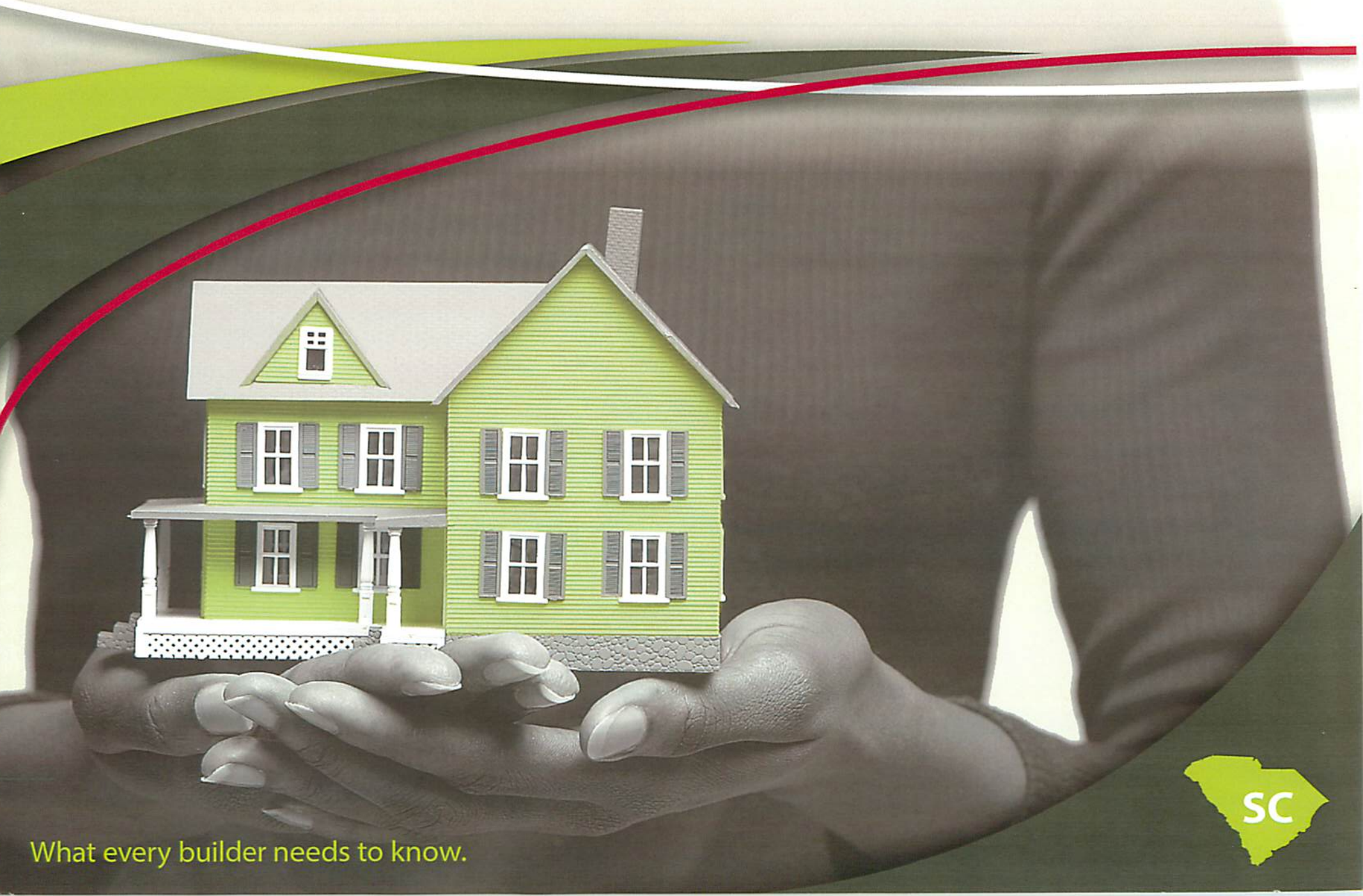
SUCCESS WITH 2009 IECC FOR SOUTH CAROLINA



What every builder needs to know.

Reproduction of this material is supported by the Department of Energy under Award Number DE-EE0003884, administered by the South Carolina Energy Office.

Mission + Company History

Advanced Energy's Applied Building Science team is committed to ensuring that every home in the nation is healthy, safe, durable, comfortable, energy efficient and environmentally responsible. Our staff of building science experts provides training and consultation services to a variety of clients in the building industry. Specializing in new construction, existing home retrofit and affordable housing, our programs and partnerships with utilities, program implementers, builders, building product manufacturers, municipalities and government agencies have resulted in more than 200,000 energy-efficient homes nationwide.

With more than 30 years of experience developing and delivering effective building science products and programs, Advanced Energy is your trusted partner in helping you exceed your program or company goals. For more information about the Applied Building Science team or our training products, contact 919.857.9000 or visit www.AdvancedEnergy.org/buildings.

Created in 1980, Advanced Energy was established largely through the efforts of the South Carolina Utilities Commission with the cooperation of the state's electric utility industry. The organization supports a wide variety of clients and partners nationally and internationally, including utilities, government agencies, municipalities and other stakeholders involved with energy efficiency efforts. Our staff of experts provides training, consulting and testing services with specialized expertise in the areas of applied building science, industrial processes and commercial buildings, motors and drives and transportation. Essentially, Advanced Energy is bringing energy efficiency to your home, your workplace, the places you go and the vehicles you take to get there.

MORE INFORMATION www.AdvancedEnergy.org

Mission + Company History

Advanced Energy, SEEA and HBASC believe in empowering local infrastructure to help prepare builders for energy code; therefore, we are happy to partner with England Enterprises, Inc. who will be presenting this training to you.

Vision

England Enterprises Training Division, LLC was established in 1992 as the only company in the southeast to assist federal, state and local jurisdictions with the training and implementation of the international building codes. England Enterprises, Inc. has always helped the new inspector as well as the seasoned professional with the ultimate mission "Helping Jurisdictions Build Safer Communities".

About John England

John England is the Chief Operating Officer of England Enterprises, Inc. He has over 35 years experience in commercial construction starting out as an electrical helper on school projects. Mr. England started England Enterprises, Inc. in 1992 doing contract management on HUD projects for the Berkley, Charleston & Dorchester Council of Government.

Currently he is involved in the day to day operations of the company and much of his time is spent teaching building inspectors, architects, engineers and contractors around the southeast.

Mr. England earned the Master Code Professional designation in 1996 under the Southern Building Codes Council which later changed to the International Code Council. There are less than 1,000 building officials around the country who have earned this designation.

Mission + Company History

The Home Builders Association of South Carolina (HBASC) is a trade association for the residential construction and development industry. The association provides a forum through which these businesses can work together to remain informed regarding new and proposed policies advanced by the local, state and federal governments that affect the housing industry.

Who We Are

The Home Builders Association of South Carolina (HBASC) is a professional, nonprofit association committed to promoting housing for people of all income levels and the production of quality homes. The HBASC membership is comprised of home builders, trade contractors, suppliers and industry professionals.

Mission + Company History

SEEA is the independent champion driving market transformation in the Southeast's energy efficiency sector through collaborative public policy, thought leadership, and programs, services and technical advisory activities.

Vision

The Southeast Energy Efficiency Alliance (SEEA) will advance energy efficiency as a primary driver of an economically vibrant, energy secure and environmentally sustainable Southeastern United States. We partner with policymakers, utilities, governments, industry and non-governmental organizations to create more energy efficient futures for the communities we serve across 11 states (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee and Virginia) and one territory (U.S. Virgin Islands) in the region.

Business Principles

Partnership: SEEA works inclusively with policy leaders, program and community partners and other stakeholders in the development of efficiency policy and the delivery of related programs.

Innovation: SEEA is committed to remaining on the cutting edge of market transformation practices and knowledge, and leveraging these to create more energy efficient futures for the region.

Sustainability: SEEA operates in a financially sustainable and responsible manner to ensure good stewardship of all partner investments.

Neutrality: SEEA is politically neutral, unbiased and holistic in its partnership with stakeholders engaged in driving energy efficiency market transformation.

Empowerment: SEEA team members support each other in their pursuit of personal growth, development and fulfillment.

APPLIED BUILDING SCIENCE

Applied Building Science

The applied building science training process is based on a whole-house systems approach combining technical building science knowledge with decades of experience in new construction, existing home retrofit and affordable housing. Our portfolio of *Success* training products ensures participants successfully implement what they learn by going beyond classroom instruction and providing the practical tools, methods and processes for use in the field.

Success trainings:

1. Give participants tools documenting critical details, steps and work processes to ensure successful implementation in the field

2. Link participants to years of building science experience and team of experts

3. Train participants on standard work processes that increase productivity and reduce waste

MORE INFORMATION www.AdvancedEnergy.org

What every builder needs to know.

Learn to implement code requirements right the first time with *Success with 2009 IECC for South Carolina* training for builders. In this course, we simplify and guide builders and contractors through the compliance process.

Topics covered during presentations:

- Introduction to major changes to the code
- Introduction to a prevention-oriented culture and establishing standard work processes
- Basic building science techniques
- Field implementation techniques for:
  - Foundation
  - Framing
  - Electrical
  - Plumbing
  - HVAC installation
  - Air sealing
  - Insulation

SC

NEW CONSTRUCTION

Process Information Sheet

PROCESS STRUCTURE

Our goal is to simplify the new code language and make it easier for your houses to comply. Our process includes these important tools:

- Classroom training
- Field materials

We suggest including these important methods when implementing our process in your company:

- Apply existing knowledge
- Field training

PROCESS VALUE

Utilizing our process will help you complete the 2009 IECC for South Carolina requirements, but it also provides additional value as well. Utilizing the Success with 2009 IECC for South Carolina process can:

- Reduce expenses
- Create low-to-no cost quality control
- Increase customer satisfaction

Process: Introduction

As the cost of energy rises, cities and states nationwide are searching for ways to reduce energy usage. For new construction, the major initiative is to include more stringent energy conservation measures in local building codes. In this economic climate, a builder who understands these new measures will have an advantage in the marketplace. *Success with 2009 IECC for South Carolina* will assist builders by simplifying these new standards and provide tools for the workplace.

Process: Structure

Our goal is to simplify the new code language and make it easier for your houses to comply. To accomplish this goal, we have created a process to implement within your company.

In this training, we will be providing our knowledge and expertise to you through these methods:

- Classroom training

  Trainers of this course will introduce you to the new code requirements, the value of process, building science basics and examples of implementation. This is your opportunity to get clarification on certain requirements, brush up on your building science knowledge and talk to our trainers about how to incorporate the Success with 2009 IECC for South Carolina process into your construction methods.

- Field materials

  In this book, there are several useful materials that introduce your subcontractors to their responsibilities for new code requirements. We also include Job Ready/Job Complete Checklists that highlight the most important and difficult requirements and help you verify that work has been done correctly. We have also included Tech Tips and Critical Details which illustrate common installation problems and the proper way to complete requirements.

Once you have completed this training, we suggest you take the knowledge and materials distributed in the training and use them at your company. To make the implementation more successful, we suggest including these methods as well:

- Apply existing knowledge

  We understand that many people who attend our training have been in the construction industry for a long time and have their own methods; however, we feel that the construction expertise that already exists within your organization can be combined with the Success with 2009 IECC for South Carolina process to achieve success in the field.

- Field training

  We give you the knowledge and tools to teach others in your organization. When you leave the in-class training, you will have a clear understanding of why you need to pass this information on to your employees and subcontractors and how to do it. In addition, we provide information sheets for many of the subcontractors to help them better understand the new code requirements.

Process: Beyond Code

Utilizing these trainings and materials will help you complete the new code requirements, but it will also bring additional benefits. Instituting this process will help work get done right the first time. It will help you reduce expenses, create low-to-no cost Quality Control and increase your customers' satisfaction.

RESCheck Information Sheet

RESCheck Introduction

From the Department of Energy:

The REScheck product group makes it fast and easy for builders, designers, and contractors to determine whether new homes, additions, and alterations meet the requirements of the IECC or a number of state energy codes. REScheck also simplifies compliance determinations for building officials, plan checkers, and inspectors by allowing them to quickly determine if a low-rise residence meets the code.

REScheck is appropriate for insulation and window trade-off calculations in residential detached one- and two-family buildings and multi-family buildings three stories or less in height above grade, such as apartments, condominiums, and townhouses. REScheck works by performing a simple U-factor x Area (UA) calculation for each building assembly to determine the overall UA of a building. The UA that would result from a building conforming to the code requirements is compared against the UA for your building. If the total heat loss (represented as a UA) through the envelope of your building does not exceed the total heat loss from the same building conforming to the code, the software generates a report that declares your building is compliant with the code.

REScheck Desktop can be downloaded and installed directly to your desktop, while REScheck-Web™ is accessible directly from the website without having to download and install.

Resources

Before using RESCheck, verify that your state allows use of the program:

- http://www.energycodes.gov/images/states-can-use-rescheck-show-compliance

After verification, download the program to your computer:

- http://www.energycodes.gov/rescheck/

Building Envelope Testing Information Sheet

NEW CONSTRUCTION

BUILDING ENVELOPE LEAKAGE: TESTING

When the test is administered, the items below must be completed:

- Close but do not seal exterior windows and doors, fireplace and stove doors
- Close but do not seal dampers (including exhaust, intake, makeup air, backdraft and flue dampers)
- Open interior doors
- Close and seal exterior openings for continuous ventilation systems and heat recovery ventilators
- Turn off heating and cooling system(s)
- Do not seal HVAC ducts, supply or return registers
- SAFETY PRECAUTION: Turn combustion appliances within the building envelope, such as water heaters, to pilot

Building Envelope Leakage: Introduction

Many new buildings include complex geometries in their design, which lead to unanticipated breaks in the air barrier of an otherwise tightly constructed home. Although leakage testing can determine the amount of leakage, it does not indicate the specific location of the leakage. When combined with other methods, such as a visual inspection, IR camera usage and/or smoke sticks, many leakage locations can be easily determined. If leakage is higher than anticipated, examine these design features first:

- Chases
- Dropped ceilings
- Stairway structures
- Shafts such as chimneys
- Soffits
- Cantilevers
- Brick pockets
- Floored attics
- Bonus rooms
- Tubs and showers
- Knee walls
- Garages

Building Envelope Testing: Introduction

The easiest way to measure building envelope leakage is with a blower door. The blower door consists of a powerful, calibrated, variable speed fan that is temporarily sealed into an exterior doorway. In a depressurization test, the fan blows air out of the house to create a 50 pascals pressure difference between the inside and outside. The pressure difference pulls air through all of the holes and penetrations in the building envelope. This is the approximate pressure a house would experience if a 20 mph wind was hitting it from all sides.

Building Envelope Testing: Measuring Leakage

The blower door measures the air leakage of the entire building envelope by measuring the airflow through the blower door fan when all windows and exterior doors are closed. The tighter the building, the less airflow is needed from the blower door fan to create a change in building pressure.

Air tightness measurements are presented in a number of different formats including:

- Square inches of leakage
- Cubic feet per minute (CFM) of airflow needed to generate 50 pascals of pressure difference (CFM_{50})
- Air changes per hour (ACH) at 50 pascals of pressure difference (ACH_{50})
- Airflow needed to generate 50 pascals of pressure difference per square foot of shell area (CFM_{50}/sf envelope)

Building Envelope Testing: 2009 IECC

The 2009 IECC for South Carolina requires a blower door test if a visual inspection is not completed. Building envelope tightness, when tested, is less than the following performance measurement:

- Seven air changes per hour (ACH_{50})

When the test is administered, the items below must be completed:

- Close but do not seal exterior windows and doors, fireplace and stove doors

Building Envelope Testing Information Sheet

- Close but do not seal dampers (including exhaust, intake, makeup air, backdraft and flue dampers)
- Open interior doors
- Close and seal exterior openings for continuous ventilation systems and heat recovery ventilators
- Turn off heating and cooling system(s)
- Do not seal HVAC ducts, supply or return registers
- SAFETY PRECAUTION: Turn combustion appliances within the building envelope, such as water heaters, to pilot

Building Envelope Testing: Recommendations

There are different manufacturers of air leakage testing equipment:

- The Energy Conservatory: www.energyconservatory.com
- Infiltec: www.infiltec.com
- Retrotec Energy Solutions: www.retrotec.com

Whichever equipment is used, it is important to follow the manufacturers specifications.

In addition, it is important for builders to consider using a third-party verifier such as a HERS rater or a BPI certified professional. Either will have the necessary training and equipment, and will be helpful throughout the verification process. To locate professionals in your area, follow the links below:

HERS Raters
http://www.resnet.us/directory/raters

BPI Certified Professionals
http://www.bpi.org/tools_locator.aspx?associateTypeID=CTR

Building Envelope Testing: Alternative

The 2009 IECC for South Carolina does provide an alternative to testing the building envelope leakage. Where required by the code official, an approved party independent of the installer of the insulation shall inspect the air barrier and insulation. A copy of the visual inspection document is included in this book.

Visual Inspection Information Sheet

2009 IECC TABLE 402.4.2 AIR BARRIER AND INSULATION INSPECTION COMPONENT CRITERIA	
Component	**Criteria**
Air barrier and thermal barrier	• Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier. • Breaks or joints in the air barrier are filled or repaired. • Air-permeable insulation is not used as a sealing material. • Air-permeable insulation is inside of an air barrier.
Ceiling/attic	• Air barrier in any dropped ceiling/soffit is substantially aligned with insulation and any gaps are sealed. • Attic access (except unvented attic), knee wall door, or drop down stair is sealed.
Walls	• Corners and headers are insulated. • Junction of foundation and sill plate is sealed.
Windows and doors	• Space between window/door jambs and framing is sealed.
Rim joists	• Rim joists are insulated and include an air barrier
Floors (including above-garage and cantilevered floors)	• Insulation is installed to maintain permanent contact with underside of subfloor decking. • Air barrier is installed at any exposed edge of insulation.
Crawl space walls	• Insulation is permanently attached to walls. • Exposed earth in unvented crawl spaces is covered with Class I vapor retarder with overlapping joints taped.
Shafts, penetrations	• Duct shafts, utility penetrations, knee walls and flue shafts opening to exterior or unconditioned space are sealed.

Visual Inspection Information Sheet

2009 IECC TABLE 402.4.2 AIR BARRIER AND INSULATION INSPECTION COMPONENT CRITERIA	
Narrow cavities	• Batts in narrow cavities are cut to fit, or narrow cavities are filled by sprayed/blown insulation.
Garage separation	• Air sealing is provided between the garage and conditioned spaces.
Recessed lighting	• Recessed light fixtures are air tight, IC rated and sealed to drywall. • Exception-fixtures in conditioned space.
Plumbing and wiring	• Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
Recessed lighting	• Recessed light fixtures are air tight, IC rated and sealed to drywall. • Exception-fixtures in conditioned space.
Shower/tub on exterior wall	• Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.
Electrical/phone box on exterior walls	• Air barrier extends behind boxes or air sealed-type boxes are installed.
Common wall	• Air barrier is installed in common wall between dwelling units.
HVAC register boots	• HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
Fireplace	• Fireplace walls include an air barrier.

