Appendix RA
2015 IECC (2019 Georgia Energy Code)

Air Barrier and Insulation Installation Component Guide

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<th>INSULATION INSTALLATION CRITERIA</th>
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<tr>
<td>1 General requirements</td>
<td>A continuous air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed.</td>
<td></td>
</tr>
<tr>
<td>2 Ceiling/attic</td>
<td>The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.</td>
<td>The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.</td>
</tr>
<tr>
<td>3 Walls</td>
<td>The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.</td>
<td>Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.</td>
</tr>
<tr>
<td>4 Windows, skylights and doors</td>
<td>The space between window/door jams and framing, and skylights and framing shall be sealed.</td>
<td></td>
</tr>
<tr>
<td>5 Rim joists</td>
<td>Rim joists shall include the air barrier.</td>
<td>Rim joists shall be insulated.</td>
</tr>
<tr>
<td>6 Floors (including above garage and cantilevered floors)</td>
<td>The air barrier shall be installed at any exposed edge of insulation.</td>
<td>Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends from the bottom to the top of all perimeter floor framing members.</td>
</tr>
<tr>
<td>7 Crawl space walls</td>
<td>Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.</td>
<td>Where provided instead of floor insulation (unvented crawl spaces), insulation shall be permanently attached to the crawlspace walls.</td>
</tr>
<tr>
<td>8 Shafts, penetrations</td>
<td>Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.</td>
<td>Capped chases shall be insulated to surrounding ceiling R-values (maintain clearance from combustion flues).</td>
</tr>
<tr>
<td>9 Narrow cavities</td>
<td></td>
<td>Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to the available cavity space.</td>
</tr>
<tr>
<td>10 Garage separation</td>
<td>Air sealing shall be provided between the garage and conditioned spaces. Band area shall be blocked, sealed and insulated.</td>
<td></td>
</tr>
<tr>
<td>11 Recessed lighting</td>
<td>Recessed light fixtures installed in the building thermal envelope shall be sealed to the drywall. Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.</td>
<td></td>
</tr>
<tr>
<td>12 Plumbing and wiring</td>
<td>Wiring and plumbing penetrations shall be sealed. Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.</td>
<td></td>
</tr>
<tr>
<td>13 Shower/tub on exterior wall</td>
<td>The air barrier installed at exterior walls adjacent to showers and tubs shall separate them from the showers and tubs.</td>
<td>Exterior walls adjacent to showers and tubs shall be insulated.</td>
</tr>
<tr>
<td>14 Electrical/phone box on exterior walls</td>
<td>The air barrier shall be installed behind electrical or communication boxes or air-sealed boxes shall be installed.</td>
<td></td>
</tr>
<tr>
<td>15 HVAC register boots</td>
<td>HVAC register boots shall be sealed to the subfloor or drywall.</td>
<td>Boots in unconditioned spaces shall be insulated. Recommend insulating boots in conditioned spaces for condensation control.</td>
</tr>
<tr>
<td>16 Concealed sprinklers</td>
<td>When required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.</td>
<td></td>
</tr>
<tr>
<td>17 Blocking between framing (e.g. beneath knee walls, cantilevered floors, garage separation walls)</td>
<td>Blocking shall be sealed to framing. Insulation shall be in contact with blocking.</td>
<td></td>
</tr>
<tr>
<td>18 Common walls</td>
<td>Air barrier is installed in common wall between dwelling units.</td>
<td></td>
</tr>
<tr>
<td>19 Fireplaces</td>
<td>New wood-burning fireplaces shall have tight-fitting flue dampers or doors, and outdoor combustion air.</td>
<td>Fireplace chase insulation shall be restrained to stay in place.</td>
</tr>
</tbody>
</table>

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Air sealing key points

1. Insulate and install sheet material behind bathtub.
2. Seal lights and bath vent fans to ceiling drywall.
3. Insulate headers and air seal corners.
4. Fan vented through exterior wall sealed at penetration.
5. Insulate and air seal corners.
6. Seal bottom plate to subfloor.
7. Narrow stud cavity batts are cut to fit.
8. Insulate exterior wall.
9. Window sealed into rough opening with backer rod and sealant.
10. Seal airtight IC-rated recessed light fixtures to drywall.
11. Seal plumbing penetrations (if ceiling is insulated).
12. Seal gap between electrical box and drywall.
13. Seal wiring and plumbing penetrations.
16. Concealed sprinklers - shall only be sealed as per manufacturer recommendations.

