# Massachusetts Energy Code 9th Edition

## Air Barrier and Insulation Installation Checklist

*(Based on IECC 2015 Table R402.4.1.1)*

### GENERAL REQUIREMENTS

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<table>
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<tbody>
<tr>
<td>1</td>
<td>☐</td>
<td>Breaks or joints in the air barrier shall be sealed.</td>
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<tr>
<td></td>
<td>☐</td>
<td>Air-permeable insulation shall not be used as a sealing material.</td>
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<td></td>
<td>☐</td>
<td>A continuous air barrier shall be installed in the building envelope.</td>
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<td>☐</td>
<td>The exterior thermal envelope contains a continuous air barrier.</td>
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### FRAMING INSPECTION

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<tbody>
<tr>
<td>2</td>
<td>☐</td>
<td>Ceiling/attic</td>
</tr>
<tr>
<td></td>
<td></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.</td>
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<tr>
<td>3</td>
<td>☐</td>
<td>Walls</td>
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<tr>
<td></td>
<td></td>
<td>• The junction of the foundation and sill plate shall be sealed.</td>
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<td></td>
<td>• The junction of the top plate and the top of exterior walls shall be sealed.</td>
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<td>• Knee walls shall be sealed.</td>
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<td></td>
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<td>• Walls are framed to allow the corner to be insulated or continuous insulation is/will be installed.</td>
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<tr>
<td>4</td>
<td>☐</td>
<td>Windows, skylights and doors</td>
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<tr>
<td></td>
<td></td>
<td>• The space between window/door jambs and framing, and skylights and framing shall be sealed.</td>
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<tr>
<td>5</td>
<td>☐</td>
<td>Rim joists</td>
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<td></td>
<td></td>
<td>• Rim joists shall include the air barrier.</td>
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<tr>
<td>6</td>
<td>☐</td>
<td>Floors (including above garage and cantilevered floors)</td>
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<tr>
<td></td>
<td></td>
<td>• The air barrier shall be installed at any exposed edge of insulation.</td>
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<tr>
<td>7</td>
<td>☐</td>
<td>Crawl space walls</td>
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<tr>
<td></td>
<td></td>
<td>• Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.</td>
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<tr>
<td>10</td>
<td>☐</td>
<td>Garage separation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Air sealing shall be provided between the garage and conditioned spaces.</td>
</tr>
<tr>
<td>13</td>
<td>☐</td>
<td>Shower/tub on exterior wall</td>
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<tr>
<td></td>
<td></td>
<td>• Exterior walls adjacent to showers and tubs shall be insulated</td>
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<tr>
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<td>• The air barrier installed at exterior walls adjacent showers and tubs shall separate them from the showers and tubs.</td>
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<tr>
<td>14</td>
<td>☐</td>
<td>Electrical/phone box on exterior walls</td>
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<tr>
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<td>• The air barrier shall be installed behind electrical or communication boxes or air-sealed boxes shall be installed.</td>
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<tr>
<td>16</td>
<td>☐</td>
<td>Concealed sprinklers</td>
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<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>
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**Notes:**
### INSULATION INSPECTION

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<tbody>
<tr>
<td>2</td>
<td>Ceiling/attic</td>
<td>• The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.</td>
</tr>
</tbody>
</table>
| 3 | Walls | • 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. |
| 5 | Rim joists | • Rim joists shall be insulated. |
| 6 | Floors (including above garage and cantilevered floors) | • 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. |
| 7 | Crawl space walls | • Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls. |
| 9 | Narrow cavities | • 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. |
| 11 | Recessed lighting | • Recessed lighting fixtures installed in the building thermal envelope shall be air tight and IC rated. |

### PLUMBING ROUGH-IN INSPECTION

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<tbody>
<tr>
<td>12</td>
<td>Plumbing and wiring</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 available space shall extend behind piping and wiring.</td>
</tr>
</tbody>
</table>

### MECHANICAL ROUGH-IN INSPECTION

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<tbody>
<tr>
<td>8</td>
<td>Shafts, penetrations</td>
<td>• Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.</td>
</tr>
<tr>
<td>15</td>
<td>HVAC register boots</td>
<td>• HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.</td>
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</table>

### FINAL INSPECTION

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<tbody>
<tr>
<td>11</td>
<td>Recessed lighting</td>
<td>• Recessed light fixtures installed in the building thermal envelope shall be sealed to the drywall.</td>
</tr>
<tr>
<td>2</td>
<td>Ceiling/Attic</td>
<td>• Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.</td>
</tr>
</tbody>
</table>

**Notes:**
Air sealing key points

1. Insulate and install sheet material behind bathtub.
2. Insulate and install headers.
3. Insulate exterior wall and air seal corners.
4. Window sealed into rough opening with backer rod and sealant.
5. Insulated exterior wall.
6. Fan vented through exterior wall sealed at penetration.
7. Window sealed into rough opening with backer rod and sealant.
8. Insulation behind stud T-wall and energy corner.
9. Narrow stud cavity batts are cut to fit.
10. Seal bottom plate to subfloor.
11. Seal airtight IC-rated recessed light fixtures to drywall.
12. Seal wiring and plumbing penetrations.
13. Insulate and install sheet material behind bathtub.
15. Seal bottom plate to subfloor.
16. Seal lights and bath vent fans to ceiling drywall.