Glazing Information Sheet

Glazing: Code Requirements

The 2009 IECC for South Carolina has specific requirements related to all types of glazing. Below are the specific requirements by climate zone:

Energy Efficiency Specifications for Glazing

Climate Zone	Fenestration (U-Value)	Skylight (U-Value)	All Glazing (SHGC)
Zone 3	.50	.65	.30

The code has some allowances and trade-offs when calculating the U-Value and solar heat gain coefficient (SHGC) of a building's glazing. According to the 2009 IECC for South Carolina:

- Up to 15 square feet (1.4m^2) of glazed fenestration per dwelling unit shall be permitted to be exempt from U-factor and SHGC requirements
- An area-weighted average of fenestration products shall be permitted to satisfy the U-factor requirements
- An area-weighted average of fenestration products, more than 50 percent glazed, shall be permitted to satisfy the SHGC requirements
- Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable specifications for glazing requirements for U-factor and SHGC

Glazing Information Sheet

Glazing: Assumptions

The 2009 IECC for South Carolina has specific values for unlabeled windows and doors:

Default Glazed Fenestration U-Factor

Type	Double Pane	Single Pane	Skylight Double	Skylight Single
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

Default Glazed Fenestration SHGC

Type	SHGC
Single Clear	0.80
Single Tinted	0.70
Double Clear	0.70
Double Tinted	0.60
Glass Block	0.60

Default Door U-Factor

Type	U-factor
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

Certificate Information Sheet

Certificate Requirements

The 2009 IECC for South Carolina requires all houses to have a permanent certificate attached to the electrical panel. This certificate must be completed by the builder or the design professional and document certain items. These include, but are not limited to:

- Wall, ceiling, attic, slab, floor, basement wall and crawlspace wall insulation R-Values
- Duct insulation R-Values
- Window and skylight SHGC and U-Values
- Types and efficiencies of heating and cooling equipment

Note: Efficiencies do not need to be listed for electric furnaces and baseboard electric heaters. In addition, efficiencies do not need to be listed for gas-fired unvented room heaters; however we highly discourage using these types of heaters due to health, safety and durability concerns.

Resources

Below are a list of resources for certificate templates. Be sure to check with your local jurisdiction before printing and attaching the certificate. Some areas may require additional information to be placed on the certificate.

- http://energy.wsu.edu/Documents/Qtr_Sheet_WSEC_2009_Certificate.pdf
- http://www.greenerchoices.org/pdf/Home_Energy_Code_Checklist.pdf
- http://permittingservices.montgomerycountymd.gov/DPS/pdf/ResidentialEnergyEfficiencyCertificate.pdf

Foundation Contents

In this section, you will find materials to assist foundation installers with the completion of code requirements. Below is a list of the content provided.

- Job Ready
- Job Complete
- Code Comparison
- Tech Tips

FOUNDATION

✓	✗	N/A	
❑	❑	❑	1. Work site is clean and construction materials are properly stored before proceeding.

Builder Verification

✓	✗	
❑	❑	Stop work until details are corrected.
❑	❑	Proceed without corrections.

The sub-contractor who signs and completes this form is doing so to the best of his/her knowledge and should not be held legally responsible for work completed by other organizations. The intent of this form is to ensure job sites are ready before beginning work.

Signature	Date

FOUNDATION

✓	✗	N/A	
❑	❑	❑	1. For crawlspaces, install poly sheeting that is at least 6-mil thickness and overlaps at least 6 inches.
❑	❑	❑	2. Damp proof the exterior of all below-grade walls.
❑	❑	❑	3. Install a drainage system along entire foundation footing of below-grade walls.
❑	❑	❑	4. Install exterior slab insulation without gaps, voids, misalignments or compression and with a rigid, opaque and weather-resistant protective covering.
❑	❑	❑	5. Install exterior insulation levels to meet the 2009 IECC.
❑	❑	❑	6. Ensure work site is clean and construction materials are properly stored before proceeding.

Certification

The sub-contractor who signs and completes this form is doing so to the best of his/her knowledge and should not be held legally responsible for work completed by other organizations. The intent of this form is to ensure job sites are ready before beginning work.

Name
Company
Signature

FOUNDATION

Job Ready	
1	None

Job Complete	
1	**2009 IECC 402.2.9:** As an alternative to insulating floors over crawlspaces, crawlspace walls shall be permitted to be insulated when the crawlspace is not vented to the outside. Crawlspace wall insulation shall be permanently fastened to the wall and extend downward from the floor to the finished grade level and then vertically and/or horizontally for at least an additional 24 inches (610 mm). Exposed earth in unvented crawlspace foundations shall be covered with a continuous Class I vapor retarder in accordance with the International Building Code. All joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend at least 6 inches (153 mm) up the stem wall and shall be attached to the stem wall.
2	**2012 IRC R406.1:** Except where required by Section R406.2 to be waterproofed, foundation walls that retain earth and enclose interior spaces and floors below grade shall be damp proofed from the top of the footing to the finished grade. Masonry walls shall have not less than 3/8 inch (9.5 mm) portland cement parging applied to the exterior of the wall. The parging shall be damp proofed in accordance with one of the following: 1. Bituminous coating. 2. Three pounds per square yard (1.63 kg/m2) of acrylic modified cement. 3. One-eighth inch (3.2 mm) coat of surface-bonding cement complying with ASTM C 887. 4. Any material permitted for waterproofing in Section R406.2. 5. Other approved methods or materials. Exception: Parging of unit masonry walls is not required where a material is approved for direct application to the masonry. Concrete walls shall be damp proofed by applying any one of the above listed damp proofing materials or any one of the waterproofing materials listed in Section R406.2 to the exterior of the wall.
3	**2012 IRC R405.1:** Drains shall be provided around all concrete or masonry foundations that retain earth and enclose habitable or usable spaces located below grade. Drainage tiles, gravel or crushed stone drains, perforated pipe or other approved systems or materials shall be installed at or below the area to be protected and shall discharge by gravity or mechanical means into an approved drainage system. Gravel or crushed stone drains shall extend at least 1 foot (305 mm) beyond the outside edge of the footing and 6 inches (152 mm) above the top of the footing and be covered with an approved filter membrane material. The top of open joints of drain tiles shall be protected with strips of building paper. Perforated drains shall be surrounded with an approved filter membrane or the filter membrane shall cover the washed gravel or crushed rock covering the drain. Drainage tiles or perforated pipe shall be placed on a minimum of 2 inches (51 mm) of washed gravel or crushed rock at least one sieve size larger than the tile joint opening or perforation and covered with not less than 6 inches (152 mm) of the same material. Exception: A drainage system is not required when the foundation is installed on well-drained ground or sand-gravel mixture soils according to the Unified Soil Classification System, Group I Soils, as detailed in Table R405.1.

FOUNDATION

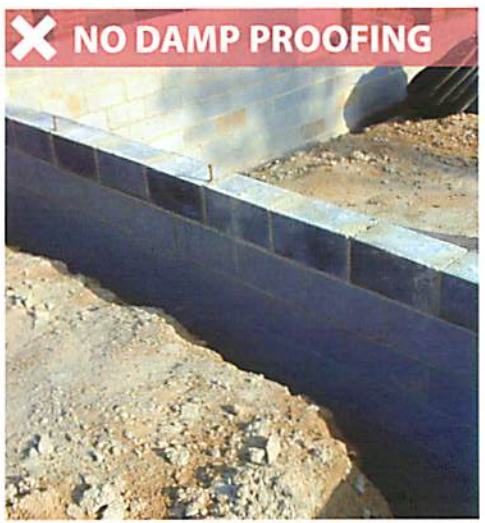
Job Complete

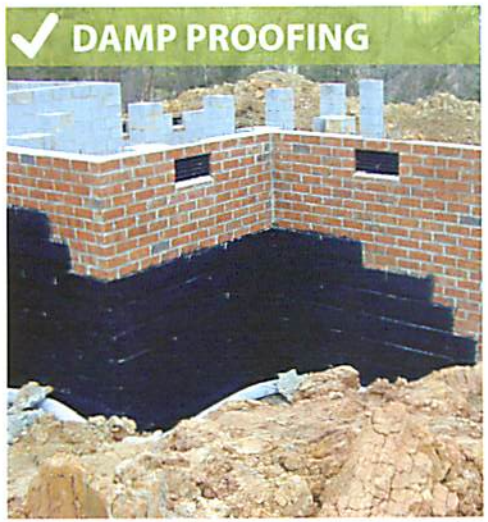
4	**2009 IECC 303.2.1:** Insulation applied to the exterior of basement walls, crawlspace walls and the perimeter of slab-on-grade floors shall have a rigid, opaque and weather-resistant protective covering to prevent the degradation of the insulation's thermal performance. The protective covering shall cover the exposed exterior insulation and extend a minimum of 6 inches (153 mm) below grade. **2012 IRC R318.4:** Foam plastic protection. In areas where the probability of termite infestation is "very heavy" as indicated in Figure R301.2(6), extruded and expanded polystyrene, polyisocyanurate and other foam plastics shall not be installed on the exterior face or under interior or exterior foundation walls or slab foundations located below grade. The clearance between foam plastics installed above grade and exposed earth shall be at least 6 inches (152 mm). Exceptions: 1. Buildings where the structural members of walls, floors, ceilings and roofs are entirely of noncombustible materials or pressure-preservative-treated wood. 2. When in addition to the requirements of Section R318.1, an approved method of protecting the foam plastic and structure from subterranean termite damage is used. 3. On the interior side of basement walls.
5	**2009 IECC 402.1.1:** The building thermal envelope shall meet the requirements of Table 402.1.1 based on the climate zone specified in Chapter 3.
6	None

FOUNDATION

1. If installing poly sheeting, install at least 6-mil thickness and overlap at least 6 inches.

2. Damp proof the exterior of all below-grade walls.



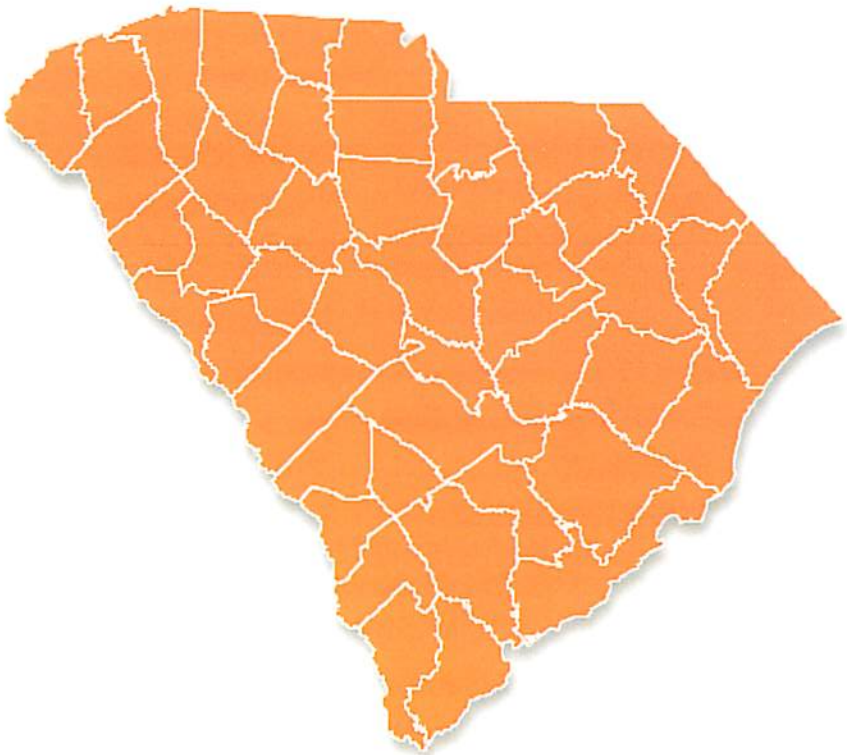


3. Install a drainage system along entire foundation footing of below-grade walls.

4. Install exterior insulation without gaps, voids, misalignments or compression and with a rigid, opaque and weather-resistant protective covering.

5. Install exterior insulation levels to meet the 2009 IECC.[a]

CLIMATE ZONE	CEILING	FRAME WALL	MASS WALL[b]	FLOOR	BASEMENT WALL[c]	CRAWL SPACE WALL[c]	SLAB[e]
Zone 3	R-30	R-13	R-5/8	R-19	R-5/13[d]	R-5/13	0



a. R-Values are minimums.
b. The second R-value applies when more than half of the insulation is on the interior of the mass wall.
c. "R-5/13" means R-5 continuous insulation sheathing on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.
d. Basement wall insulation is not required in warm-humid locations defined by Figure 301.1 and Table 301.1 of the 2009 IECC.
e. R-5 shall be added to the required slab edge R-values for heated slabs. Insulation depth shall be the depth of the footing or two feet, whichever is less in Climate Zones 1-3 for heated slabs.

Interactive Map:
http://energycode.pnl.gov/EnergyCodeReqs/

Framing Contents

In this section, you will find materials to assist framers with the completion of code requirements. Below is a list of the content provided.

- Job Ready
- Job Complete
- Code Comparison
- Tech Tips
- Attic Framing Information Sheet

FRAMING

✓	✗	N/A	
❑	❑	❑	1. All below-grade walls have been damp proofed.
❑	❑	❑	2. A drainage system is installed along entire foundation footing of below-grade walls.
❑	❑	❑	3. Exterior rigid insulation levels meet the 2009 IECC.
❑	❑	❑	4. Exterior rigid insulation is installed without gaps, voids, misalignments or compression and with a rigid, opaque and weather-resistant protective covering.
❑	❑	❑	5. All walls separating conditioned and unconditioned spaces that will not have an interior finish are noted on the plans and sections.
❑	❑	❑	6. Work site is clean and construction materials are properly stored in a dry location before proceeding.

Builder Verification

✓	✗	
❑	❑	Stop work until details are corrected.
❑	❑	Proceed without corrections.

The sub-contractor who signs and completes this form is doing so to the best of his/her knowledge and should not be held legally responsible for work completed by other organizations. The intent of this form is to ensure job sites are ready before beginning work.

Signature	Date

FRAMING

✓	✗	N/A	
❑	❑	❑	1. Damp proof all framed below-grade walls.
❑	❑	❑	2. Frame attic to allow the full amount of required insulation under attic platforms.
❑	❑	❑	3. Frame corners and headers to allow for insulation installation.
❑	❑	❑	4. For walls separating conditioned and unconditioned space, install framing that allows for the required R-value, has a top plate, bottom plate and an exterior air barrier. RECOMMENDED: rigid air barrier.
❑	❑	❑	5. For walls that will not have an interior finish and are separating conditioned and unconditioned spaces, insulate wall cavities and install an interior air barrier. RECOMMENDED: rigid air barrier.
❑	❑	❑	6. Cap all dropped ceilings/soffits, shafts and chases with an air barrier and air seal. RECOMMENDED: rigid air barrier.
❑	❑	❑	7. For all floor systems within the conditioned envelope, install a band or blocking separating conditioned and unconditioned space. RECOMMENDED: rigid air barrier.
❑	❑	❑	8. For cantilevers, insulate, attach an air barrier to the underside and air seal. This air barrier can be the exterior finish material if it is airtight. RECOMMENDED: rigid air barrier.
❑	❑	❑	9. Install flashing at the bottom of all exterior walls and at roof-wall connections.
❑	❑	❑	10. Install an overlapped drainage plane on all exterior walls (i.e. building wrap).
❑	❑	❑	11. Air seal all gaps and voids between conditioned and unconditioned spaces.
❑	❑	❑	12. Work site is clean and construction materials are properly stored in a dry location before proceeding.

Certification

The sub-contractor who signs and completes this form is doing so to the best of his/her knowledge and should not be held legally responsible for work completed by other organizations. The intent of this form is to ensure job sites are ready before beginning work.

Name

Company

Signature

FRAMING

Job Ready

1	**2012 IRC R406.1:** Except where required by Section R406.2 to be waterproofed, foundation walls that retain earth and enclose interior spaces and floors below grade shall be damp proofed from the top of the footing to the finished grade. Masonry walls shall have not less than 3/8 inch (9.5 mm) portland cement parging applied to the exterior of the wall. The parging shall be damp proofed in accordance with one of the following: 1. Bituminous coating. 2. Three pounds per square yard (1.63 kg/m2) of acrylic modified cement. 3. One-eighth inch (3.2 mm) coat of surface-bonding cement complying with ASTM C 887. 4. Any material permitted for waterproofing in Section R406.2. 5. Other approved methods or materials. Exception: Parging of unit masonry walls is not required where a material is approved for direct application to the masonry. Concrete walls shall be damp proofed by applying any one of the above listed damp proofing materials or any one of the waterproofing materials listed in Section R406.2 to the exterior of the wall.
2	**2012 IRC R405.1:** Drains shall be provided around all concrete or masonry foundations that retain earth and enclose habitable or usable spaces located below grade. Drainage tiles, gravel or crushed stone drains, perforated pipe or other approved systems or materials shall be installed at or below the area to be protected and shall discharge by gravity or mechanical means into an approved drainage system. Gravel or crushed stone drains shall extend at least 1 foot (305 mm) beyond the outside edge of the footing and 6 inches (152 mm) above the top of the footing and be covered with an approved filter membrane material. The top of open joints of drain tiles shall be protected with strips of building paper. Perforated drains shall be surrounded with an approved filter membrane or the filter membrane shall cover the washed gravel or crushed rock covering the drain. Drainage tiles or perforated pipe shall be placed on a minimum of 2 inches (51 mm) of washed gravel or crushed rock at least one sieve size larger than the tile joint opening or perforation and covered with not less than 6 inches (152 mm) of the same material. Exception: A drainage system is not required when the foundation is installed on well-drained ground or sand-gravel mixture soils according to the Unified Soil Classification System, Group I Soils, as detailed in Table R405.1.
3	**2009 IECC 402.1.1:** The building thermal envelope shall meet the requirements of Table 402.1.1 based on the climate zone specified in Chapter 3.
4	**2009 IECC 303.2.1:** Insulation applied to the exterior of basement walls, crawlspace walls and the perimeter of slab-on-grade floors shall have a rigid, opaque and weather-resistant protective covering to prevent the degradation of the insulation's thermal performance. The protective covering shall cover the exposed exterior insulation and extend a minimum of 6 inches (153 mm) below grade.
5	**2009 IECC 402.4.1:** The building thermal envelope shall be durably sealed to limit infiltration. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.
6	None

FRAMING

Job Complete

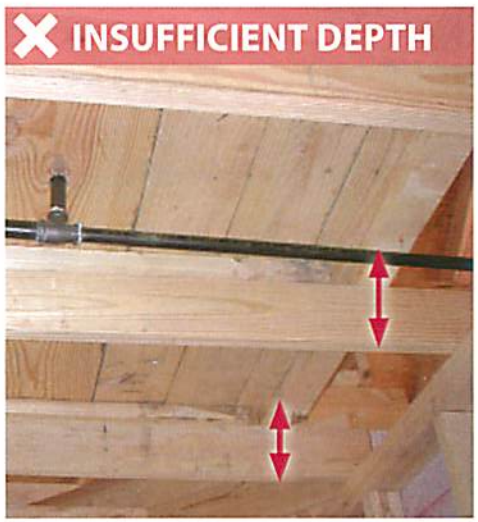
1	**2012 IRC R406.1:** Except where required by Section R406.2 to be waterproofed, foundation walls that retain earth and enclose interior spaces and floors below grade shall be damp proofed from the top of the footing to the finished grade. Masonry walls shall have not less than 3/8 inch (9.5 mm) portland cement parging applied to the exterior of the wall. The parging shall be damp proofed in accordance with one of the following: 1. Bituminous coating. 2. Three pounds per square yard (1.63 kg/m2) of acrylic modified cement. 3. One-eighth inch (3.2 mm) coat of surface-bonding cement complying with ASTM C 887. 4. Any material permitted for waterproofing in Section R406.2. 5. Other approved methods or materials. Exception: Parging of unit masonry walls is not required where a material is approved for direct application to the masonry. Concrete walls shall be damp proofed by applying any one of the above listed damp proofing materials or any one of the waterproofing materials listed in Section R406.2 to the exterior of the wall.
2	**2009 IECC 402.1.1:** The building thermal envelope shall meet the requirements of Table 402.1.1 based on the climate zone specified in Chapter 3.
3	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
4	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
5	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
6	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
7	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
8	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**