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Electrical panel box, recommend install on interior (non-insulated) wall. If installed on exterior wall, air barrier shall extend behind box or air-sealed box shall be installed.

Chases and common by-passes

1. Seal top plate
2. Cap top of chase with solid air barrier and insulate above dropped soffit
3. Seal bottom plate
4. Seal penetrations in common wall
5. Seal electrical boxes and fixtures to drywall
6. Seal HVAC penetrations
7. Seal electrical penetrations through sheathing
8. Seal electrical boot penetrations
9. Seal plumbing penetrations
10. Seal electrical penetrations
11. Seal HVAC penetrations
12. Seal bottom plate to subfloor and exterior sheathing
13. Install insulation and sealed air barrier behind tub (required)
14. Seal bathtub drain penetration
15. Seal HVAC boot penetrations
16. Install air barrier on interior of all insulated walls

Shower/tub drain rough opening

13. Install insulation and sealed air barrier behind tub (required)
14. Electrical panel box, recommend install on interior (non-insulated) wall. If installed on exterior wall, air barrier shall extend behind box or air-sealed box shall be installed.
15. Seal HVAC penetrations
16. Seal bottom plate to subfloor and exterior sheathing

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Air sealing key points continued

Wall cross-section

1. Seal drywall to top plate with caulk, gaskets or glue (recommended)
2. Seal drywall to top and bottom plates with caulk, gaskets or glue (recommended)
3. Seal bottom plate to subfloor
4. Seal band joist to subfloor and plates
5. Seal drywall to subfloor and plates
6. Install exterior water resistive barrier as per IRC 703.2
7. Air seal and insulate rim/band joist
8. See Insulation Details for Ceilings with Attic Spaces.
9. Wind wash baffle and dam for air-permeable insulation
10. Use backer rod and sealant or spray foam appropriate for windows to fill gaps between window/door and rough opening

Window rough opening

- Use backer rod and sealant or spray foam appropriate for windows to fill gaps between window/door and rough opening

Sealed CLASS I vapor retarder required in crawlspace

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**Combustion chase penetrations**

- Seal around chimney flues with sheet metal cap.
- Rigid or spray foam option (recommended covering with ignition barrier for fire protection).
- Internal air barrier (recommended) or air impermeable insulation.
- Blocking above supporting wall for cantilevered floor (required).
- Insulation above top plate of supporting wall.
- Underfloor insulation must be installed in permanent contact with subfloor (air barrier required at any exposed edge of insulation).

**Combustion closet**

Combustion air inlets as per mechanical and/or fuel gas code.

- Flue stack.
- Insulate water lines for freeze protection.
- Seal gas and plumbing penetrations through walls.
- Insulate walls per code (required if walls are part of building thermal envelope).
- Insulated water heater (not required).
- Door closes against solid threshold.
- Bottom plate sealed.
- Solid (non-louvered) door with weatherstripping on all four edges.

**Exterior penetrations**

- Seal exterior wall penetrations for refrigeration lines, condensate line, etc.