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Electrical/phone box on exterior walls. The air barrier shall be installed behind electrical or communication boxes or air-sealed boxes 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. Install air barrier on interior of all insulated walls
5. Seal HVAC penetrations
6. Seal electrical penetrations through sheathing
7. Seal bottom plate to subfloor and exterior sheathing
8. Seal chases
9. Seal electric boxes and fixtures to drywall
10. Seal HVAC boot penetrations
11. Seal penetrations in common wall
12. Seal electrical penetrations
13. Seal plumbing penetrations
14. Seal electrical penetrations
15. Seal HVAC boot penetrations
16. Install insulation and sealed air barrier behind tub (required)
17. Seal bathtub drain penetration
18. Seal penetrations in common wall

Shower/tub drain rough opening

13. Install insulation and sealed air barrier behind tub (required)
14. Electrical/phone box on exterior walls. The air barrier shall be installed behind electrical or communication boxes or air-sealed boxes shall be installed.

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**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**

1. Seal drywall to top plate with caulk, gaskets or glue (recommended).
2. Tape or caulk exterior sheathing seams (often the sheathing is the primary air barrier in framed walls).
3. Sill gasket or double-bead of caulk under bottom plate.
4. Insulation is permanently attached to walls.
5. Seal band joist to subfloor and plates.
6. Underfloor insulation must be installed to maintain permanent contact with subfloor (air barrier required at any exposed edge of insulation).
7. Sealed CLASS I vapor retarder required in crawlspace.
8. Wind wash baffle and dam for air-permeable insulation.
9. See Insulation Details for Ceilings with Attic Spaces.
10. Install exterior water resistive barrier as per IRC 703.2.

See 2015 IECC Air sealing key points continued.

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Air sealing key points continued

Combustion chase penetrations

- Seal around chimney flues with sheet metal cap
- Rigid or spray foam recommended (cover 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)

Rooms containing fuel-burning appliances*

- Combustion air inlets as per mechanical and/or fuel gas code
- Insulate water lines for freeze protection
- Insulate walls per building thermal envelope requirement
- Insulated water heater (not required)
- Door closes against solid threshold
- Bottom plate sealed
- Solid (non-louvered) door with weatherstripping on all four edges

*Exceptions: Direct vent appliances (intake and exhaust) and wood-burning fireplaces with tight fitting doors and outdoor combustion air.

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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.

Attic kneewall insulation
R-13 cavity + R-5 continuous or R-20 in 2x6 with sealed attic-side air barrier (eg. OSB/plywood)

Add blocking

Blocking - fit in joist cavity, caulked or foamed

Attic kneewalls

Caulk/seal rough opening

Insulated to same R-value as kneewall (rigid insulation recommended)

Weather-strip door opening and threshold

Two-level attic

Dam for blown insulation

Unconditioned Space

Air barrier required

Attic kneewall insulation R-13 + R-5 or R-20 in 2x6 with OSB/plywood

Caulk

Glue

Blocking

Conditioned space

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), R-value same as surrounding ceiling

**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

Rigid insulation plus batt or spray polyurethane foam (recommended), R-value same as surrounding ceiling

Seal gap between frame and rough opening with caulk, backer rod, or foam

Boxed enclosure for staircase has rigid hinged lid with insulation on top

Rigid insulation plus batt or spray polyurethane foam (recommended), R-value same as surrounding ceiling

Weatherstripping

Panel

Trim

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Garage blocking and sealing key points

Blocking, air sealing and insulation required above garage separation wall

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**Air sealing key points continued**

1. **Web truss**
   - Seal bottom plate to subfloor
   - Garage (unconditioned)

2. **Air barrier behind steps**
   - Basement (conditioned)

3. **Garage to house door**
   - Garage (unconditioned)

4. **Inset garage to house door**
   - Rigid mineral wool board, cellulose blanket, fiberglass or sprayed foam
   - Cover with ignition barrier, if required

5. **Sheath and insulate**
   - Basement (conditioned)

6. **Rigid mineral wool board, cellulose blanket, fiberglass or sprayed foam**
   - Cover 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.

