and Installation Certificate (CF-6R, with insulation material bag labels or coverage charts attached), signed by the insulation installer, shall be available on the building site for each of the HERS rater's verification inspections. Note: The HERS rater cannot verify compliance credit without these completed forms.

CF-6R & CF-4R Insulation Installation Quality Certificate

NOTE: THE FOLLOWING FORM IS PROVIDED FOR INFORMATION IS REQUIRED TO BE DOCUMENTED IN A FORMAT SPECIFIED BY THE COMMISSION. IT WILL LIKELY BE INCLUDED IN THE RESIDENTIAL CONSERVATION MANUAL AND NOT IN THE ACM MANUAL.

Site Address _____ Permit _____

- Installation meets all applicable requirements as specified in the Insulation Installation Procedures
(CF-6R only)
- Insulation certificate, (IC-1) signed by the installer stating: insulation manufacturer's name, material identification, installed R-values, and for loose-fill insulation: minimum weight per square foot and minimum inches
- Installation Certificate, (CF-6R) signed by the installer certifying that the installation meets all applicable requirements as specified in the Insulation Installation Procedures
(CF-4R only)

1. FLOOR

- All floor joist cavity insulation installed to uniformly fit the cavity side-to-side and end-to-end
- Insulation in contact with the subfloor or rim joists insulated
- Insulation properly supported to avoid gaps, voids, and compression

2. WALLS

- Wall stud cavities caulked or foamed to provide an air tight envelope
- Wall stud cavity insulation uniformly fills the cavity side-to-side, top-to-bottom, and front-to-back
- No gaps
- No voids over 3/4" deep or more than 10% of the batt surface area.
- Hard to access wall stud cavities such as: corner channels, wall intersections, and behind tub/shower enclosures insulated to proper R-Value
- Small spaces filled
- Rim-joists insulated
- Loose fill wall insulation meets or exceeds manufacturer's minimum weight-per-square-foot requirement. (CF-6R only)

3. ROOF/CEILING PREPARATION

- All draft stops in place to form a continuous ceiling and wall air barrier
- All drops covered with hard covers
- All draft stops and hard covers caulked or foamed to provide an air tight envelope
- All recessed light fixtures IC and air tight (AT) rated and sealed with a gasket or caulk between the housing and the ceiling
- Floor cavities on multiple-story buildings have air tight draft stops to all adjoining attics
- Eave vents prepared for blown insulation - maintain net free-ventilation area
- Kneewalls insulated or prepared for blown insulation
- Area under equipment platforms and cat-walks insulated or accessible for blown insulation
- Attic rulers installed

4. ROOF/CEILING BATTS

- No gaps
- No voids over ¾ in. deep or more than 10% of the batt surface area.
- Insulation in contact with the air-barrier
- Recessed light fixtures covered
- Net free-ventilation area maintained at eave vents

5. ROOF/CEILING LOOSE-FILL

- Insulation uniformly covers the entire ceiling (or roof) area from the outside of all exterior walls.
- Baffles installed at eaves vents or soffit vents - maintain net free-ventilation area of eave vent
- Attic access insulated
- Recessed light fixtures covered
- Insulation at proper depth – insulation rulers visible and indicating proper depth and R-value
- Loose-fill 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: In order 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. (CF-6R only)
- Loose-fill mineral fiber 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). (CF-4R only)
- 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 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 if the loose-fill insulation has been in place less than seven days the thickness shall be greater than within 1/2 inch of the the manufacturer's minimum required thickness at the time of installation less 1/2 inch to account for settling (or greater). 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 ~~(or greater) shall be in place~~. Minimum thickness measured (inches). (CF-4R only)~~

DECLARATION

I hereby certify that the installation meets all applicable requirements as specified in the Insulation Installation Procedures.

<u>Item #s</u>	<u>Signature, Date</u>	<u>Title, Company Name</u>
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~~APPENDIX H~~

Glossary of Terms

Approved, as to a home energy rating provider or home energy rating system, means reviewed and approved by the Commission under Section 1675.

Certified, as to a home energy rater, means having been found by a certified home energy rating provider to have successfully completed the requirements established by that home energy rating provider.

Home Energy Rater means a person certified to perform the site inspection and data collection, diagnostic testing, and data entry and analysis required to produce a home energy rating.

Home Energy Rating means a representation on a 0 to 100 scale of the annual source energy efficiency of a building.

Home Energy Rating Provider means a person or entity that administers an approved home energy rating system.

Home Energy Rating System means a fixed set of procedures, utilizing specifically defined assumptions, measurements and calculations, which produces a home energy rating.

Low-Rise Residential Building means a building, other than a hotel/motel as defined in Title 24, Part 6, Section 101(b), of the California Code of Regulations, that is of occupancy group R-1 and is three stories or less, or that is of occupancy group R-3, as those occupancy groups are defined in Title 24, Part 2, Section 1201, of the California Code of Regulations.