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Air sealing key points continued

- Install blocking and rafter baffle to prevent wind-washing if vented, insulated roofline (required)
- Sealed attic-side air barrier (required for air permeable cavity insulation) — OSB, insulated sheathing, air impermeable cavity insulation, etc.
- R-18 attic kneewall insulation (Georgia requirement)
  - R-13 cavity + R-5 continuous,
  - R-15 cavity + R-3 continuous,
  - or R-19 in 2x6 with sealed attic-side air barrier (eg. OSB/plywood)
- Blocking - fit in joist cavity, caulked or foamed

Attic knee-walls

- Caulk/seal rough opening
- Rigid insulation (recommended)
  - Minimum R-5 (Georgia requirement)
- Weather-strip door opening and threshold

Two-level attic

- Dam for blown insulation
- Unconditioned Space
- Air barrier required
- Conditioned space
- R-18 attic kneewall insulation (Georgia requirement)
  - R-13 + R-5, R-15 + R-3, or R-19 in 2x6 with OSB/plywood

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Air sealing key points continued

**Attic scuttle**

- Insulation dams prevent loose-fill insulation from falling through access
- Hatch lid pushes up and out of the way for access
- Rigid insulation plus batt or spray polyurethane foam (recommended), minimum R-19 (Georgia requirement)

**Attic pull-down stairs**

- Rigid insulation box forms lid for pull-down attic staircase (recommended)
- Insulation dams prevent loose-fill insulation from falling through access
- Cover box pushes up and out of the way for access
- Minimum R-5 (Georgia requirement)
- Insulated cover minimum R-5 (Georgia requirement)
- Weatherstripping

**Attic pull-down stairs**

- Insulation dams prevent loose-fill insulation from falling through access
- Insulation board minimum R-5 (Georgia requirement)
- Seal gap between frame and rough opening with caulk, backer rod, or foam

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Garage blocking and sealing key points

Blocking, air sealing and insulation required above garage separation wall
Air sealing key points continued

1. Seal bottom plate to subfloor
2. Garage (unconditioned)
3. Air barrier behind steps
4. Garage to house door
5. Web trusses
6. Basement (conditioned)
7. Garage (unconditioned)
8. Inset garage to house door
9. Air seal
10. Sheath and insulate
11. Rigid mineral wool board or cellulose blanket
12. Rigid or sprayed foam (recommend covering with ignition barrier, if required)

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Duct Sealing key points

All seams in plenums, trunk lines and boots must be sealed with mastic or mastic tape.

- Mastic at swivel joints (gores)
- Mastic
- Ceiling register
- Mastic
- Ceiling register
- Mastic

Supply leakage

- Supply leakage
- Supply air
- Mastic
- Supply leakage

Caulk between drywall and boot

- Caulk between drywall and boot

Seal box to subfloor

- Seal box to subfloor
- Seal flange with mastic
- Seal elbow gores with mastic
- Seal joints and edges of sheet metal box with mastic

Seal seams then install duct wrap

- Seal seams then install duct wrap
- Seal boot seams and then insulate
- Seal gaps between boot and drywall
- Seal boot seams and then insulate

All closure systems shall have mastic applied that is at least 0.08 inches (2mm) thick.

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**Air Handler Sealing key points**

- Pull insulation to plenum and cinch after applying mastic
- Mastic the permanent connections
- Condensate line drain with “P-trap” and cleanout
- Air-tight sealed/gasketed filter cover
- Separate drain for pan
- Float switch

**FLUE**

- Use metal coupling for flex to connections
- Seal connections with mastic and straps
- Cover coupling with insulation

**FILTER ACCESS**

- Strap and mastic on inner liner with second strap holding insulation in place
- Mastic flange to plenum

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Multifamily Air-sealing Details

1. Cap and seal all chases including chases for grouped utility lines and radon vents.

2. Seal penetrations in mechanical closet including penetrations for the:
   - supply plenum
   - outside air ventilation
   - refrigerant line
   - plumbing
   - electrical
   - gas fuel

3. Seal band area at exterior sheathing side and all penetrations through band.

4. UL-compliant air sealing at drywall finishing for any wall adjacent to stairwell or elevator. Air seal this gap at every change in floor level.