FRAMING

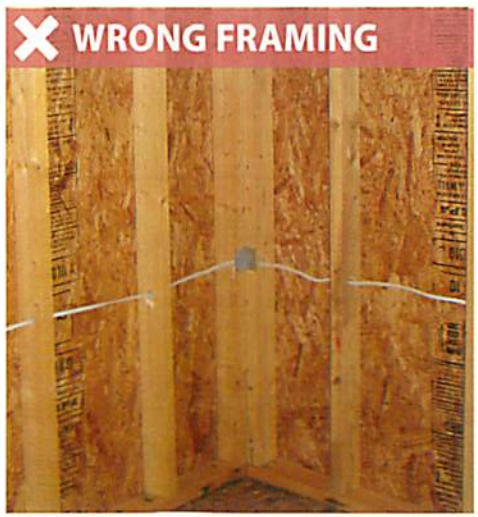
Job Complete

9	Approved corrosion-resistant flashing shall be applied shingle-fashion in a manner to prevent entry of water into the wall cavity or penetration of water to the building structural framing components. Self-adhered membranes used as flashing shall comply with AAMA 711. The flashing shall extend to the surface of the exterior wall finish. Approved corrosion-resistant flashings shall be installed at all of the following locations: 1. Exterior window and door openings. Flashing at exterior window and door openings shall extend to the surface of the exterior wall finish or to the water-resistive barrier for subsequent drainage. Flashing at exterior window and door openings shall be installed in accordance with one or more of the following: 1.1. The fenestration manufacturer's installation and flashing instructions, or for applications not addressed in the fenestration manufacturer's instructions, in accordance with the flashing manufacturer's instructions. Where flashing instructions or details are not provided, pan flashing shall be installed at the sill of exterior window and door openings. Pan flashing shall be sealed or sloped in such a manner as to direct water to the surface of the exterior wall finish or to the water-resistive barrier for subsequent drainage. Openings using pan flashing shall also incorporate flashing or protection at the head and sides. 1.2. In accordance with the flashing design or method of a registered design professional. 1.3. In accordance with other approved methods. 2. At the intersection of chimneys or other masonry construction with frame or stucco walls, with projecting lips on both sides under stucco copings. 3. Under and at the ends of masonry, wood or metal copings and sills. 4. Continuously above all projecting wood trim. 5. Where exterior porches, decks or stairs attach to a wall or floor assembly of wood-frame construction. 6. At wall and roof intersections. 7. At built-in gutters.
10	**2012 IRC R703.2:** One layer of No. 15 asphalt felt, free from holes and breaks, complying with ASTM D 226 for Type 1, felt or other approved water-resistive barrier shall be applied over studs or sheathing of all exterior walls. Such felt or material shall be applied horizontally, with the upper layer lapped over the lower layer not less than 2 inches (51 mm). Where joints occur, felt shall be lapped not less than 6 inches (152 mm). The felt or other approved material shall be continuous to the top of walls and terminated at penetrations and building appendages in a manner to meet the requirements of the exterior wall envelope as described in Section R703.1.
11	**Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
12	None

2. Frame attic to allow the full amount of required insulation under attic platform.

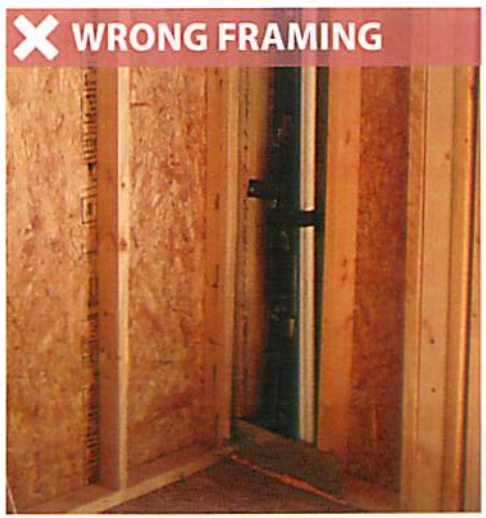


3. Frame corners and headers to allow for insulation installation.



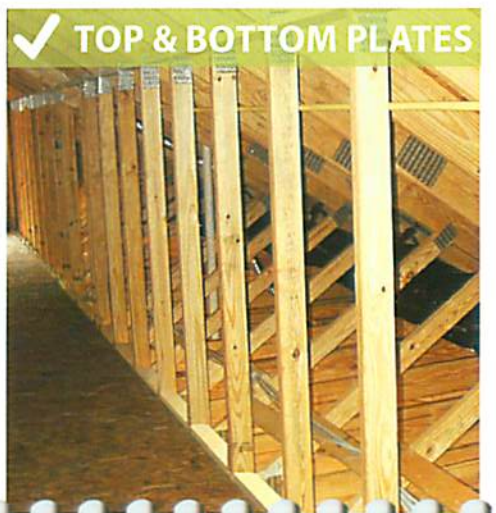
2. Frame attic to allow the full amount of required insulation under attic platforms.

3. Frame corners and headers to allow for insulation installation.

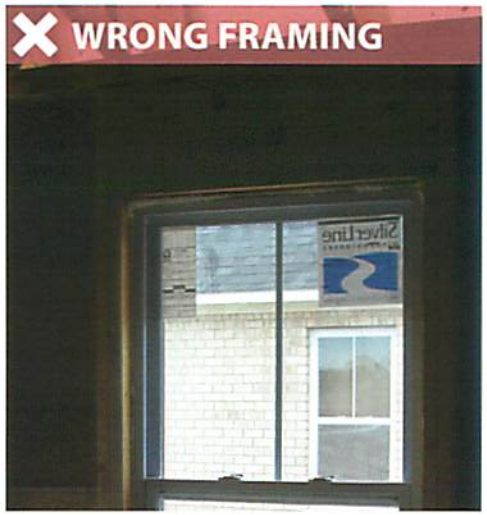


3. Frame corners and headers to allow for insulation installation.

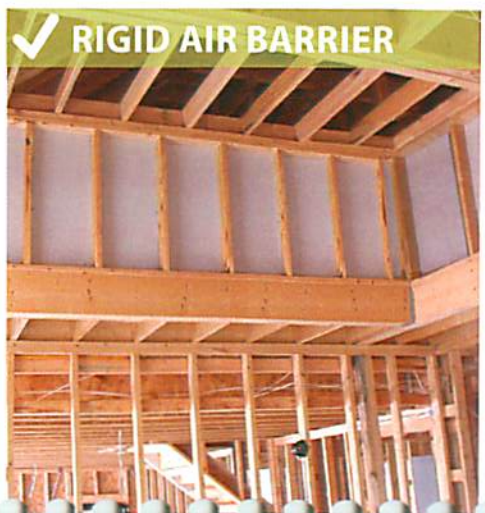
4. For walls separating conditioned and unconditioned space, install framing that allows for the required R-value, has a top plate, bottom plate and an exterior air barrier. RECOMMENDED: rigid air barrier.



3. Frame corners and headers to allow for insulation installation.



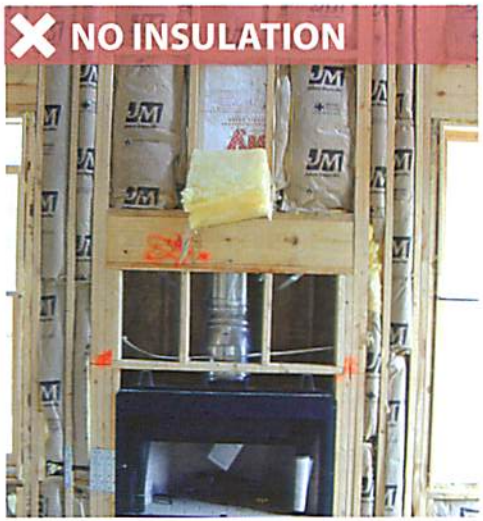
4. For walls separating conditioned and unconditioned space, install framing that allows for the required R-value, has a top plate, bottom plate and an exterior air barrier. RECOMMENDED: rigid air barrier.

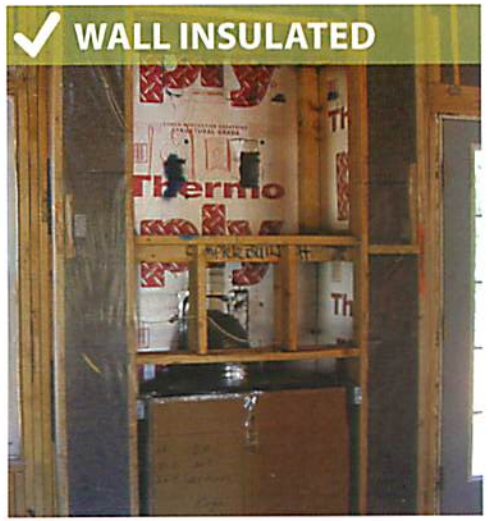


FRAMING

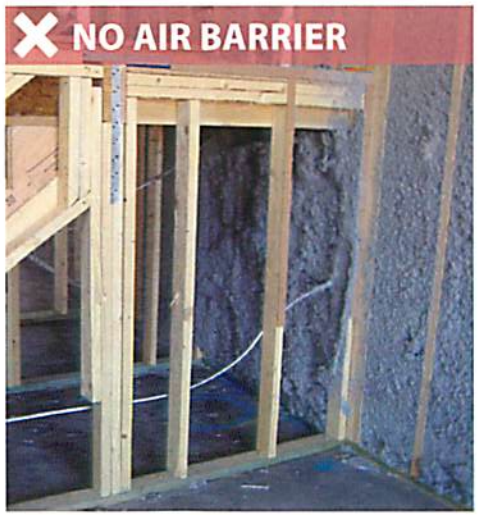
4. For walls separating conditioned and unconditioned space, install framing that allows for the required R-value, has a top plate, bottom plate and an exterior air barrier. RECOMMENDED: rigid air barrier.

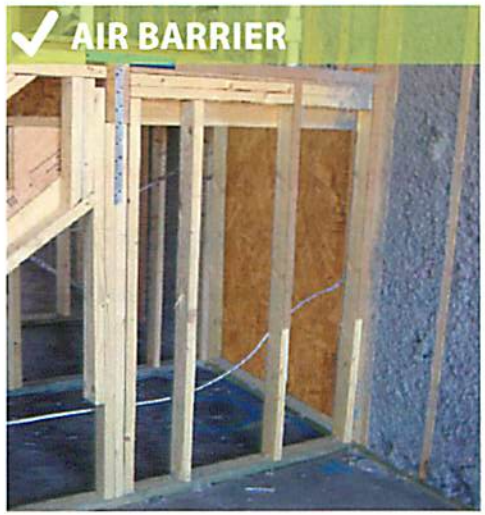
5. For walls separating conditioned and unconditioned space, install framing that allows for the required R-value, has a top plate, bottom plate and an exterior air barrier. RECOMMENDED: rigid air barrier.



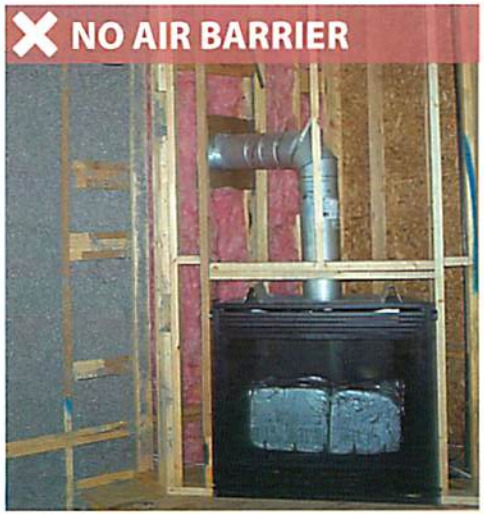


5. For walls that will not have an interior finish and are separating conditioned and unconditioned spaces, insulate wall cavities and install an interior air barrier. RECOMMENDED: rigid air barrier.

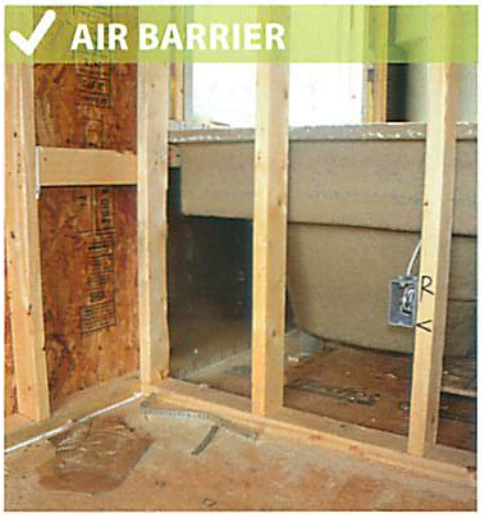




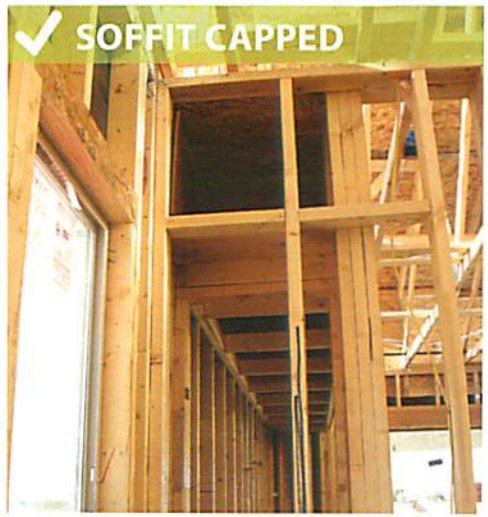
5. For walls that will not have an interior finish and are separating conditioned and unconditioned spaces, insulate wall cavities and install an interior air barrier. RECOMMENDED: rigid air barrier.



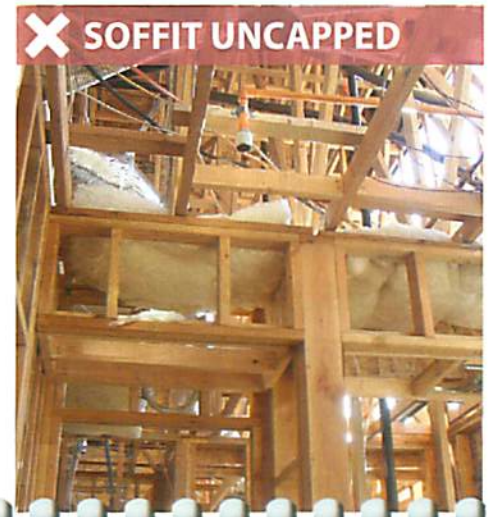
5. For walls that will not have an interior finish and are separating conditioned and unconditioned spaces, insulate wall cavities and install an interior air barrier. RECOMMENDED: rigid air barrier.



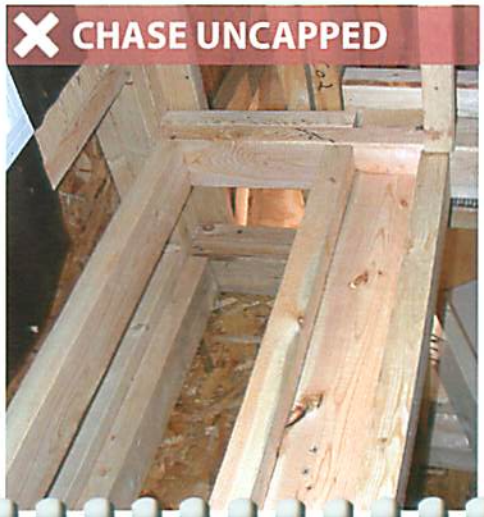
6. Cap all dropped ceilings/soffits, shafts and chases with an air barrier and air seal. RECOMMENDED: rigid air barrier.

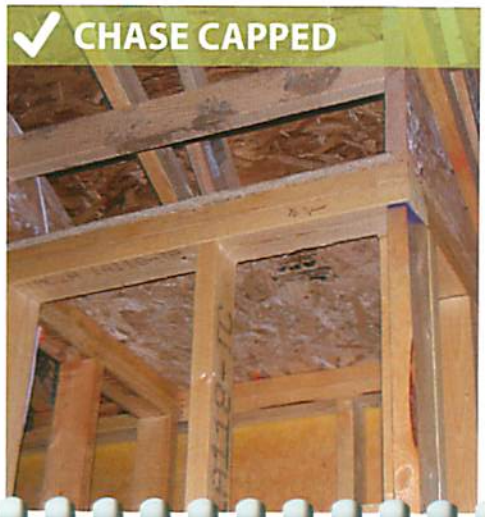


6. Cap all dropped ceilings/soffits, shafts and chases with an air barrier and air seal. RECOMMENDED: rigid air barrier.



6. Cap all dropped ceilings/soffits, shafts and chases with an air barrier and air seal. RECOMMENDED: rigid air barrier.





FRAMING

7. For all floor systems within the conditioned envelope, install a band or blocking separating conditioned and unconditioned space. RECOMMENDED: rigid air barrier.

✗ NO BLOCKING

✓ BLOCKING INSTALLED

8. For cantilevers, insulate, attach an air barrier to the underside and air seal. This air barrier can be the exterior finish material if it is airtight. RECOMMENDED: rigid air barrier.

✗ NO RIGID AIR BARRIER

✓ SEALED BARRIER

9. Install flashing at the bottom of all exterior walls and at roof-wall connections.

✗ NO FLASHING

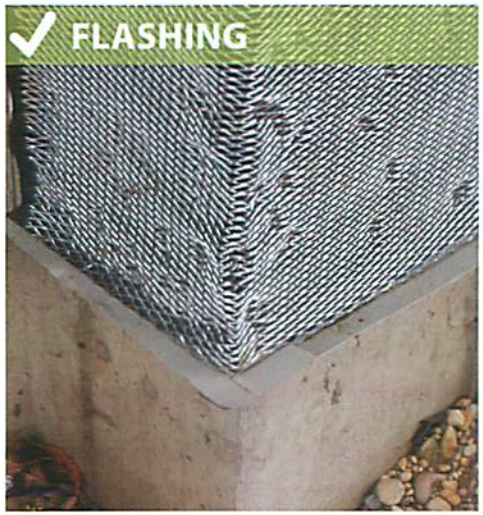
✓ FLASHING

9. Install flashing at the bottom of all exterior walls and at roof-wall connections.

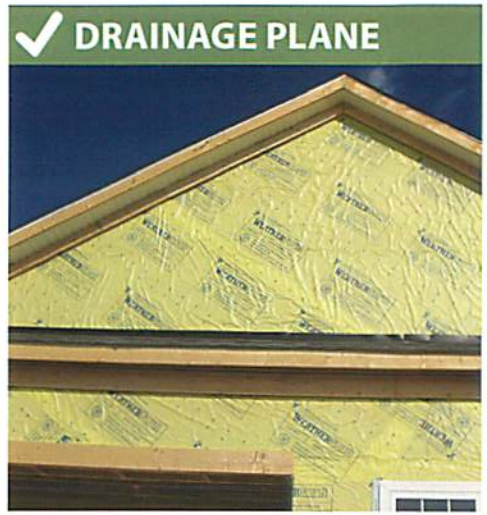
✗ NO FLASHING

✓ FLASHING INSTALLED

9. Install flashing at the bottom of all exterior walls and at roof-wall connections.



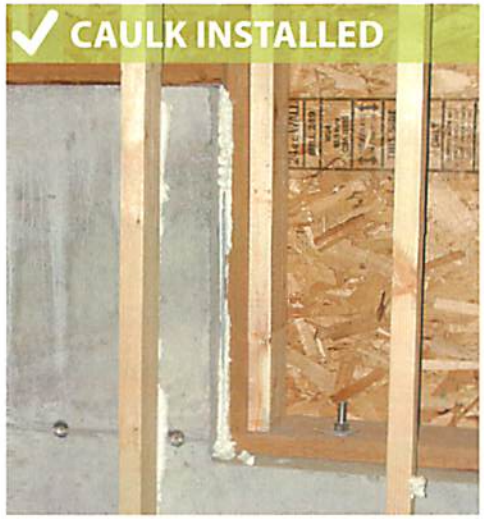
10. Install an overlapped drainage plane on all exterior walls (i.e. building wrap).



11. Air seal all gaps and voids between conditioned and unconditioned spaces.

11. Air seal all gaps and voids between conditioned and unconditioned spaces.

11. Air seal all gaps and voids between conditioned and unconditioned spaces.



Attic Framing Information Sheet

CODE INTERPRETATION

Due to the different interpretations, it is very important to talk to code officials in your local jurisdiction before selecting either of these interpretations. By communicating with your local jurisdiction, you will be able to ensure you are purchasing and installing the correct framing system.

Attic Framing Requirements: Introduction

According to the 2009 IECC Section 402.2.1 Ceilings with Attic Spaces:

> *When Section 402.1.1 would require R-38 in the ceiling, R-30 shall be deemed to satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Similarly, R-38 shall be deemed to satisfy the requirement for R-49 wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. This reduction shall not apply to the U-factor alternative approach in Section 402.1.3 and the total UA alternative in Section 402.1.4.*

This exception for attic framing and insulation addresses Climate Zones 4-8; however, the code is silent regarding the required amount of insulation over the wall top plate at the eaves for Climate Zones 1-3.

