## Appendix RA

### Air Sealing and Insulation Key Points

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>AIR BARRIER CRITERIA</th>
<th>INSULATION INSTALLATION CRITERIA</th>
</tr>
</thead>
<tbody>
<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>Air-permeable insulation shall not be used as a sealing material.</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 jambs 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>Air sealing shall be provided between the garage and conditioned spaces.</td>
<td>Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.</td>
</tr>
<tr>
<td>10 Garage separation</td>
<td>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.</td>
<td>Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.</td>
</tr>
<tr>
<td>12 Plumbing and wiring</td>
<td>Wiring and plumbing penetrations shall be sealed.</td>
<td>Batts 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>
</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.</td>
<td>Insulation shall be in contact with blocking.</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. Seal airtight IC-rated recessed light fixtures to drywall.
2. Insulate and install sheet material behind bathtub.
3. Insulate headers.
4. Insulate exterior wall.
5. Window sealed into rough opening with backer rod and sealant.
7. Insulate and air seal corners.
8. Fan vented through exterior wall sealed at penetration.
9. Seal bottom plate to subfloor.
10. Narrow stud cavity batts are cut to fit.
11. Insulate and air seal corners.
12. Seal gap between electrical box and drywall.
13. Seal wiring and plumbing penetrations.
14. Seal plumbing penetrations (if ceiling is insulated).
15. Fan vented through exterior wall sealed at penetration.
16. Seal lights and bath vent fans to ceiling drywall.

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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

Seal chases
Seal electrical boxes and fixtures to drywall
Seal HVAC penetrations
Seal HVAC boot penetrations
Seal penetrations in common wall
Seal electrical penetrations through sheathing
Seal bottom plate to subfloor and exterior sheathing
Cap top of chase with solid air barrier and insulate above dropped soffit
Install air barrier on interior of all insulated walls

Shower/tub drain rough opening

Install insulation and sealed air barrier behind tub (required)
Seal bathtub drain penetration
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.

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Air sealing key points continued

Window rough opening

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

Wall cross-section

Seal drywall to top and bottom plates with caulk, gaskets or glue (recommended)

Seal bottom plate to subfloor

Seal band joist to subfloor and plates

Seal drywall to top plate with caulk, gaskets or glue (recommended)

Install exterior water resistive barrier as per IRC 703.2

Air seal and insulate rim/band joist

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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

- Insulate water lines for freeze protection
- 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**

- **Blocking** - fit in joist cavity, caulked or foamed
- **Sealed attic-side air barrier** (required for air permeable cavity insulation)—OSB, insulated sheathing, air impermeable cavity insulation, etc.
- Install blocking and rafter baffle to prevent wind-washing if vented, insulated roofline (required)
- Add blocking
- **Attic knee-walls**
  - 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)
- **Two-level attic**
  - Dam for blown insulation
  - Unconditioned Space
  - Air barrier required
  - R-18 attic kneewall insulation (Georgia requirement)
  - R-13 + R-5, R-15 + R-3, or R-19 in 2x6 with OSB/plywood
  - Conditioned space

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**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).
- Cover box pushes up and out of the way for access.
- Insulation dams prevent loose-fill insulation from falling through access.
- Air seal gasket.
- Insulated cover minimum R-5 (Georgia requirement).

**Insulation dams** prevent loose-fill insulation from falling through access. A 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).

**Weatherstripping** helps seal gaps between frame and rough opening with caulk, backer rod, or foam.

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Georgia International Energy Conservation Code Supplements and Amendments 2019
Garage blocking and sealing key points

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

- Seal bottom plate to subfloor
- Garage (unconditioned)
- Air barrier behind steps
- Garage to house door
- Web trusses
- Rigid or sprayed foam (recommend covering with ignition barrier, if required)
- Basement (conditioned)
- Garage to house door
- Inset garage to house door
- Web truss
- Air seal
- Sheath and insulate
- Rigid mineral wool board or cellulose blanket
- Basement (conditioned)