5. Seal miscellaneous clustered penetrations through building envelope (e.g. refrigerant lines).

Sheathing or water-resistive barrier on exterior sheathing

Seal joints in sheathing

Seal all band joist penetrations

Seal vent penetration

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Air sealing key points continued

Multifamily

1. Seal gap between levels

2. Cavity insulation plus exterior sheathing

3. Seal penetrations through exterior sheathing

4. Seal gap between levels

5. Recommend rigid foam between concrete masonry units and framed stud wall

Steel framing requirements
- Thermal break (e.g. rigid foam) required if steel studs

6. FRAMED MULTI-STORY LIVING UNITS

7. CONCRETE MASONRY UNIT STAIRWELL or ELEVATOR CHASE

8. Seal gap between concrete wall and framed units at each level

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Air sealing key points continued

Multifamily Mechanical Closet

*Seal perimeter of drain penetration*

*Seal plenum penetration through drywall*

*Seal electrical and plumbing penetrations and perimeter of outside air ventilation duct*

*Utility chase capped and sealed at perimeter - at all levels*

*Intermittent inline supply fan with controls to ensure concurrent air handler operation*

*Seal electrical and plumbing penetrations*

*Seal refrigerant penetration*

*Seal plumbing penetration*

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Building Thermal Envelope — The basement walls, exterior walls, floor, roof, and any other building element that enclose conditioned space. This boundary also includes the boundary between conditioned space and any exempt or unconditioned space. —2015 IECC

The building thermal envelope is the barrier that separates the conditioned space from the outside or unconditioned spaces. The building envelope consists of two parts - an air barrier and a thermal barrier that must be both continuous and contiguous (touching each other). In a typical residence, the building envelope consists of the roof, walls, windows, doors, and foundation. Examples of unconditioned spaces include attics, vented crawlspaces, garages, and basements with ceiling insulation and no HVAC supply registers.

Example 1 – Prescriptive Compliance
- Attic
- Conditioned space
- Garage
- Conditioned space
- Basement/vented crawlspace

Example 2 – Alternate Compliance
- Vaulted conditioned space
- Kneewall
- Attic
- Conditioned space
- Garage
- Conditioned space
- Basement (conditioned or indirectly-conditioned)

Example 3 – Alternate Compliance
- Conditioned space
- Indirectly-conditioned crawlspace

This is a conventional approach that likely locates all ductwork in unconditioned spaces.

Prescriptive R-values
- Flat ceiling: R-38
- Exterior walls: R-13
- Floor over garage and basement/crawl: R-19 (climate zones 3 & 4)
- Ductwork sealed with mastic and insulated to R-8 in attic, R-6 in basement/crawlspace
- Garage5, attic and basement/crawl are unconditioned spaces

If supply registers deliver conditioned air to basement, it is considered conditioned. With no supply air, it is considered an indirectly-conditioned space.

Example R-values1
- Flat ceiling: R-38
- Kneewalls: R-18 (required)5 (R-13+ R-5, R-15 + R-3, R-19 in 2x6)
- Vaulted ceiling: R-20 air-permeable insulation plus R-5 rigid foam board3
- Exterior walls: R-13
- Basement masonry walls: R-5
- Basement slab: R-04
- Ductwork sealed with mastic and insulated to R-8 in attic, R-6 in basement
- Garage5 and attic are unconditioned spaces

The top conditioned floor functions as a vaulted ceiling with interior walls although it appears to have kneewalls and a flat ceiling. An advantage of this approach is that all upstairs ductwork is located inside the building envelope.

The crawlspace walls are insulated and do not contain vents. The crawlspace ground is covered with 100% plastic and functions as a “mini-basement.”

Example R-values1
- Vaulted ceiling: R-20 air-impermeable foam insulation
- Exterior walls: R-13 + R-5 sheathing
- Crawlspace walls: R-5
- Ductwork sealed with mastic and insulated to R-6
- Garage5 is unconditioned space

1 R-values shown are examples and not necessarily prescriptive code requirements. Refer to the Georgia Energy Code for specific prescriptive insulation requirements.
2 An attic kneewall is any vertical wall that separates conditioned space from an unconditioned attic. In Georgia, kneewalls must be insulated to R-18. A sealed attic-side air barrier (OSB, foil-faced sheathing, etc.) is required when using air permeable insulation.
3 Requires trade-off since prescriptive ceiling requirement is R-38, see roofline installed insulation options and section 806.5 of the 2012 IRC.
4 Slab insulation is not required in Georgia due to termite risk.
5 Although there is nothing to prevent the garage walls from being insulated, due to indoor air quality concerns, the garage should never be considered inside the building.