- Seal seams then install duct wrap
- Seal boot seams and then insulate
- Seal gaps between boot and drywall
- Seal box to subfloor
- Seal flange with mastic
- Seal elbow gores with mastic

Mastic at swivel joints (gores)

Caulk between drywall and boot

Supply leakage

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

Caulk between

Mastic

Supply air

Mastic at swivel joints (gores)

Mastic

Supply leakage

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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
- Float switch
- Air-tight sealed/gasketed filter cover
- Separate drain for pan
- Strap and mastic on inner liner with second strap holding insulation in place
- Mastic flange to plenum
- Pull insulation to plenum and cinch after applying mastic
- Mastic permanent connections
- Condensate line drain with "P-trap" and cleanout
- Use metal coupling and straps for flex-to-flex connections
- Mechanically attach with straps and seal connections with mastic
- Cover coupling with insulation, bind insulation cover with tape

Label: Cabinet leakage ≤ 2% of design airflow as per ASHRAE 193

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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 with water-resistive barrier on exterior sheathing

Seal joints in sheathing

Seal vent penetration

Seal all band joint penetrations

BATH EXHAUST VENT

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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

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

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

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

**Prescriptive R-values**
- Flat ceiling: R-49
- Exterior walls: R-20 or 13+5
- Floor over garage and basement/crawl: R-30
- Ductwork sealed with mastic and insulated to R-8 in attic, R-6 in basement/crawlspace
- Garage, 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.

**Prescriptive R-values**
- Flat ceiling: R-49
- Kneewalls: R-20 or 13+5
- Vaulted ceiling: R-30
- Exterior walls: R-20 or 13+5
- Basement masonry walls: R-5
- Basement slab: R-10, 2ft
- Ductwork sealed with mastic and insulated to R-8 in attic, R-6 in basement
- Garage 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.”

**Prescriptive R-values**
- Vaulted ceiling: R-30
- Air-impermeable foam insulation
- Exterior walls: R-13 + R-5 sheathing
- Crawlspace walls: R-15 continuous
- Garage is unconditioned space

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1. An attic kneewall is any vertical wall that separates conditioned space from an unconditioned attic. A sealed attic-side air barrier (OSB, foil-faced sheathing, etc.) is required when using air permeable insulation.

2. Reduction from R-49 to R-30 limited to 500 ft² or 20% of insulated ceiling area, whichever is less.

3. Interior slab insulation must extend downward from the top of the slab creating a thermal break between the slab edge and the stem wall. Exterior slab insulation must extend downward from the top of the slab with above-grade insulation protected from UV and physical damage. Insulation must continue vertically or horizontally for 2 ft below grade.

4. 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)

NOTE: R-38 complete coverage is deemed equivalent to prescriptive R-49

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.
Roofline Installed Insulation Options

Reference Table 402.1.2 and 402.1.4 in 2015 IECC. Refer to Section 806.5 “Unvented Attic Assemblies” in the 2015 IRC for additional detail.

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)

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

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

Air-permeable insulation, additional R-29 minimum or use REScheck, Performance or ERI

Air impermeable insulation (e.g., open- or closed-cell spray foam) R-20 minimum

Air impermeable insulation (e.g., rigid foam board)

Air-permeable insulation (e.g., fiberglass, cellulose insulation) R-29 minimum or use REScheck, Performance or ERI

Air-permeable insulation (e.g., fiberglass, cellulose insulation)

R-20 minimum

1/2" drywall interior ceiling

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

Ridge vent

2015 IECC
IECC Insulation Installation Details

Wall and ceiling insulation that makes up portions of the building thermal envelope shall be installed per the manufacturer’s instructions and IECC Table 402.4.1.1.

Two criteria affect installed insulation quality: 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).

Insulation Installation Guidelines:

Voids/Gaps
  o Voids or gaps in the insulation are minimized (only occasional and very small gaps)

Compression/Incomplete Fill
  o Compression/Incomplete Fill for both air permeable insulation (e.g., fiberglass, cellulose) and air impermeable insulation (e.g., spray polyurethane foam) is minimal.

Additional Wall Insulation Requirements
  o All vertical air permeable insulation shall be installed in substantial contact with an air barrier on all six (6) sides. Exception: Unfinished basements and rim/band joist cavity insulation (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.
  o Attic kneewall details – Attic kneewalls shall be insulated to a total R-value of at least R-20 cavity or 13+5 cavity and continuous. 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 kneewalls 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 meet the following guidelines.

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
  o Voids or gaps in the insulation are minimal

Compression/Incomplete Fill
  o Compression/Incomplete Fill for both air permeable insulation (e.g., fiberglass, cellulose) and air impermeable insulation (e.g., spray polyurethane foam) is minimal.
  o 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.

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Wall Insulation key points

Voids / Gaps

**Passing Grade**
- Insulation fully fills cavity at top and bottom
- Narrow cavity fully insulated

**Unacceptable Installation**
- Insulation does not extend to bottom of cavity
- Narrow cavity not insulated

Compression / Incomplete Fill

**Passing Grade**
- Insulation is slit around electrical wire
- Proper width insulation fully fills narrow cavity

**Unacceptable Installation**
- Insulation is compressed behind electrical wire
- Insulation does not fully fill entire cavity

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Ceiling Insulation key points

Passing Grade ✅

ATTIC CARD Brand X Fiberglass
Settled R-value: 49
Initial Installed thickness: 16.75"
Settled thickness: 16.75"
0.711 lbs. / s.f.
Bag weight: 32 lbs.
22.2 bags / 1000 s.f.
@1,800 s.f. : 40 bags

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

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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

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