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**Duct Sealing** key points

- Seal seams then install duct wrap
- Seal flange with mastic
- Seal elbow gores with mastic
- Seal joints and edges of sheet metal box with mastic
- Seal boot seams and then insulate
- Seal gaps between boot and drywall
- Seal box to subfloor
- Mastic at swivel joints (gores)
- Mastic
- Mastic at swivel joints
- Supply leakage
- Supply air
- Mastic
- Supply leakage
- Ceiling register
- Caulk between drywall and boot
- Mastic
- Mastic
- Mastic
- Mastic
- Mastic
- Mastic
- Mastic

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

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

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Appendix RA

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

Float switch

Air-tight sealed/gasketed filter cover

Separate drain for pan

Mastic flange to plenum

Strap and mastic on inner liner with second strap holding insulation in place

Tape temporary connections

Use metal coupling for flex to connections

Seal connections with mastic and straps

Cover coupling with insulation

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Multifamily Air-sealing Details

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

Seal penetrations in mechanical closet including penetrations for the:

- supply plenum
- outside air ventilation
- refrigerant line
- plumbing
- electrical
- gas fuel

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

3. 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

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

Sheathing or water-resistive barrier on exterior sheathing

Seal joints in sheathing

Seal vent penetrations

Seal all band joint penetrations
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

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

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

8. FRAMED MULTI-STORY LIVING UNITS

9. CONCRETE MASONRY UNIT STAIRWELL or ELEVATOR CHASE

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Air sealing key points continued

Multifamily Mechanical Closet

- Seal plenum penetration through drywall
- Seal refrigerant penetration
- Seal plumbing penetration
- Seal perimeter of drain penetration
- 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
- Utility chase capped and sealed at perimeter - at all levels

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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 crawlspace, garages, and basements with ceiling insulation and no HVAC supply registers.

Example 1 – Prescriptive Compliance

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
- Garage, attic and basement/crawl are unconditioned spaces

Example R-values

- Flat ceiling: R-38
- Kneewalls: R-18 (required) (R-13+ R-5, R-15 + R-3, R-19 in 2x6)
- Vaulted ceiling: R-20 air-permeable insulation plus R-5 rigid foam board
- Exterior walls: R-13
- Basement masonry walls: R-5
- Basement slab: R-0
- Ductwork sealed with mastic and insulated to R-8 in attic, R-6 in basement
- Garage and attic are unconditioned spaces

Example 2 – Alternate Compliance

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-values

- 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
- Garage is unconditioned space

Example 3 – Alternate Compliance

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-values

- 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
- Garage is unconditioned space

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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)

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

Standard rafter
and top plate
with tapered insulation depth

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

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

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 of 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)
R-5 minimum in climate zones 2 & 3
R-15 minimum in climate zone 4

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)
R-20 minimum if trade-offs are used (Georgia requirements)

Air-permeable insulation
R-20 minimum if trade-offs are used (Georgia requirements)

Vent baffles and dams create a channel that fully extends from soffit to ridge vent

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Appendix RA
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”.

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Wall Insulation key points

Passing Grade
- Insulation is notched and completely surrounds electrical box
- Insulation fully fills cavity at top and bottom
- Insulation extends from front to back and fully fills entire cavity

Unacceptable Installation
- Incomplete insulation coverage around electrical box
- Insulation does not extend to bottom of cavity
- Insulation does not fully fill entire cavity

Voids / Gaps
- Narrow cavity fully insulated
- Narrow cavity not insulated

Compression / Incomplete Fill
- Insulation is slit around electrical wire
- Proper width insulation fully fills narrow cavity
- Insulation is compressed behind electrical wire
- Improper width insulation is compressed into narrow cavity

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**Ceiling Insulation key points**

**Passing Grade**

**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

- **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**
- **Consistent, level insulation coverage for all insulation types**
- **Insulation dam and vent baffle**
  - Vent baffles extend at least 4” above top of insulation
  - Insulation batt in full contact with air barrier (ceiling drywall)

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Ceiling Insulation key points

Unacceptable installation

- Insulation batt not slit around electrical wire
- Insulation coverage tapered at soffit vent
- No baffle or dam
- Insulation batt not in full contact with air barrier (ceiling drywall)
- Insulation depth guide not installed
- No insulation dam at attic access means tapered coverage of loose-fill insulation
- Incomplete coverage is lumpy, mounded, inconsistent or missing

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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