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Insulation Details for Ceilings with Attic spaces
Rafter and Truss

**Standard Truss**
with tapered insulation depth

**Energy Truss**
with full height insulation (recommended)

**Standard rafter and top plate**
with tapered insulation depth

**Rafter on raised top plate**
with full height insulation (recommended)

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**NOTE:**
R-30 complete coverage is deemed equivalent to prescriptive R-38

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**Note:** Wind wash baffle and air-permeable insulation dam. For air permeable insulation in vented attics, baffles shall be installed adjacent to soffit and eave vents. A minimum of a 1-inch space shall be provided between the insulation and the roof sheathing and at the location of the vent. The baffle shall extend over the top of the insulation inward until it is at least 4 inches vertically above the top of the insulation. Any solid material such as cardboard or thin insulating sheathing shall be permissible as the baffle.

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Roofline Installed Insulation Options

Reference Table 402.1.1 and 402.1.6 in the Georgia Energy Code amendments to the 2015 IECC and Section 806.5 “unvented attic assemblies” in the Georgia Amendments to the 2012 IRC

Vaulted unvented attic – roofline air-impermeable insulation
(e.g., spray foam insulation)

Vaulted unvented attic – roofline air-permeable insulation
(e.g., fiberglass, cellulose insulation)

Cathedralized vented ceiling – roofline air-permeable insulation
(e.g., fiberglass, cellulose insulation)

Option 1
Air impermeable insulation continuous above rafters (e.g. rigid foam board) combined with air-permeable insulation (e.g., fiberglass, cellulose insulation)

Option 2
Air impermeable insulation between rafters (e.g. rigid foam board or spray foam) combined with air-permeable insulation (e.g., fiberglass, cellulose insulation)

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Georgia Insulation Installation – Passing Grade Details

Wall and ceiling insulation that makes up portions of the building thermal envelope shall be installed to Passing Grade quality.

Two criteria affect installed insulation grading: voids/gaps (in which no insulation is present in a portion of the overall insulated surface) and compression/incomplete fill (in which the insulation does not fully fill out or extend to the desired depth).

Voids/Gaps
- Voids or gaps in the insulation are < 1% of overall component surface area (only occasional and very small gaps allowed for Passing Grade)

Compression/Incomplete Fill
- Compression/Incomplete Fill for both air permeable insulation (e.g., fiberglass, cellulose) and air impermeable insulation (e.g., spray polyurethane foam) must be less than 1 inch in depth or less than 30% of the intended depth, whichever is more stringent. The allowable area of compression/incomplete fill must be less than 2% of the overall insulated surface to achieve a Passing Grade.
- Any compression/incomplete fill with a depth greater than the above specifications (up to 1” or 30% of the intended depth, whichever is more stringent) shall not achieve a Passing Grade.

Additional Wall Insulation Requirements
- All vertical air permeable insulation shall be installed in substantial contact with an air barrier on all six (6) sides. Exception: Unfinished basements, rim/band joist cavity insulation and fireplaces (insulation shall be restrained to stay in place).
  - For unfinished basements, air permeable insulation and associated framing in a framed cavity wall shall be installed less than ¼” from the basement wall surface.
- Attic knee wall details – Attic knee walls shall be insulated to a total R-value of at least R-18 through any combination of cavity and continuous insulation. Air permeable insulation shall be installed with a fully sealed attic-side air barrier (e.g., OSB with seams caulked, rigid insulation with joints taped, etc.). Attic knee walls with air impermeable insulation shall not require an additional attic-side air barrier.