One interpretation is that when Section 402.1.1 would require R-30 in the ceiling, a decrease in insulation levels over the wall top plate at the eaves is acceptable. In this situation, insulation must completely fill the area between the ventilation baffle or chute and the wall top plate. If this interpretation is selected, the requirement may be met using a standard truss, a standard truss with wider overhangs, or a raised heel/energy truss.

Another interpretation is that the code does not specify an option below R-30 and the full height of uncompressed R-30 must be installed in the entire ceiling including the insulation that extends over the wall top plate at the eaves. If this interpretation is selected, the requirement may be met using a standard truss with wider overhangs or a raised heel/energy truss.

Attic Framing Requirements: Code Interpretation

Due to the different interpretations, it is very important to talk to code officials in your local jurisdiction before selecting either of these interpretations. By communicating with your local jurisdiction, you will be able to ensure you are purchasing and installing the correct framing system.

HVAC INSTALLATION

HVAC Installation Contents

In this section, you will find materials to assist HVAC installers with the completion of code requirements. Below is a list of the content provided.

- HVAC Information Sheet
- Job Ready
- Job Complete
- Code Comparison
- Tech Tips
- Duct Leakage Testing Information Sheet
- Duct Sealing Critical Detail
- Bathroom Exhaust Fan Critical Detail
- Ventilation Information Sheet

HVAC Information Sheet

HVAC CONTRACTORS: NEW CODE REQUIREMENTS

The new 2009 IECC for South Carolina brings additional responsibilities to HVAC contractor. Some of the major additions include:

- Manual S Selection
- Mechanical ventilation for tight buildings
- Duct leakage testing

Introduction

The 2009 IECC for South Carolina includes many new requirements for the HVAC contractor. This information sheet will briefly explain the most significant changes to the code and how it affects the HVAC system.

Load Calculations

The 2009 IECC for South Carolina requires load calculations for all residential buildings. If completed correctly, load calculations will ensure that properly sized equipment will be installed. Properly sized equipment will increase the comfort of the occupant by providing proper dehumidification in addition to necessary heating and cooling. It will also improve the efficiency and durability of the HVAC system by preventing equipment from short cycling (turning on and off frequently). These load calculations must be created using ACCA's Manual J or an equivalent method. After, they must be used in accordance to ACCA Manual S to appropriately select equipment.

Equipment Selection

Note: The 2009 IECC for South Carolina does not specify HVAC equipment efficiencies; however, the National Appliance Energy Conservation Act (NAECA) requires HVAC equipment manufacturers to meet minimum standards. The most recent efficiency increase was put into effect in 2006 and all equipment should be readily available. The standards are listed below:

NAECA Required Energy Efficiencies for Heating and Cooling	
Equipment	Efficiency
Air Conditioner	13 SEER
Heat Pump	13 SEER + 7.7 HSPF
Gas Furnace	78% AFUE
Gas Steam Boiler	75% AFUE
Other Boilers	80% AFUE
Mobile Home Furnace	75% AFUE

Proper Duct Installations

While proper duct installation has always been part of the South Carolina Energy codes, now there are verification measures to ensure correct installation. Ducts must be properly supported and sealed. There are a wide variety of sealants that may be used: welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, liquid sealants or tapes. Liquid mastics and mastic-plus-embedded-fabric systems provide a durable, airtight seal, better than other products.

Duct Leakage Test

A duct leakage test is now required by the 2009 IECC for South Carolina. This test verifies that the duct system was properly installed and sealed. The duct leakage of the system must be tested at 25 pascals and the leakage requirements varies depending on time of testing. Currently, the test may be administered by anyone, but it is recommended to use an independent third-party verifier, such as a HERS Rater or BPI professional. On the following page are the duct leakage requirements:

Duct Leakage Testing Requirements	
Rough-in	CFM/100 ft² of conditioned floor area
Total leakage	≤ 6 CFM
Total leakage without air handler	≤ 4 CFM
Post construction	CFM/100 ft² of conditioned floor area
Total leakage	≤ 12 CFM
Leakage to outdoors	≤ 8 CFM

Ventilation

The 2009 IECC for South Carolina requires that if bathrooms have mechanical exhaust ventilation, the fans must exhaust 50 CFM intermittently or 20 CFM continuously. If the kitchen has mechanical exhaust ventilation, the fans must exhaust 100 CFM intermittently or 25 CFM continuously.

If a house is tight (tested by a blower door to be less than five air changes per hour), then a whole-house mechanical ventilation system must be installed. Additional pages in this section explain more about the types and benefits of ventilation.

SC

NEW CONSTRUCTION

HVAC CONTRACTORS: LOAD CALCULATIONS

The 2009 IECC for South Carolina requires the HVAC contractor to complete a load calculation. Below is the requirement:

- For one- and two-family dwellings and townhouses, heating and cooling equipment shall be selected in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies.

Load Calculation Information Sheet

Load Calculations: Introduction

The 2009 IECC for South Carolina requires load calculations for all residential buildings. If completed correctly, load calculations will ensure that properly sized equipment will be installed. Properly sized equipment will increase the comfort of the occupant by providing proper dehumidification in addition to necessary heating and cooling. It will also improve the efficiency and durability of the HVAC system by preventing equipment from short cycling (turning on and off frequently). These load calculations must be created using ACCA's Manual J or an equivalent method. Below is the requirement as stated in the Mechanical Code:

For one- and two-family dwellings and townhouses, heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies.

Load Calculations: Recommendations

There are several methods to complete a load calculation, but investing in computer software, such as Wrightsoft or Elite, to complete a Manual J load calculation is recommended. If you, as a HVAC contractor, are not interested in completing load calculations for your projects, it is possible to contract with other individuals or organizations, such as HERS raters, to complete the load calculations.

Load Calculations: Verification

ACCA provides a helpful informational sheet for those completing the load calculations. To see the original, flip to the Appendix section. Below is their list of verification measures:

- Indoor heating temperature: 70°F at 30% RH
- Indoor cooling temperature: 75°F at 50% RH
- Outdoor design temperature: Table 1 of Manual J 8
- SHGC and U-values reasonable for the window and skylight types and frame constructions
- Window and skylight shading (curtains, drapes, insect screens, tinting, etc.) and roof overhang adjustments
- Total area for the windows, skylights and glass doors ≈ Area shown on the drawing plans
- Exposure directions match house site
- Wall, ceiling and floor insulation R-values
- Total area for walls, ceilings and floors ≈ Area on drawing plans
- Correct roof color and material
- Listed envelope tightness matches (tight, semi-tight, average, semi-loose, loose)
- Total above grade volume = Volume on drawing plans
- Appliance gains = 1200 Btuh, 2400 Btuh or a value recommended by Manual J 8
- Maximum Occupants = Number of Bedrooms + 1
- Btuh (cooling) = 230 x Number of Occupants
- Btuh (heating) = 200 x Number of Occupants
- If duct location = unconditioned space, then ducts are insulated
- Duct tightness category = 'average sealed' or higher (i.e., notably sealed, extremely sealed)
- Intermittent bathroom and kitchen fans excluded from the infiltration calculations

Load Calculation Information Sheet

- Dedicated exhaust fans (continuous) included in the calculations
- Heat recovery equipment and/or a ventilating dehumidifier included in the calculations

HVAC INSTALLATION

✓	✗	N/A	
❑	❑	❑	1. Attic framing allows full level of insulation to be installed under attic platforms.
❑	❑	❑	2. For walls separating conditioned and unconditioned space, framing that allows for the required R-value, has a top plate, bottom plate and an exterior rigid sheathing is installed.
❑	❑	❑	3. For walls that will not have an interior finish and are separating conditioned and unconditioned spaces, wall cavities are insulated and an interior rigid air barrier is installed.
❑	❑	❑	4. All dropped ceilings/soffits, shafts and chases are capped with a rigid air barrier and air seal.
❑	❑	❑	5. All floor systems within the conditioned envelope have a band or blocking separating conditioned and unconditioned space.
❑	❑	❑	6. Manual J Load calculations or an equivalent method are accurate and complete for the dwelling unit.
❑	❑	❑	7. Right sized equipment is selected based on the ACCA Manual S or other approved equipment selection method.
❑	❑	❑	8. Ensure work site is clean and construction materials are properly stored before proceeding.

Builder Verification

✓	✗	
❑	❑	Stop work until details are corrected.
❑	❑	Proceed without corrections.

The sub-contractor who signs and completes this form is doing so to the best of his/her knowledge and should not be held legally responsible for work completed by other organizations. The intent of this form is to ensure job sites are ready before beginning work.

Signature	Date

HVAC INSTALLATION

✓	✗	N/A	
❑	❑	❑	1. Seal all duct terminations to drywall and/or subfloor and all HVAC penetrations in the building envelope with foam, caulk or mastic. Use fire-rated sealants where applicable.
❑	❑	❑	2. Seal all HVAC components at all joints, seams and corners with bucket mastic.
❑	❑	❑	3. Mechanically fasten all metal ductwork with screws. Attach the inner liner of flexible ducts with nylon/plastic straps and tighten with a manufacturer-approved tool.
❑	❑	❑	4. Insulate all supply duct work in unconditioned space to R-8. Insulate all return duct work to R-6. If exterior insulation, mechanically fasten duct insulation with straps and seal all joints and seams of vapor retarder.
❑	❑	❑	5. Do not compress insulated flexible ducts more than the thickness of the insulation.
❑	❑	❑	6. Support flexible duct (including spot ventilation) at least every 4 feet and do not bend greater than 90°.
❑	❑	❑	7. Install outside air ventilation intakes at least 10 feet from any exhaust vent or stack.
❑	❑	❑	8. Coordinate bath fan exhaust duct direction with Electrical Contractor.
❑	❑	❑	9. Terminate exhaust ventilation duct work to the outside and install a screen over the termination.
❑	❑	❑	10. For heat pumps, install a heat strip outdoor temperature lockout that prevents supplemental heat operation and set it to the balance point.
❑	❑	❑	11. For furnaces, install a programmable thermostat.
❑	❑	❑	12. Ensure work site is clean and construction materials are properly stored before proceeding.

Certification

The sub-contractor who signs and completes this form is doing so to the best of his/her knowledge and should not be held legally responsible for work completed by other organizations. The intent of this form is to ensure job sites are ready before beginning work.

Name

Company

Signature

HVAC INSTALLATION

Job Ready	
1	**2009 IECC 402.1.1:** The building thermal envelope shall meet the requirements of Table 402.1.1 based on the climate zone specified in Chapter 3.
2	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
3	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
4	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
5	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
6	**2012 IRC M1401.3:** Heating and cooling equipment and appliances shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies.
7	**2012 IRC M1401.3:** Heating and cooling equipment and appliances shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies.
8	None

HVAC INSTALLATION

Job Complete

1	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
2	**2009 IECC 403.2.2: A**ll ducts, air handlers, filter boxes and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601.4.1 of the International Residential Code. Duct tightness shall be verified by either of the following: 1. Post construction test 2. Rough-in test Exceptions: Duct tightness test is not required if the air handler and all ducts are located within conditioned space. **2012 IRC M1601.4.1:** All longitudinal and transverse joints, seams and connections in metallic and nonmetallic ducts shall be constructed as specified in SMACNA HVAC Duct Construction Standards—Metal and Flexible and NAIMA Fibrous Glass Duct Construction Standards. All joints, longitudinal and transverse seams and connections in ductwork shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, liquid sealants or tapes. Closure systems used to seal ductwork listed and labeled in accordance with UL 181A shall be marked "181A-P" for pressure-sensitive tape, "181 A-M" for mastic or "181 A-H" for heat-sensitive tape. Closure systems used to seal flexible air ducts and flexible air connectors shall comply with UL 181B and shall be marked "181B-FX" for pressure-sensitive tape or "181B-M" for mastic.
3	**2012 IRC M1601.4.1:** Duct connections to flanges of air distribution system equipment shall be sealed and mechanically fastened. Mechanical fasteners for use with flexible nonmetallic air ducts shall comply with UL 181B and shall be marked "181B-C." Closure systems used to seal metal ductwork shall be installed in accordance with the manufacturer's installation instructions. Unlisted duct tape is not permitted as a sealant on any duct.
4	**2009 IECC 403.2.1:** Supply ducts in attics shall be insulated to a minimum of R-8. All other ducts shall be insulated to a minimum of R-6. Exception: Ducts or portions thereof located completely inside the building thermal envelope. **2012 IRC M1601.4.5:** Where ducts used for cooling are externally insulated, the insulation shall be covered with a vapor retarder having a maximum permeance of 0.05 perm [2.87 ng/(Pa • s • m2)] or aluminum foil having a minimum thickness of 2 mils (0.051 mm). Insulations having a permeance of 0.05 perm [2.87 ng/(Pa • s • m2)] or less shall not be required to be covered. All joints and seams shall be sealed to maintain the continuity of the vapor retarder.
5	**2009 IECC 403.2.1:** Supply ducts in attics shall be insulated to a minimum of R-8. All other ducts shall be insulated to a minimum of R-6. Exception: Ducts or portions thereof located completely inside the building thermal envelope.
6	**2012 IRC M1601.4.3:** Metal ducts shall be supported by 1/2-inch-wide (13 mm) 18-gage metal straps or 12-gage galvanized wire at intervals not exceeding 10 feet (3048 mm) or other approved means. Nonmetallic ducts shall be supported in accordance with the manufacturer's installation instructions.

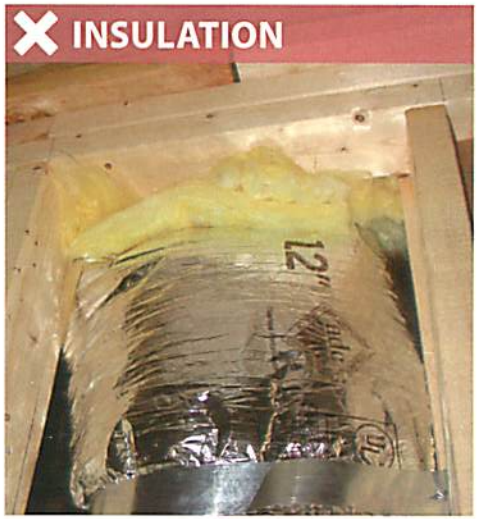
HVAC INSTALLATION

Job Complete

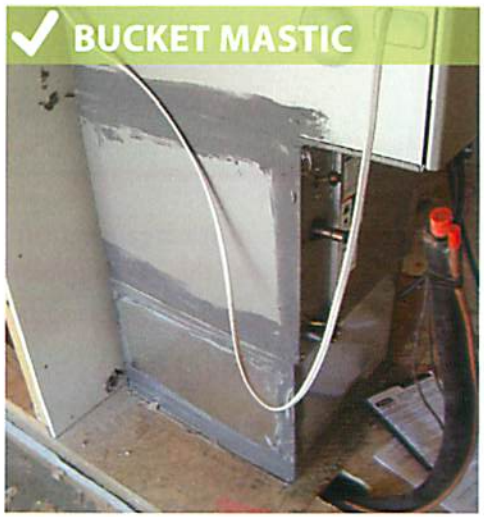
7	**2012 IRC R303.5.1:** Mechanical and gravity outdoor air intake openings shall be located a minimum of 10 feet (3048 mm) from any hazardous or noxious contaminant, such as vents, chimneys, plumbing vents, streets, alleys, parking lots and loading docks, except as otherwise specified in this code. Where a source of contaminant is located within 10 feet (3048 mm) of an intake opening, such opening shall be located a minimum of 3 feet (914 mm) below the contaminant source. For the purpose of this section, the exhaust from dwelling unit toilet rooms, bathrooms and kitchens shall not be considered as hazardous or noxious.
8	None
9	**2012 IRC R303.6:** Air exhaust and intake openings that terminate outdoors shall be protected with corrosion-resistant screens, louvers or grilles having a minimum opening size of 1/4 inch (6 mm) and a maximum opening size of 1/2 inch (13 mm), in any dimension. Openings shall be protected against local weather conditions. Outdoor air exhaust and intake openings shall meet the provisions for exterior wall opening protectives in accordance with this code.
10	**2009 IECC 403.1.2:** Heat pumps having supplementary electric-resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.
11	**2009 IECC 403.1.1:** Where the primary heating system is a forced-air furnace, at least one thermostat per dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55°F (13°C) or up to 85°F (29°C). The thermostat shall initially be programmed with a heating temperature set point no higher than 70°F (21°C) and a cooling temperature set point no lower than 78°F (26°C).
12	None

HVAC INSTALLATION

1. Seal all duct work to drywall and/or subfloor and all HVAC penetrations in the building envelope with foam, caulk or mastic.



2. Seal all HVAC components at all joints, seams and corners with bucket mastic.

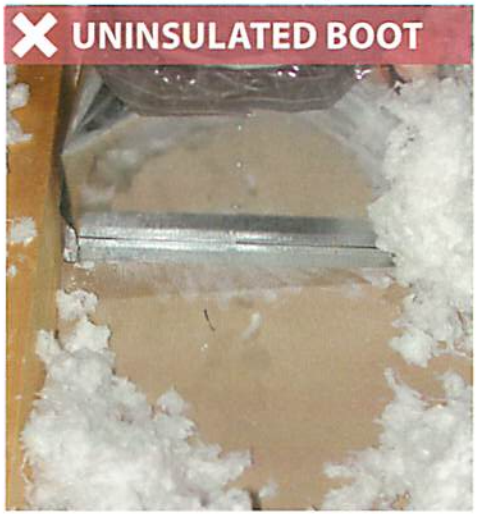


1. Seal all duct work to drywall and/or subfloor and all HVAC penetrations in the building envelope with foam, caulk or mastic.

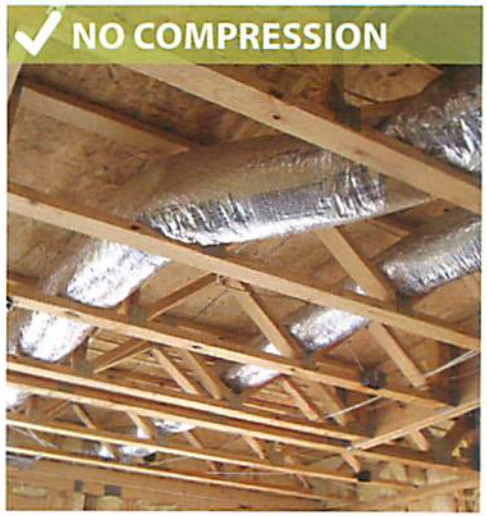
3. Mechanically fasten all metal duct work with screws. Attach the inner liner of flexible ducts with nylon/plastic straps and tighten with a manufacturer-approved tool.

HVAC INSTALLATION

4. Insulate all supply ductwork in unconditioned space to R-8. Insulate all return duct work to R-6. If exterior insulation, mechanically fasten duct insulation with straps and seal all joints and seams of vapor retarder.

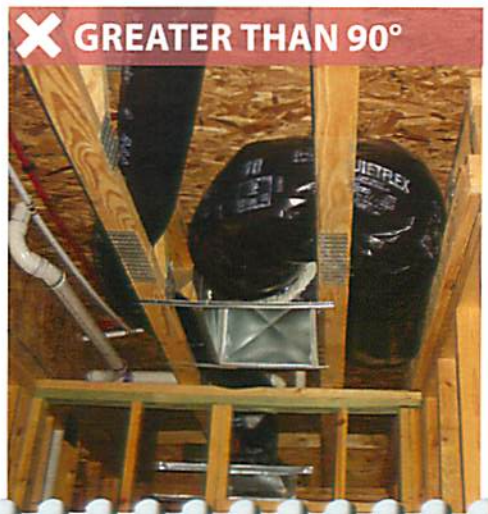


5. Do not compress insulated flexible ducts more than the thickness of the insulation.



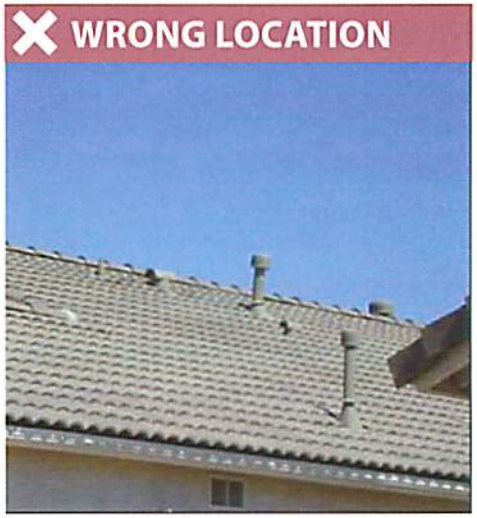
6. Support flexible duct (including spot ventilation) at least every 4 feet and do not bend greater than 90°.