Underfloor insulation that makes up portions of the building thermal envelope shall be installed to Passing Grade quality.

Two criteria affect installed insulation grading: voids/ gaps (in which no insulation is present in a portion of the overall insulated surface) and compression/incomplete fill (in which the insulation does not fully fill out or extend to the desired depth).

Voids/Gaps
- Voids or gaps in the insulation are minimal for Passing Grade (< 2% of overall component surface area)

Compression/Incomplete Fill
- Compression/Incomplete Fill for both air permeable insulation (e.g., fiberglass, cellulose) and air impermeable insulation (e.g., spray polyurethane foam) must be less than 1 inch in depth or less than 30% of the intended depth, whichever is more stringent. The allowable area of compression/incomplete fill must be less than 10% of the overall insulated surface to achieve a Passing Grade.
- Any compression/incomplete fill with a depth greater than the above specifications (up to 1” or 30% of the intended depth, whichever is more stringent) shall not achieve a Passing Grade.
- Air-permeable underfloor insulation shall be permanently installed against the subfloor decking. Adequate insulation supports (e.g., wire staves) for air permeable insulation shall be installed at least every 18-24”. Exception: The floor framing-cavity insulation shall be permitted to be in contact with the topside of sheathing or continuous insulation installed on the bottom side of floor framing where combined with insulation that meets or exceeds the minimum wood frame wall R-value and that extends from the bottom to the top of all perimeter floor framing members.
Wall Insulation key points

Voids / Gaps

Passing Grade ✔️
- Insulation is notched and completely surrounds electrical box
- Insulation fully fills cavity at top and bottom
- Narrow cavity fully insulated

Unacceptable Installation ❌
- Incomplete insulation coverage around electrical box
- Insulation does not extend to bottom of cavity
- Narrow cavity not insulated

Compression / Incomplete Fill

Passing Grade ✔️
- Insulation is slit around electrical wire
- Insulation extends from front to back and fully fills entire cavity
- Proper width insulation fully fills narrow cavity

Unacceptable Installation ❌
- Insulation is compressed behind electrical wire
- Insulation does not fully fill entire cavity
- Improper width insulation is compressed into narrow cavity

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Ceiling Insulation key points

**Passing Grade**

- Airtight, IC-rated fixture sealed to drywall ceiling and completely covered by loose-fill insulation or fiberglass batt cut to fit
- Insulation dam at attic access maintains full height coverage of loose-fill insulation
- Insulation batt in full contact with air barrier (ceiling drywall)
- Insulation depth guide (install facing attic access, one ruler per 300 sq.ft.)
- R-5 pull-down stairs with weather-stripping
- Dam and vent baffle
- Vent baffles extend at least 4" above top of insulation
- Consistent, level insulation coverage for all insulation types

**ATTIC CARD Brand X Fiberglass**
- Initial Installed thickness: 14"
- Settled thickness: 12"
- Settled R-value: 38
- Installed density: 1.8 lb./ft³
- 1,800 sq.ft. @ 90 bags

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Ceiling Insulation key points

Unacceptable installation

- Insulation batt not slit around electrical wire
- Insulation coverage tapered at soffit vent
- Insulation batt not in full contact with air barrier (ceiling drywall)
- Insulation depth guide not installed
- Standard pull-down stairs with no insulation or weather-stripping
- No insulation dam at attic access means tapered coverage of loose-fill insulation
- Incomplete coverage is lumpy, mounded, inconsistent or missing
- Non-airtight fixture not sealed to drywall ceiling and insulation held back

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Floor Insulation key points

**Passing Grade**

- Installed insulation is in complete contact with air barrier (subfloor)
- Insulation coverage is complete
- Insulation is slit around plumbing and wiring and securely fastened with minimal compression

**Unacceptable Installation**

- Insulation is not installed in complete contact with air barrier (subfloor)
- Insulation coverage is incomplete due to obstructions (plumbing, electrical, ductwork, etc.)
- Insulation is compressed around plumbing and wiring and is not securely fastened