6. Support flexible duct (including spot ventilation) at least every 4 feet and do not bend greater than 90°.

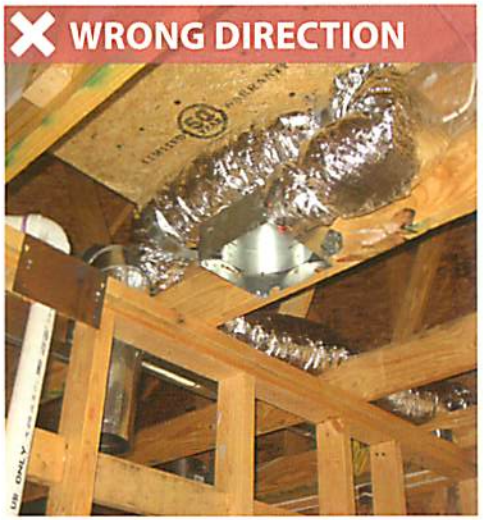


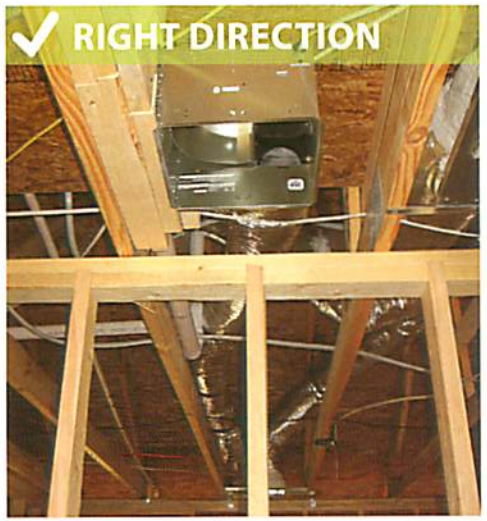
HVAC INSTALLATION

7. Install outside air ventilation intakes at least 10 feet from any exhaust vent or stack.



8. Coordinate bath fan exhaust duct direction with Electrical Contractor.





9. Terminate exhaust ventilation duct work to the outside and install a screen over the termination.

10. For heat pumps, install a heat strip outdoor temperature lockout that prevents supplemental heat operation and set it to the balance point.

Duct Leakage Testing Information Sheet

SC

NEW CONSTRUCTION

HVAC CONTRACTORS: DUCT LEAKAGE TEST

The new 2009 IECC for South Carolina requires a duct leakage test to verify duct leakage. The test will be completed during or after construction. The steps below are followed for the duct leakage test:

- Block ventilation ducts attached to the system
- Attach the testing equipment to the largest return or the air handler
- Block all supplies, returns and air handlers
- Insert a hose in one of the supply ducts to measure the 25 pascal pressure

DUCT LEAKAGE TEST : EXCEPTIONS

There are two exceptions which permit duct systems to not be tested. These exceptions are:

- The air handler and all ducts are located within conditioned space
- Installation of a partial system as part of replacement, renovation or addition

Duct Leakage: Introduction

In the past, many buildings included complex duct designs and poorly sealed connections that lead to unanticipated breaks in the air barrier of an otherwise tightly constructed duct system. To counteract this leakage, the 2009 IECC for South Carolina requires duct leakage testing. Although duct leakage testing can determine the amount of leakage, it does not indicate the specific location of the leakage. When combined with other methods, such as a visual inspection, pressure pan usage and/or fog machines, many leakage locations can be easily determined. Design features that often incorporate large duct leakage paths include:

- Ducts made from panned joists
- Return grille and filter constructions
- HVAC cabinet panels
- Taped connections
- Duct transitions
- Supply terminations

Duct Leakage Testing: Introduction

Similar to the blower door test where a fan is used to measure building leakage, a smaller test fan system is used to measure duct system air leakage. The typical duct testing fan consists of a powerful, calibrated, variable-speed fan that is connected to a duct system. The tighter the duct system, the less air needed from the fan to create a change in duct system pressure.

Duct Leakage Testing: Code Requirement

A duct leakage test is now required by the 2009 IECC for South Carolina. This test verifies that the duct system was properly installed and sealed. The duct leakage of the system must be tested at 25 pascals and the leakage requirements varies depending on time of testing. Currently, the test may be administered by anyone, but it is recommended to use an independent third-party verifier, such as a HERS Rater or BPI professional.

Duct Leakage Testing Requirements	
Rough-in	CFM/100 ft² of conditioned floor area
Total leakage	≤ 6 CFM
Total leakage without air handler	≤ 4 CFM
Post construction	**CFM/100 ft² of conditioned floor area**
Total leakage	≤ 12 CFM
Leakage to outdoors	≤ 8 CFM

The test may be completed during or after construction. The steps below are followed for the duct leakage test:

- Turn off all HVAC equipment
- Block ventilation ducts attached to the system
- Attach the testing equipment to the largest return or the air handler
- Block all supplies, returns and air handlers
- Insert a hose in one of the supply ducts to measure the 25 pascal pressure

Duct Leakage Testing Information Sheet

Duct Leakage Testing: Recommendations

There are different manufacturers of air leakage testing equipment:

- The Energy Conservatory: www.energyconservatory.com
- Infiltec: www.infiltec.com
- McGill Airflow: www.mcgillairflow.com
- Oriflow: www.oriflow.com
- Retrotec Energy Solutions: www.retrotec.com

Whichever equipment is used, it is important to follow the manufacturers specifications.

In addition, it is recommended that builders consider using a third-party verifier such as a HERS rater or a BPI certified professional. Both will have the necessary training and equipment and will be helpful throughout the verification process. To locate professionals in your area, follow the links below:

HERS Raters
http://www.resnet.us/directory/raters

BPI Certified Professionals
http://www.bpi.org/tools_locator.aspx?associateTypeID=CTR

DUCT SEALING: BOOTS

It is recommended to seal all joints in the air distribution system with bucket duct mastic and fabric mesh.

The tester will be measuring the total duct leakage and the duct leakage to the outside at CFM at 25 Pa (with reference to the outside).

✓ MASTIC BOOT

✓ INSTALL LINER

✓ INSTALL ZIP TIE

✓ MASTIC CONNECTION

✓ INSULATE BOOT

✓ SEAL SEAMS

✓ SEAL TO SUBFLOOR

✓ SEAL TO DRYWALL

DUCT SEALING: PLENUMS

It is recommended to seal all joints in the air distribution system with bucket duct mastic and fabric mesh.

The tester will be measuring the total duct leakage and the duct leakage to the outside at CFM at 25 Pa (with reference to the outside).

✓ MASTIC PLENUM

✓ MASTIC COLLAR

✓ INSTALL ZIP TIE

✓ MASTIC CONNECTION

✓ INSULATE COLLAR

✓ SEAL SEAMS

✓ MASTIC AIR HANDLER

✓ USE BUCKET MASTIC

EXHAUST FAN

Bath Exhaust Fan: Introduction

Each bathroom that has an exhaust fan must exhaust a minimum of 20 CFM continuously or 50 CFM intermittently directly to the outside.

Bath Exhaust Fan: Mechanical Localized Exhaust

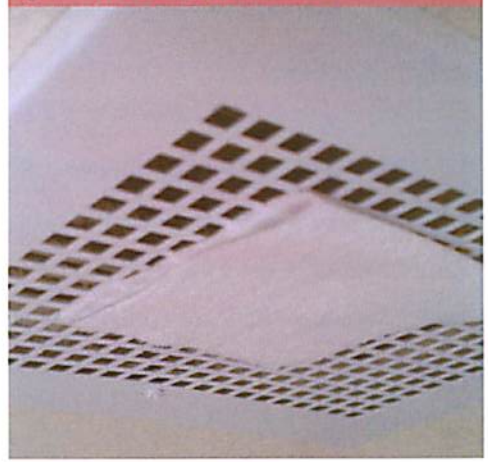
There are three important areas to watch during the construction process. If all of the key factors on the next two pages are working properly, the bathroom fan should operate the way it was intended. If the proper testing equipment is not available to verify the airflow, follow the simplified version on the right side of this page.

Bath Exhaust Fan: Key Inspection Areas

1. Fan
2. Duct
3. Exterior

If the fan can hold two stacked 2-ply squares of toilet paper at the fan grille, the fan is pulling approximately 50 cubic feet per minute (CFM).

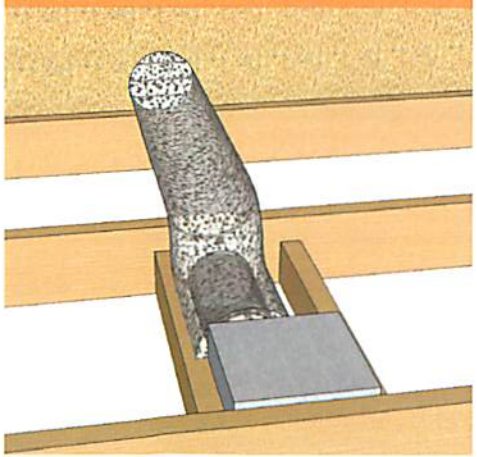
✓ AIR FLOW TEST



As a rule of thumb, to ensure that your bath fan will pull a minimum of 50 CFM once it is installed, install a fan rated for 70 CFM. In addition, verify the fan sone rating is less than 3.

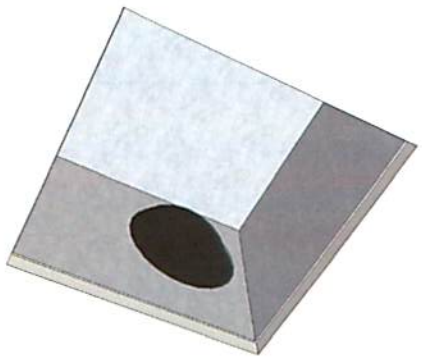
Orient the fan outlet so the duct will have the shortest and straightest route to the outside of the building.

✓ ORIENTATION



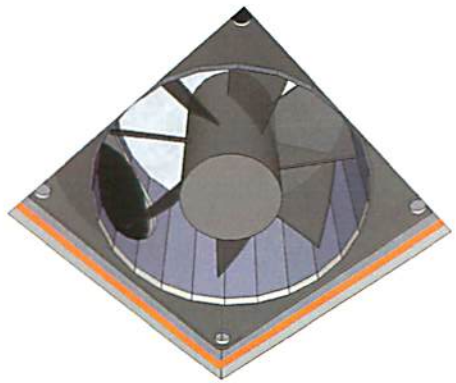
Bath fans must have backdraft damper to keep outside air from entering the bathroom. Remove shipping tape from the damper and ensure it swings freely.

✓ DAMPER

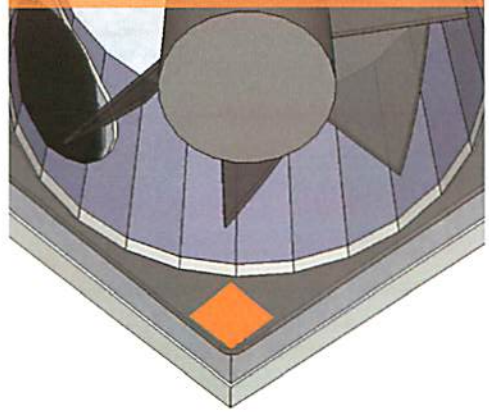


Caulk all of the holes between the drywall and the fan housing unit as well as all holes in the housing unit.

✓ SEALING



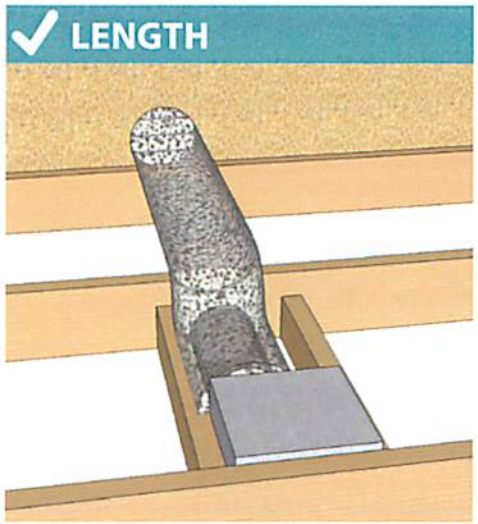
✓ RATING



EXHAUST FAN

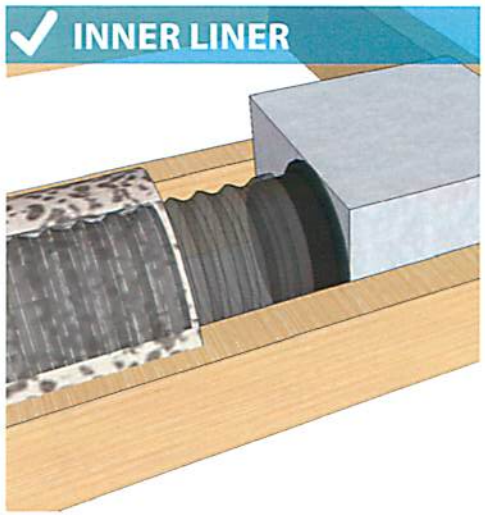
Cut the duct to the exact length to eliminate the possibility of unnecessary curves, crimping, restrictions or length.

✓ LENGTH



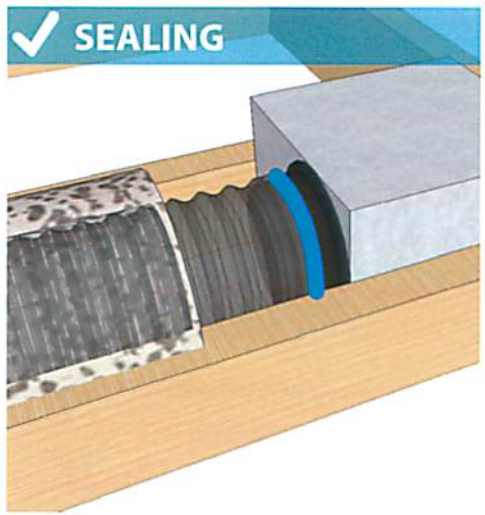
Ensure the inner liner is not tucked inside of the insulation or restricting movement of the fan damper.

✓ INNER LINER



After checking the inner liner reaches both the fan collar and the exhaust termination, seal it in place.

✓ SEALING

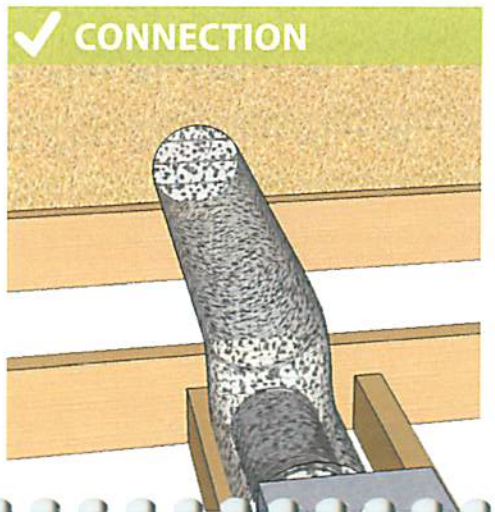


The termination should have little to no restriction, with the exception of a metal insect screen. Remove any packing tape during install.

✓ TERMINATION

Verify the duct terminates outside of the building, especially if the termination is located at the soffit.

✓ CONNECTION



Ventilation Information Sheet

VENTILATION RECOMMENDATIONS

Currently, the 2009 IECC for South Carolinas requires mechanical outside air ventilation if the house has tight construction. Tight construction is qualified by:

- Blower door results are less than 5 ACH_{50}

Mechanical outside air ventilation is an important part of HVAC systems, especially with new houses being constructed much tighter than ever before. It is important to design ventilation into the system rather than rely on infiltration from unknown holes in the building envelope.

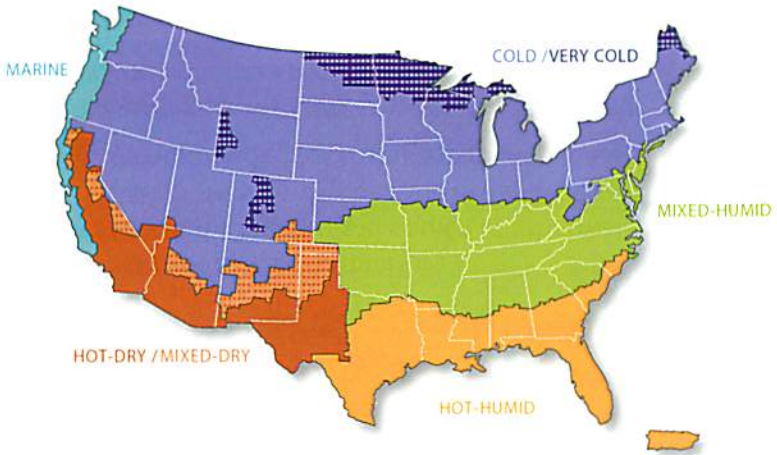
Outside Air Ventilation: Introduction

Today's construction materials and techniques all work to reduce air exchange with the outdoors making new homes relatively tight. The new 2009 IECC for South Carolina requires tighter construction than ever before. If the supply of outside air depends only on infiltration, then air quality in these new homes will suffer from stagnant, polluted air and moisture problems and result in dissatisfied homeowners. By establishing a mechanical ventilation system that exhausts inside air and supplies outside air, potential problems can be mitigated. While ventilation is not currently required by code for all buildings, it is important to be installed as a part of any HVAC system. This information sheet presents the basics of ventilation. Below the 2012 IRC R303.4 section describes where mechanical outside air ventilation is required:

> *Where the air infiltration rate of a dwelling unit is less than 5 air changes per hour when tested with a blower door at a pressure of 0.2 inch w.c (50 Pa) in accordance with Section N1102.4.1.2, the dwelling unit shall be provided with whole-house mechanical ventilation in accordance with Section M1507.3.*

Ventilation: Climate

Climate should play a major role in determining the optimal ventilation strategy and it is advised to design a ventilation strategy that will not contribute to moisture issues. The simple solution is to ensure that only the driest mass of air moves through walls and similar spaces. Knowing the climate of the home's location is necessary before selecting a ventilation strategy. The map shows different climate regions.



Ventilation: Rate

If mechanical outside air ventilation is installed, the 2012 International Residential Code requires certain rates:

Ventilation Rates					
Dwelling Unit Floor Area	Number of bedrooms				
Square Feet	0-1	2-3	4-5	6-7	>7
< 1500	30	45	60	75	90
1501-3000	45	60	75	90	105
3001-4500	60	75	90	105	120
4501-6000	75	90	105	120	135
6001-7500	90	105	120	135	150
> 7500	105	120	135	150	165

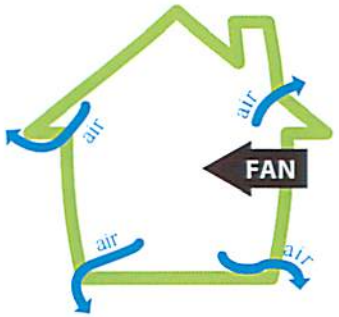
Ventilation Information Sheet

Ventilation: Types

After determining the climate of the house location and the rate of outside air ventilation, it is important to understand the appropriate types of outside air ventilation strategies. There are three different design options. Any of these three design options are appropriate for mechanical outside air ventilation; however, it is important to consider which design would work best with the climate and other systems in the home. Below are descriptions of the different types of design:

Supply-Only Ventilation

This type of system puts the home under a slight positive pressure. Fans push air into the home, which is exhausted through existing pathways (existing bath and kitchen exhaust vents) or through cracks in the building shell. This strategy is best used in humid and mixed- humid climates and will prevent migration of water vapor from the outside into building cavities.



This type of ventilation system is recommended for the Southeastern United States. It is a cost-effective approach to providing ventilation and does not draw unfiltered humid air into the house.

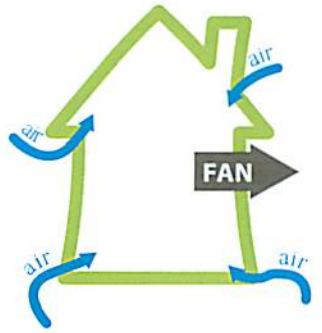
Exhaust-Only Ventilation

This type of system puts the home under a slight negative pressure. Fans pull indoor air out of the home while drawing outside air in through existing pathways (outside air intakes) or through cracks in the building shell. This ventilation strategy is best used in dry and cold climates where it prevents water migration of water vapor from the indoor space into building cavities. A difficulty with exhaust-only ventilation is the inability to control where the outside air is being pulled from. In humid climates; however, this ventilation strategy can lead to significant moisture problems.

It is important to understand the potential negative impacts on the health of the house and the occupants of exhaust-only ventilation in the Southeastern United States. Outside air provided by infiltration comes from unknown sources and could contain contaminants or unwanted moisture.

Balanced Ventilation

This type of system uses an exhaust and outside air supply fan to create a balanced system. With traditional, forced air systems, this balance is often difficult to achieve. Instead, packaged systems like Energy Recovery Ventilators (ERVs) or Heat Recovery Ventilators (HRVs) are installed to achieve the balanced flow and work well with non-traditional systems, such as mini-split HVAC systems and ground-source geothermal systems. This ventilation strategy can be used in any type of climate, but is highly recommended for costal and marine areas.



Balanced ventilation is the preferred method of ventilation; however, the higher cost is often prohibitive.

Electrical Contents

In this section, you will find materials to assist electricians with the completion of code requirements. Below is a list of the content provided.

- Job Ready
- Job Complete
- Code Comparison
- Tech Tips
- Bathroom Exhaust Fan Critical Detail

ELECTRICAL

✓	✗	N/A	
❑	❑	❑	1. For walls separating conditioned and unconditioned space, framing that allows for the required R-value has a top plate, bottom plate and an exterior rigid sheathing is installed.
❑	❑	❑	2. For walls that will not have an interior finish and are separating conditioned and unconditioned spaces, wall cavities are insulated and an interior rigid air barrier is installed.
❑	❑	❑	3. All dropped ceilings/soffits, shafts and chases are capped with a rigid air barrier and air sealed.
❑	❑	❑	4. Selected bath fans will pull at least 50 CFM intermittently or 20 CFM continuously when installed.
❑	❑	❑	5. Ensure work site is clean and construction materials are properly stored before proceeding.

Builder Verification

✓	✗	
❑	❑	Stop work until details are corrected.
❑	❑	Proceed without corrections.

The sub-contractor who signs and completes this form is doing so to the best of his/her knowledge and should not be held legally responsible for work completed by other organizations. The intent of this form is to ensure job sites are ready before beginning work.

Signature	Date

ELECTRICAL

✓	✗	N/A	
❑	❑	❑	1. Cut all holes cleanly and no more than 1 inch larger than the penetrating object.
❑	❑	❑	2. Air seal electrical penetrations between conditioned and unconditioned space. Use fire-rated sealants where applicable.
❑	❑	❑	3. Install recessed lighting fixtures that are insulation-contact rated (IC), sealed to drywall with caulk foam or gasket and are airtight or are located in an airtight sealed box.
❑	❑	❑	4. Coordinate bath fan exhaust duct direction with HVAC Contractor.
❑	❑	❑	5. Install high-efficacy lamps (e.g. CFLs, LEDs, fluorescent) in 50% of light fixtures.
❑	❑	❑	6. Ensure work site is clean and construction materials are properly stored before proceeding.

Certification

The sub-contractor who signs and completes this form is doing so to the best of his/her knowledge and should not be held legally responsible for work completed by other organizations. The intent of this form is to ensure job sites are ready before beginning work.

Name
Company
Signature

AIR SEALING

Job Ready

1	**2009 IECC 402.1.1:** The building thermal envelope shall meet the requirements of Table 402.1.1 based on the climate zone specified in Chapter 3.
2	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
3	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
4	**2012 IMC Table 403.3 Minimum Ventilation Rates**
5	None

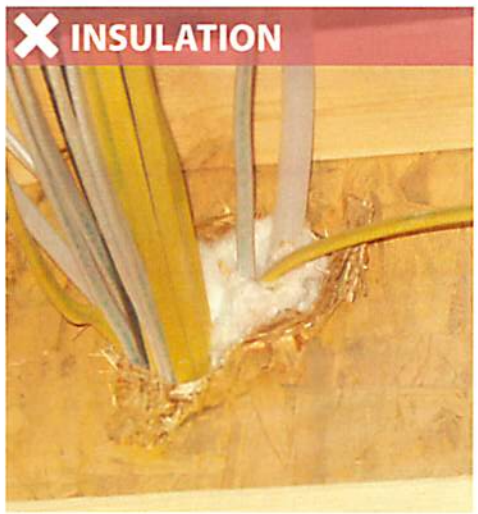
Job Complete

1	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
2	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
3	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
4	None
5	**2009 IECC 404.1:** A minimum of 50 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps.
6	None

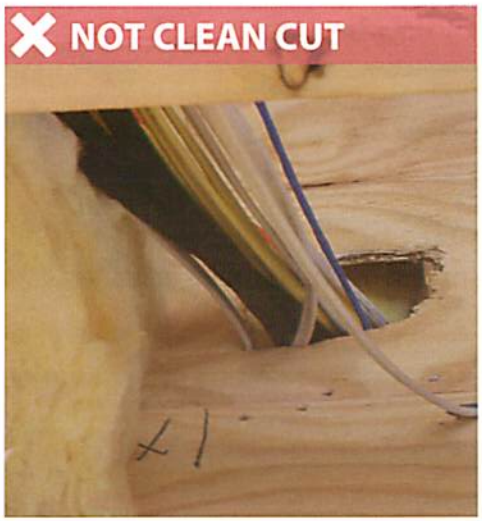
ELECTRICAL

1. Cut all holes cleanly and no more than 1 inch larger than the penetrating object.

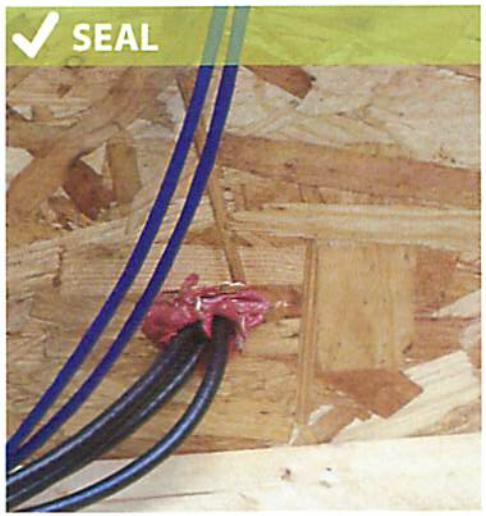
2. Air seal electrical penetrations between conditioned and unconditioned space. Use fire-rated sealants where applicable.



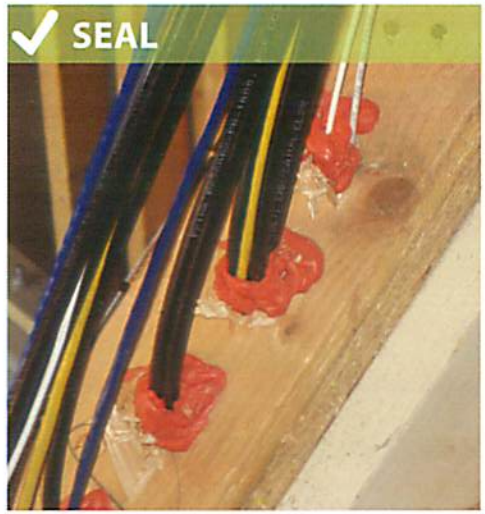
1. Cut all holes cleanly and no more than 1 inch larger than the penetrating object.



2. Air seal electrical penetrations between conditioned and unconditioned space. Use fire-rated sealants where applicable.



2. Air seal electrical penetrations between conditioned and unconditioned space. Use fire-rated sealants where applicable.



3. Install recessed lighting fixtures that are insulation-contact rated (IC), sealed to drywall with caulk foam or gasket, and are airtight or are located in an airtight sealed box.

4. Coordinate bath fan exhaust duct direction with HVAC Contractor.

4. Coordinate bath fan exhaust duct direction with HVAC Contractor.

5. Install high-efficacy lamps (e.g. CFLs, LEDs, fluorescent) in 50% of light fixtures.

High Efficacy Bulb Requirements	
Bulb (Watt)	Efficiency (lumens/Watt)
≤ 15	40
15 - 40	50
> 40	60

The high-efficacy bulb count is based on the number of lamps and includes both pin-based fixtures (fluorescent tubes and pin-based compacts) and standard screw-base fixtures. The provision applies to indoor spaces and outdoor facades of all residential buildings, including accessory structures and garages.

EXHAUST FAN

Bath Exhaust Fan: Introduction

Each bathroom that has an exhaust fan must exhaust a minimum of 20 CFM continuously or 50 CFM intermittently directly to the outside.

Bath Exhaust Fan: Mechanical Localized Exhaust

There are three important areas to watch during the construction process. If all of the key factors on the next two pages are working properly, the bathroom fan should operate the way it was intended. If the proper testing equipment is not available to verify the airflow, follow the simplified version on the right side of this page.

Bath Exhaust Fan: Key Inspection Areas

1. Fan
2. Duct
3. Exterior

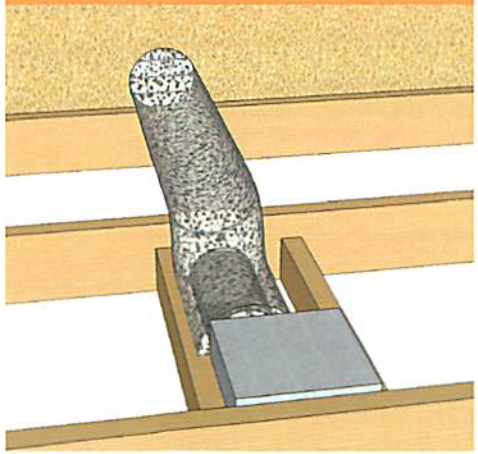
If the fan can hold two stacked 2-ply squares of toilet paper at the fan grille, the fan is pulling approximately 50 cubic feet per minute (CFM).

✓ AIR FLOW TEST

As a rule of thumb, to ensure that your bath fan will pull a minimum of 50 CFM once it is installed, install a fan rated for 70 CFM. In addition, verify the fan sone rating is less than 3.

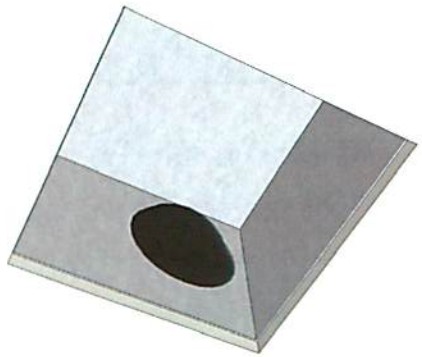
Orient the fan outlet so the duct will have the shortest and straightest route to the outside of the building.

✓ ORIENTATION



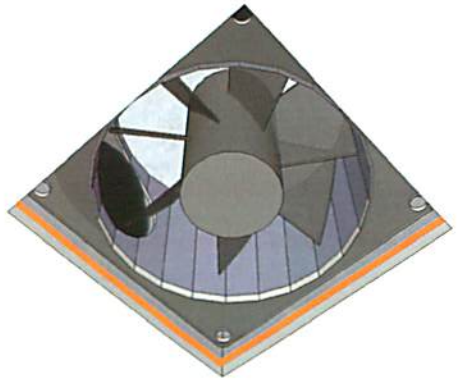
Bath fans must have backdraft damper to keep outside air from entering the bathroom. Remove shipping tape from the damper and ensure it swings freely.

✓ DAMPER

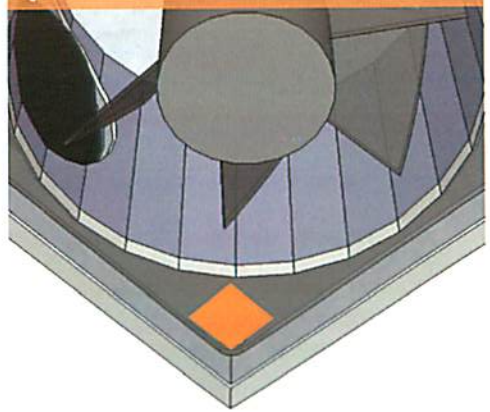


Caulk all of the holes between the drywall and the fan housing unit as well as all holes in the housing unit.

✓ SEALING



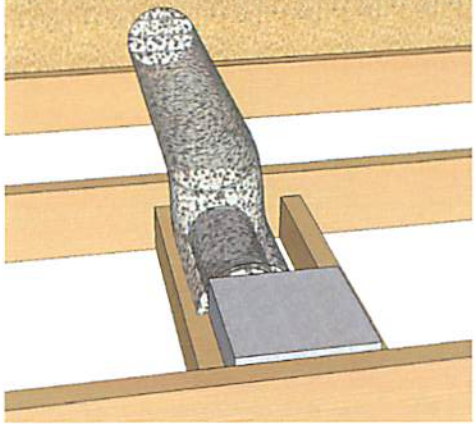
✓ RATING



EXHAUST FAN

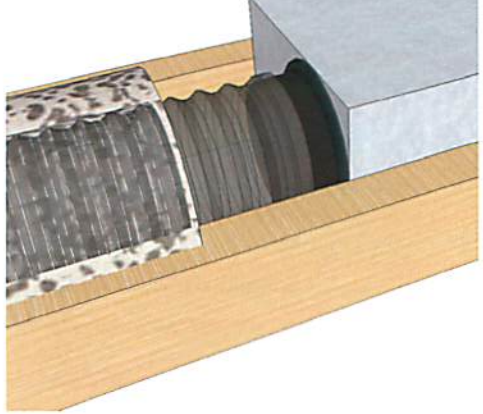
Cut the duct to the exact length to eliminate the possibility of unnecessary curves, crimping, restrictions or length.

✓ LENGTH



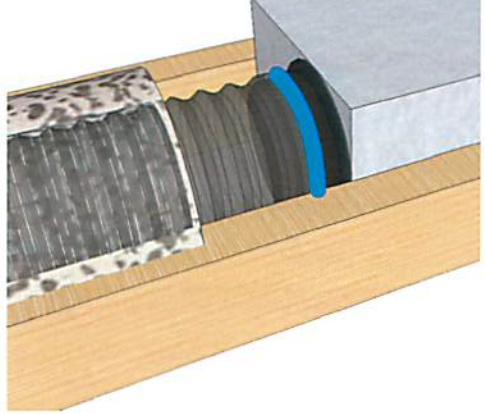
Ensure the inner liner is not tucked inside of the insulation or restricting movement of the fan damper.

✓ INNER LINER



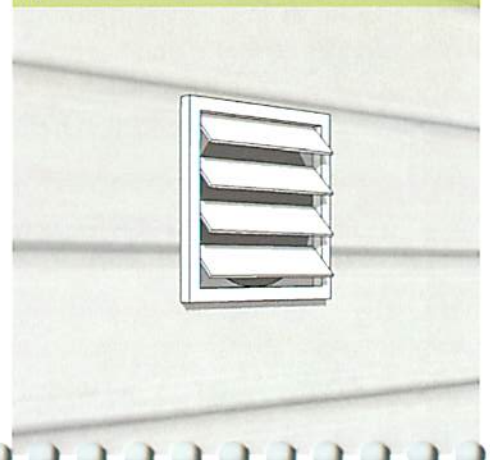
After checking that the inner liner reaches both the fan collar and the exhaust termination, seal it in place.

✓ SEALING



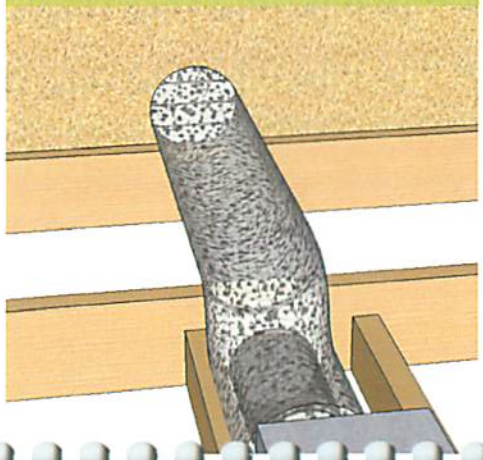
The termination should have little-to-no restriction, with the exception of a metal insect screen. Remove any packing tape during install.

✓ TERMINATION



Verify the duct terminates outside of the building, especially if the termination is located at the soffit.

✓ CONNECTION



Plumbing Contents

In this section, you will find materials to assist plumbers with the completion of code requirements. Below is a list of the content provided.

- Job Ready
- Job Complete
- Code Comparison
- Tech Tips

PLUMBING

✓	✗	N/A	
❑	❑	❑	1. For walls separating conditioned and unconditioned space, framing allows for the required R-value has a top plate, bottom plate and an exterior rigid sheathing is installed.
❑	❑	❑	2. For walls that will not have an interior finish and are separating conditioned and unconditioned spaces, wall cavities are insulated and an interior rigid air barrier is installed.
❑	❑	❑	3. All dropped ceilings/soffits, shafts and chases are capped with a rigid air barrier and air sealed.
❑	❑	❑	4. Ensure work site is clean and construction materials are properly stored before proceeding.

Builder Verification

✓	✗	
❑	❑	Stop work until details are corrected.
❑	❑	Proceed without corrections.

The sub-contractor who signs and completes this form is doing so to the best of his/her knowledge and should not be held legally responsible for work completed by other organizations. The intent of this form is to ensure job sites are ready before beginning work.

Signature	Date

PLUMBING

✓	✗	N/A	
❑	❑	❑	1. Cut all holes cleanly and no more than 1 inch larger than the penetrating object.
❑	❑	❑	2. Air seal all penetrations between conditioned and unconditioned space. Use fire-rated sealants where applicable.
❑	❑	❑	3. For walls that will not have an interior finish and are separating conditioned and unconditioned spaces, insulate wall cavities and install an interior rigid air barrier.
❑	❑	❑	4. Ensure work site is clean and construction materials are properly stored before proceeding.

Certification

The sub-contractor who signs and completes this form is doing so to the best of his/her knowledge and should not be held legally responsible for work completed by other organizations. The intent of this form is to ensure job sites are ready before beginning work.

Name
Company
Signature

AIR SEALING

Job Ready

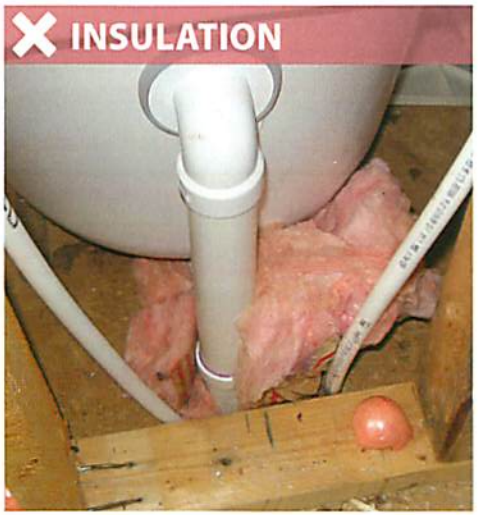
1	**2009 IECC 402.1.1:** The building thermal envelope shall meet the requirements of Table 402.1.1 based on the climate zone specified in Chapter 3.
2	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
3	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
4	None

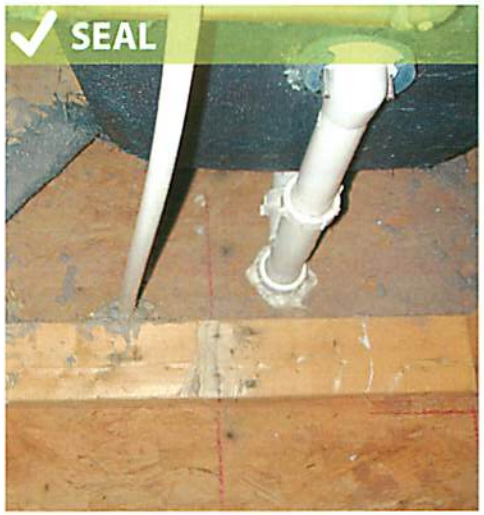
Job Complete

1	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
2	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
3	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
4	None

1. Cut all holes cleanly and no more than 1 inch larger than the penetrating object.

2. Air seal all penetrations between conditioned and unconditioned space. Use fire-rated sealants where applicable.



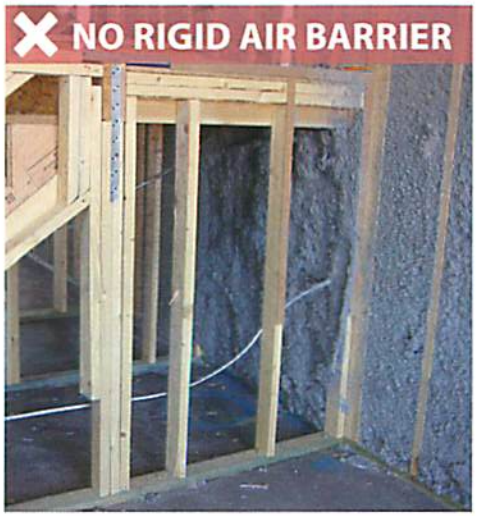


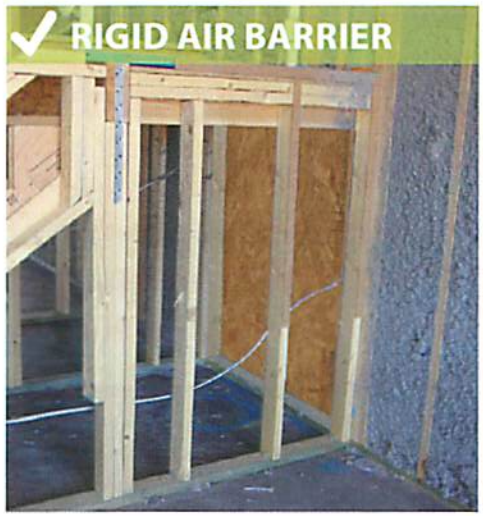
1. Cut all holes cleanly and no more than 1 inch larger than the penetrating object.

2. Air seal all penetrations between conditioned and unconditioned space. Use fire-rated sealants where applicable.

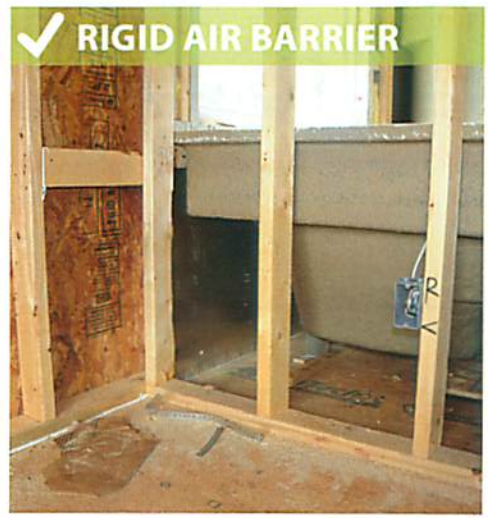
FRAMING

3. For walls that will not have an interior finish and are separating conditioned and unconditioned spaces, insulate wall cavities and install an interior rigid air barrier.





3. For walls that will not have an interior finish and are separating conditioned and unconditioned spaces, insulate wall cavities and install an interior rigid air barrier.



Water Heater Information Sheet

Equipment Selection

Note: The 2009 IECC for South Carolina does not specify HVAC equipment efficiencies. However, the National Appliance Energy Conservation Act (NAECA) requires water heating equipment manufacturers to meet minimum standards. The most recent efficiency increase was put into effect in 2006 and all equipment should be readily available. These standards are listed below:

NAECA Required Energy Efficiencies for Water Heaters

Water Heater Type	Storage Tank Size (Gallons)*	Energy Efficiency Requirement (EF)
Gas-Fired Storage Water Heater	30	.61
	40	.59
	50	.57
	75	.53
Oil-Fired Storage Water Heater	30	.61
	40	.59
	50	.57
	75	.53
Electric Storage Water Heater	30	.93
	40	.92
	50	.91
	75	.87

NAECA Required Energy Efficiencies for Water Heaters

Water Heater Type	Storage Tank Size (Gallons)*	Energy Efficiency Requirement (EF)
Table Top Water Heater	30	.89
	40	.88
	50	.83
Gas-Fired Instantaneous Water Heater	0	.62
Electric Instantaneous Water Heater	0	.93

* If the applicable tank size is not listed on this chart, calculate the EF requirement by using the equations below:

Gas-Fired Storage Water Heater
EF = 0.67—(0.0019 × Rated Storage Volume in gallons)

Oil-Fired Storage Water Heater
EF = 0.59—(0.0019 × Rated Storage Volume in gallons)

Electric Storage Water Heater
EF = 0.97—(0.00132 × Rated Storage Volume in gallons)

Tabletop Water Heater
EF = 0.93—(0.00132 × Rated Storage Volume in gallons)

Gas-Fired Instantaneous Water Heater
EF = 0.62—(0.0019 × Rated Storage Volume in gallons)

Instantaneous Electric Water Heater
EF = 0.93—(0.00132 × Rated Storage Volume in gallons)

Air Sealing Contents

In this section, you will find materials to assist air sealers with the completion of code requirements. Below is a list of the content provided.

- Job Ready
- Job Complete
- Code Comparison
- Tech Tips

AIR SEALING

✓	✗	N/A	
❑	❑	❑	1. For walls separating conditioned and unconditioned space, framing that allows for the required R-value, has a top plate, bottom plate and an exterior rigid sheathing is installed.
❑	❑	❑	2. For walls that will not have an interior finish and are separating conditioned and unconditioned spaces, wall cavities are insulated and an interior rigid air barrier is installed.
❑	❑	❑	3. All dropped ceilings/soffits, shafts and chases are capped with a rigid air barrier.
❑	❑	❑	4. Overhanging floor cavities are insulated before being enclosed with rigid sheathing.
❑	❑	❑	5. All floor systems within the conditioned envelope have a band or blocking separating conditioned and unconditioned space.
❑	❑	❑	6. All holes are cleanly cut and are no more than 1 inch larger than the penetrating object.
❑	❑	❑	7. Work site is clean and construction materials are properly stored before proceeding.

Builder Verification

✓	✗	
❑	❑	Stop work until details are corrected.
❑	❑	Proceed without corrections.

The sub-contractor who signs and completes this form is doing so to the best of his/her knowledge and should not be held legally responsible for work completed by other organizations. The intent of this form is to ensure job sites are ready before beginning work.

Signature	Date

AIR SEALING

✓	✗	N/A	
❑	❑	❑	1. Air seal all dropped ceilings/soffits, shafts and chases.
❑	❑	❑	2. For all floor systems within the conditioned envelope, air seal bands or blocking that separates conditioned and unconditioned space.
❑	❑	❑	3. Air seal all rigid air barriers that enclose overhanging floor cavities.
❑	❑	❑	4. Air seal all gaps and voids between conditioned and unconditioned spaces.
❑	❑	❑	5. Air seal around windows and doors using backer rod, caulk or low expansion foam.
❑	❑	❑	6. Air seal all penetrations between conditioned and unconditioned spaces. Use fire-rated sealants where applicable.
❑	❑	❑	7. Air seal supply and return duct terminations to drywall and/or subfloor with caulk, foam or equivalent material. Use fire-rated sealants where applicable.
❑	❑	❑	8. Ensure work site is clean and construction materials are properly stored before proceeding.

Certification

The sub-contractor who signs and completes this form is doing so to the best of his/her knowledge and should not be held legally responsible for work completed by other organizations. The intent of this form is to ensure job sites are ready before beginning work.

Name
Company
Signature

AIR SEALING

Job Ready

1	**2009 IECC 402.1.1:** The building thermal envelope shall meet the requirements of Table 402.1.1 based on the climate zone specified in Chapter 3.
2	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
3	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
4	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
5	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
6	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
7	None

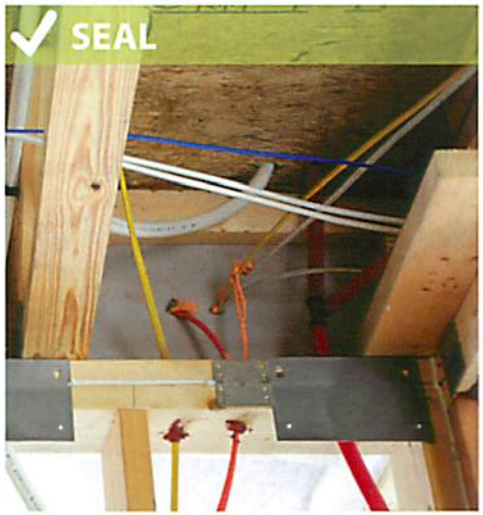
Job Complete

1	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
2	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
3	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
4	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
5	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
6	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
7	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
8	None

AIR SEALING

1. Air seal all dropped ceilings/soffits, shafts and chases.

2. For all floor systems within the conditioned envelope, air seal bands or blocking that separates condition and unconditioned space.

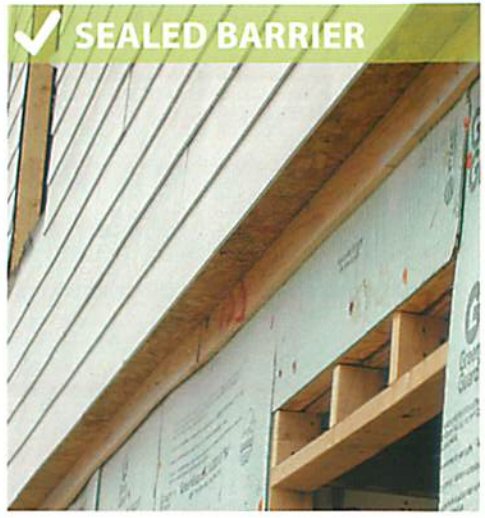


1. Air seal all dropped ceilings/soffits, shafts and chases.

2. For all floor systems within the conditioned envelope, air seal bands or blocking that separates condition and unconditioned space.

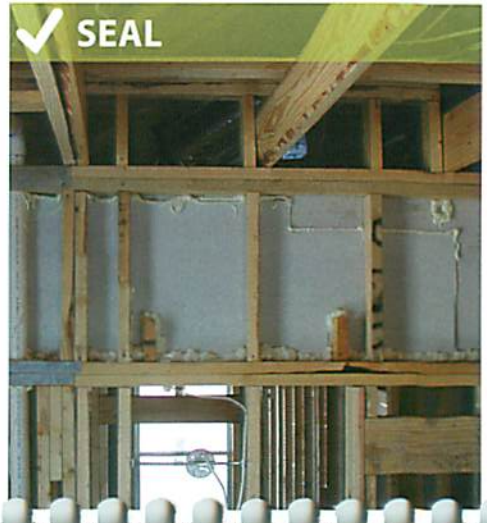
3. Air seal all rigid air barriers that enclose overhanging floor cavities.

3. Air seal all rigid air barriers that enclose overhanging floor cavities.



4. Air seal all gaps and voids between conditioned and unconditioned spaces.

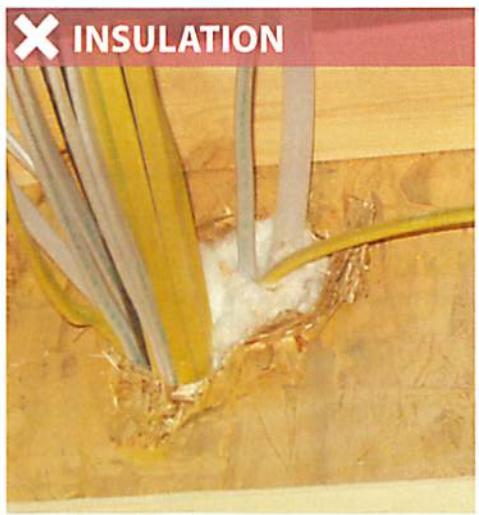
4. Air seal all gaps and voids between conditioned and unconditioned spaces.



AIR SEALING

5. Air seal around windows and doors using backer rod, caulk or low expansion foam.

6. Air seal all penetrations between conditioned and unconditioned spaces. Use fire-rated sealants where applicable.



5. Air seal around windows and doors using backer rod, caulk or low expansion foam.

6. Air seal all penetrations between conditioned and unconditioned space. Use fire-rated sealants where applicable.

7. Air seal supply and return duct terminations to drywall and/or subfloor with caulk, foam or equivalent material. Use fire-rated sealants where applicable.

7. Air seal supply and return duct terminations to drywall and/or subfloor with caulk, foam or equivalent material. Use fire-rated sealants where applicable.

Insulation Contents

In this section, you will find materials to assist insulators with the completion of code requirements. Below is a list of the content provided.

- Insulation Information Sheets
- Job Ready
- Job Complete
- Code Comparison
- Tech Tips

Insulation Information Sheet

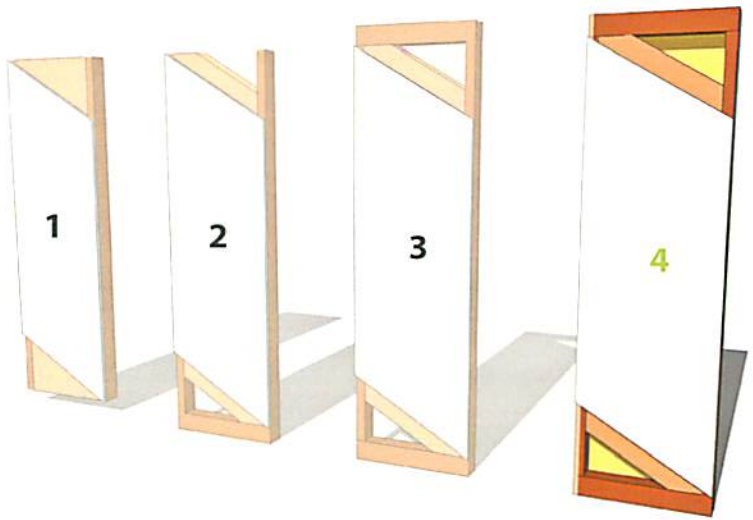
WHAT TYPE OF INSULATION?

It is more important that the insulation is properly installed rather than the specific type being used. Avoid these five flaws when installing insulation to achieve a proper installation:

- Gaps
- Voids
- Misalignment
- Compression
- Wind intrusion

Proper Installation: Framing

Properly installed insulation consists of insulation framed on all six sides, including top and bottom plates, rigid backing and sheathing. Ensure that framing is correctly installed prior to the start of insulation. By verifying that the framer has created six-sided wall cavities, insulators will save time and money through preventive measures. The images below illustrate how framing must be installed for insulation to meet the required Grade I installation.



Improper Framing - Insulation will not meet Grade I

1. No top or bottom plate and no backing
2. Bottom plate, but no top plate and no backing
3. Top and bottom plate, but no backing

Proper Framing - Insulation will meet Grade I

4. Top and bottom plate, includes backing (best design)

Proper Installation: Insulation

Once the framing has been verified as properly installed, it is more important that the insulation is properly installed. It is not important which type of insulation is used, but it is important to train installers. Training on how to properly install the type of insulation to avoid flaws will create a Grade I installation, as well as create a more comfortable and durable home.

Train installers on these five flaws and how to avoid them:

- **Gaps:** Ensure the insulation fills the entire exterior wall, ceiling or floor cavity
- **Voids:** Verify all exterior wall, ceiling and floor cavities have insulation
- **Misalignment:** Ensure all insulation is touching the air barrier
- **Compression:** Verify that insulation is installed without compression
- **Wind Intrusion:** Ensure there is a physical separation (such as wind baffles) between insulation in the attic and weather conditions

To better understand what improper and proper installation looks like for each of these five flaws, refer to the images and text on the Tech Tips in this section.

INSULATION

✓	✗	N/A	
❑	❑	❑	1. Attic framing allows full level of insulation to be installed under attic platforms and eaves.
❑	❑	❑	2. For walls separating conditioned and unconditioned space, framing that allows for the required R-value, has a top plate, bottom plate and an exterior rigid sheathing is installed.
❑	❑	❑	3. For walls that will not have an interior finish and are separating conditioned and unconditioned spaces, wall cavities are insulated and an interior rigid air barrier is installed.
❑	❑	❑	4. All dropped ceilings/soffits, shafts and chases are capped with a rigid air barrier and air seal.
❑	❑	❑	5. For all floor systems within the conditioned envelope, band or blocking separating conditioned and unconditioned space is installed.
❑	❑	❑	6. Overhanging floor cavities are insulated before being enclosed with rigid sheathing.
❑	❑	❑	7. All gaps and voids are air sealed between conditioned and unconditioned spaces.
❑	❑	❑	8. Verify that a vapor retarder is not installed.
❑	❑	❑	9. Work site is clean and materials are properly stored in a dry location before proceeding.

Builder Verification

✓	✗	
❑	❑	Stop work until details are corrected.
❑	❑	Proceed without corrections.

The sub-contractor who signs and completes this form is doing so to the best of his/her knowledge and should not be held legally responsible for work completed by other organizations. The intent of this form is to ensure job sites are ready before beginning work.

Signature	Date

INSULATION

✓	✗	N/A	
❑	❑	❑	1. For vented attics, install wind baffles on top of all exterior walls, leaving room for insulation over top plates and ventilation above.
❑	❑	❑	1. Install insulation to meet the 2009 IECC R-value requirements.
❑	❑	❑	2. Install insulation to fill the cavity between conditioned and unconditioned space without gaps, voids, misalignments or compression.
❑	❑	❑	3. Cut and split insulation around blocking, plumbing, HVAC and electrical components.
❑	❑	❑	4. Install insulation to completely fill floor and/or cantilever framing or to maintain permanent contact with the subfloor.
❑	❑	❑	5. Air seal around windows and doors using backer rod, caulk or low expansion foam.
❑	❑	❑	6. Insulate the attic access to the same level as surroundings and install weather stripping around the perimeter.
❑	❑	❑	7. For attics with loose fill insulation, install baffles around the attic access opening.
❑	❑	❑	8. Work site is clean and materials are properly stored in a dry location before proceeding.

Certification

The sub-contractor who signs and completes this form is doing so to the best of his/her knowledge and should not be held legally responsible for work completed by other organizations. The intent of this form is to ensure job sites are ready before beginning work.

Name

Company

Signature

HVAC INSTALLATION

Job Ready

1	**2009 IECC 402.1.1:** The building thermal envelope shall meet the requirements of Table 402.1.1 based on the climate zone specified in Chapter 3.
2	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
3	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
4	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
5	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
6	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
7	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
8	None
9	None

Job Complete

1	**2009 IECC 402.1.1:** The building thermal envelope shall meet the requirements of Table 402.1.1 based on the climate zone specified in Chapter 3.
2	**2009 IECC 402.1.1:** The building thermal envelope shall meet the requirements of Table 402.1.1 based on the climate zone specified in Chapter 3.
3	**2009 IECC 303.2:** All materials, systems and equipment shall be installed in accordance with the manufacturer's installation instructions and the International Building Code.
4	**2012 IRC R806.3:** Where eave or cornice vents are installed, insulation shall not block the free flow of air. A minimum of a 1-inch (25 mm) space shall be provided between the insulation and the roof sheathing and at the location of the vent.
5	**2009 IECC Table 402.4.2 Air Barrier And Insulation Inspection Component Criteria**
6	**2009 IECC 402.2.3:** Access doors from conditioned spaces to unconditioned spaces (e.g., attics and crawl spaces) shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access shall be provided to all equipment that prevents damaging or compressing the insulation. A wood framed or equivalent baffle or retainer is required to be provided when loose fill insulation is installed, the purpose of which is to prevent the loose fill insulation from spilling into the living space when the attic access is opened, and to provide a permanent means of maintaining the installed R-value of the loose fill insulation.

HVAC INSTALLATION

Job Complete	
7	**2009 IECC 402.2.3:** Access doors from conditioned spaces to unconditioned spaces (e.g., attics and crawl spaces) shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access shall be provided to all equipment that prevents damaging or compressing the insulation.
8	**2009 IECC 402.2.3:** A wood framed or equivalent baffle or retainer is required to be provided when loose fill insulation is installed, the purpose of which is to prevent the loose fill insulation from spilling into the living space when the attic access is opened, and to provide a permanent means of maintaining the installed R-value of the loose fill insulation.
9	None

INSULATION

1. For vented attics, install wind baffles on top of all exterior walls, leaving room for insulation over top plates and ventilation above.

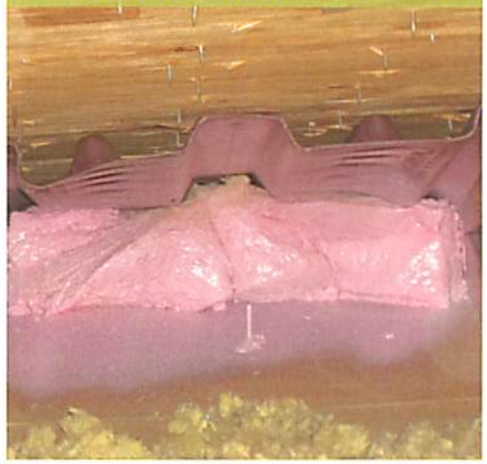
✗ MISALIGNMENT

✓ RIGHT INSTALLATION

1. For vented attics, install wind baffles on top of all exterior walls, leaving room for insulation over top plates and ventilation above.

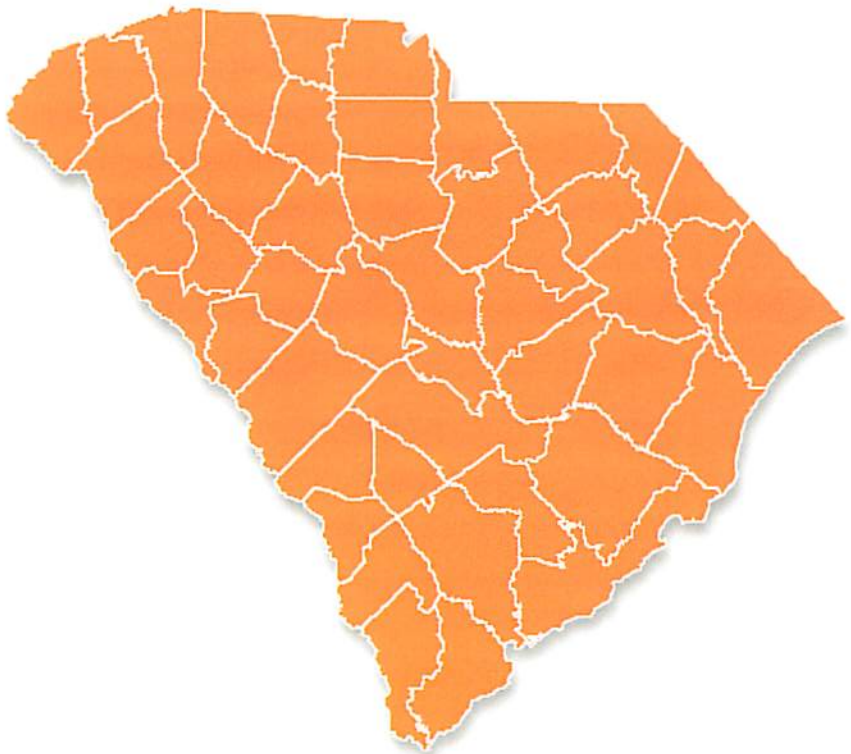
✗ WIND WASHING

✓ RIGHT INSTALLATION



2. Install insulation to meet the 2009 IECC R-value requirements.[a]

CLIMATE ZONE	CEILING	FRAME WALL	MASS WALL[b]	FLOOR	BASEMENT WALL[c]	CRAWL SPACE WALL[c]	SLAB[e]
Zone 3	R-30	R-13	R-5/8	R-19	R-5/13[d]	R-5/13	0



a. R-Values are minimums.
b. The second R-value applies when more than half of the insulation is on the interior of the mass wall.
c. "R-5/13" means R-5 continuous insulation sheathing on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.
d. Basement wall insulation is not required in warm-humid locations defined by Figure 301.1 and Table 301.1 of the 2009 IECC.
e. R-5 shall be added to the required slab edge R-values for heated slabs. Insulation depth shall be the depth of the footing or two feet, whichever is less in Climate Zones 1-3 for heated slabs.

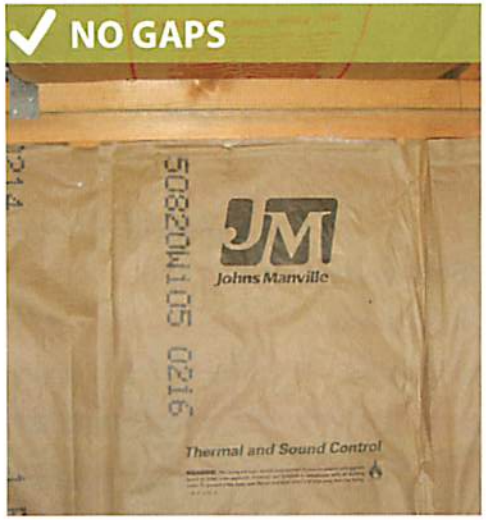
Interactive Map:
http://energycode.pnl.gov/EnergyCodeReqs/

INSULATION

3. Install insulation to fill the cavity between conditioned and unconditioned space without gaps, voids, misalignments or compression.

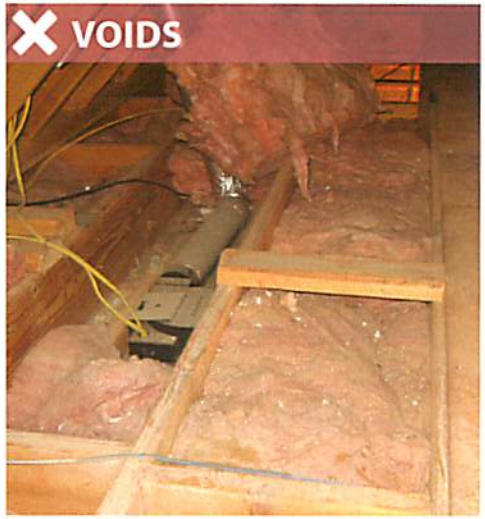
✗ GAPS

✓ NO GAPS

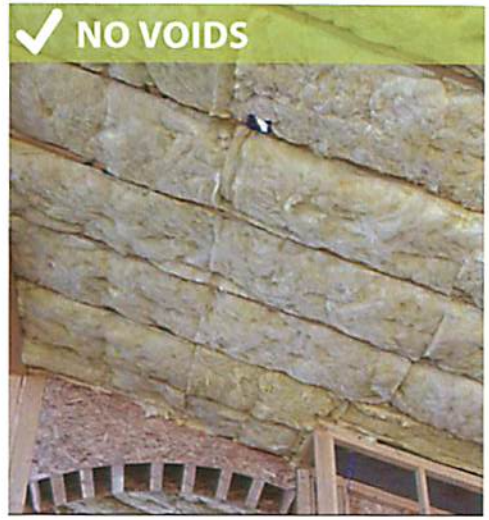


3. Install insulation to fill the cavity between conditioned and unconditioned space without gaps, voids, misalignments or compression.

✗ VOIDS



✓ NO VOIDS



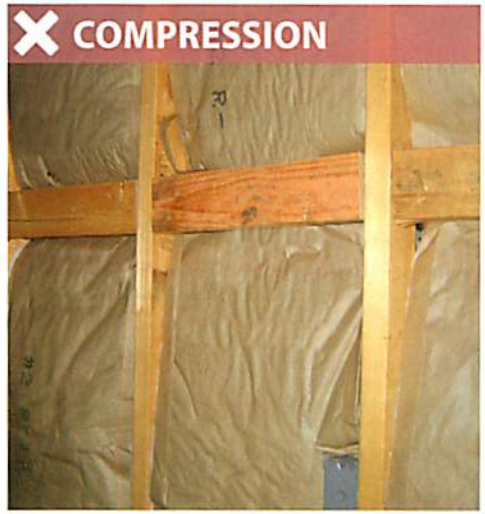
3. Install insulation to fill the cavity between conditioned and unconditioned space without gaps, voids, misalignments or compression.

✗ MISALIGNMENT

✓ NO MISALIGNMENT

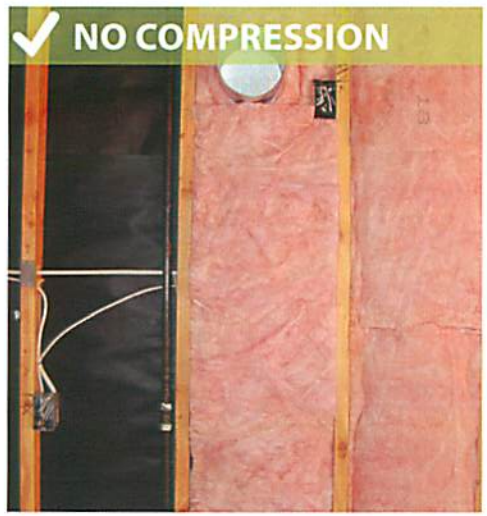
3. Install insulation to fill the cavity between conditioned and unconditioned space without gaps, voids, misalignments or compression.

✗ COMPRESSION



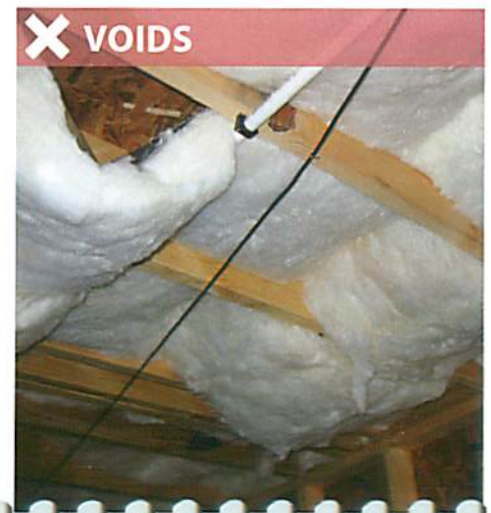
✓ NO COMPRESSION

4. Cut and split insulation around blocking, plumbing, HVAC and electrical components.

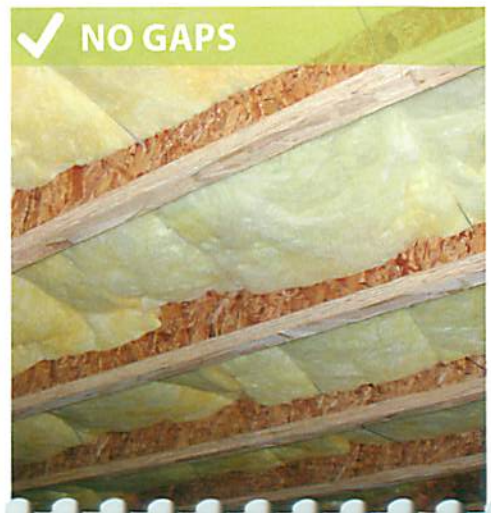


4. Cut and split insulation around blocking, plumbing, HVAC and electrical components.

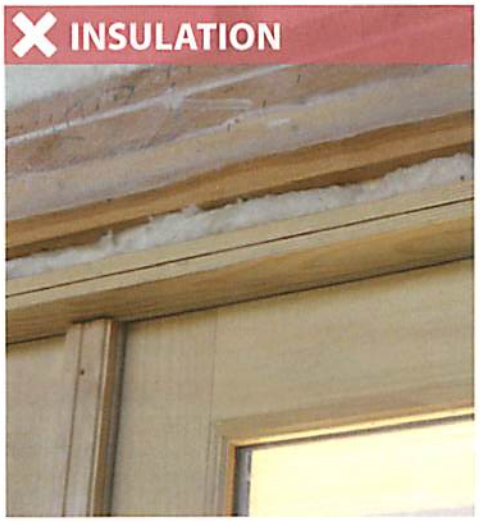
5. Install insulation to completely fill floor and/or cantilever framing or to maintain permanent contact with the subfloor.



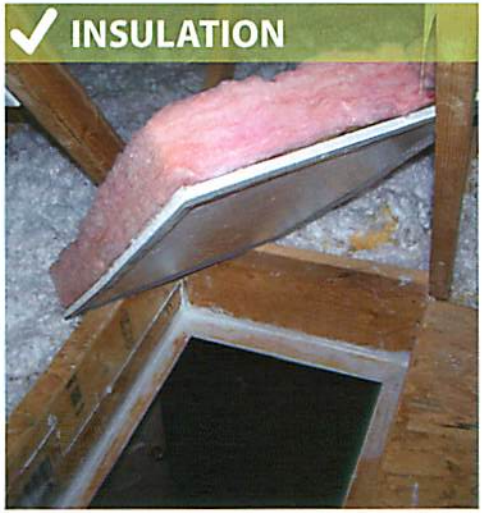
5. Install insulation to completely fill floor and/or cantilever framing or to maintain permanent contact with the subfloor.



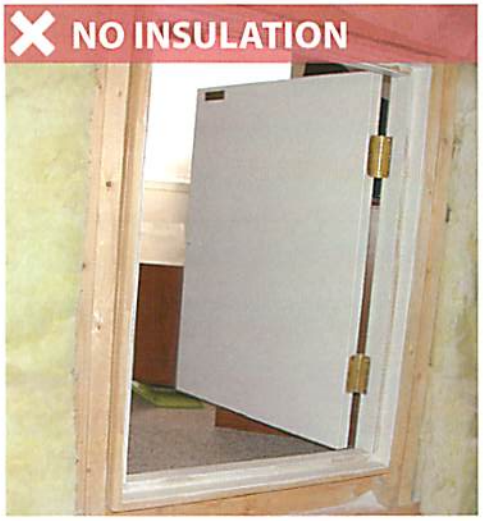
6. Air seal around windows and doors using backer rod, caulk or low expansion foam.



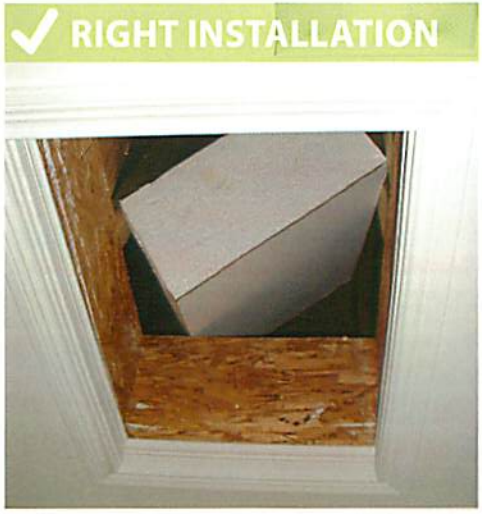
7. Insulate the attic access to the same level as surroundings and install weather stripping around the perimeter.



7. Insulate the attic access and install weather stripping around the perimeter.



8. For attics with loose fill insulation, install baffles around the attic access opening.



Appendix Contents

In this section, you will find materials to assist with the completion of code requirements. Below is a list of the content provided.

- Resources
- Glossary
- ACCA Manual J Informational Sheet
- ACCA Manual S Informational Sheet

Resources

Free Online International Codes

http://publicecodes.cyberregs.com/icod/index.htm

South Carolina Building Codes Council

http://www.llr.state.sc.us/pol/BCC/

South Carolina Energy Office

http://www.energy.sc.gov/

Online Code Environment and Advocacy Network (OCEAN)

http://energycodesocean.org/

U.S. Department of Energy

http://www.energycodes.gov/

Database of State Incentives for Renewables and Efficiency

http://www.dsireusa.org/

Glossary

The definitions listed below are from the 2009 iecc and may be helpful to better understand the code requirements.

Above-grade wall

A wall more than 50 percent above grade and enclosing conditioned space. This includes between-floor spandrels, peripheral edges of floors, roof and basement knee walls, dormer walls, gable end walls, walls enclosing a mansard roof and skylight shafts.

Air barrier

Material(s) assembled and joined together to provide a barrier to air leakage through the building envelope. An air barrier may be a single material or a combination of materials.

Alteration

Any construction or renovation to an existing structure other than repair or addition that requires a permit. Also, a change in a mechanical system that involves an extension, addition or change to the arrangement, type or purpose of the original installation that requires a permit.

Basement wall

A wall 50 percent or more below grade and enclosing conditioned space.

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.

C-factor (thermal conductance)

The coefficient of heat transmission (surface to surface) through a building component or assembly, equal to the time rate of heat flow per unit area and the unit temperature difference between the warm side and cold side surfaces (btu/h ft2 × °f) [w/(m2 × k)].

Conditioned floor area

The horizontal projection of the floors associated with the conditioned space.

Conditioned space

An area or room within a building being heated or cooled, containing uninsulated ducts, or with a fixed opening directly into an adjacent conditioned space.

Crawl space wall

The opaque portion of a wall that encloses a crawl space and is partially or totally below grade.

Duct

A tube or conduit utilized for conveying air. The air passages of self-contained systems are not to be construed as air ducts.

Duct system

A continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, plenums, fans and accessory air-handling equipment and appliances.

Dwelling unit

A single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.

Glossary

Energy recovery ventilation system

Systems that employ air-to-air heat exchangers to recover energy from exhaust air for the purpose of preheating, precooling, humidifying or dehumidifying outdoor ventilation air prior to supplying the air to a space, either directly or as part of an HVAC system.

Energy simulation tool

An approved software program or calculation-based methodology that projects the annual energy use of a building.

Exterior wall

Walls including both above-grade walls and basement walls.

Fenestration

Skylights, roof windows, vertical windows (fixed or moveable), opaque doors, glazed doors, glazed block and combination opaque/glazed doors. Fenestration includes products with glass and nonglass glazing materials.

Heated slab

Slab-on-grade construction in which the heating elements, hydronic tubing, or hot air distribution system is in contact with, or placed within or under, the slab.

High-efficacy lamps

Compact fluorescent lamps, T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy of:

- 60 Lumens per watt for lamps over 40 watts,
- 50 Lumens per watt for lamps over 15 watts to 40 watts, and
- 40 Lumens per watt for lamps 15 watts or less.

Humidistat

A regulatory device, actuated by changes in humidity, used for automatic control of relative humidity.

Infiltration

The uncontrolled inward air leakage into a building caused by the pressure effects of wind or the effect of differences in the indoor and outdoor air density or both.

Insulating sheathing

An insulating board with a core material having a minimum R-value of R-2.

Manual

Capable of being operated by personal intervention (see "automatic").

Proposed design

A description of the proposed building used to estimate annual energy use for determining compliance based on total building performance.

Readily accessible

Capable of being reached quickly for operation, renewal or inspection without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders or access equipment (see "accessible").

Residential building

For this code, includes R-3 buildings, as well as R-2 and R-4 buildings three stories or less in height above grade.

Glossary

Roof assembly

A system designed to provide weather protection and resistance to design loads. The system consists of a roof covering and roof deck or a single component serving as both the roof covering and the roof deck. A roof assembly includes the roof covering, underlayment, roof deck, insulation, vapor retarder and interior finish.

R-value (thermal resistance)

The inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area (h • ft2 • °f/btu) [(m2 • k)/w].

Skylight

Glass or other transparent or translucent glazing material installed at a slope of 15 degrees (0.26 Rad) or more from vertical. Glazing material in skylights, including unit skylights, solariums, sunrooms, roofs and sloped walls is included in this definition.

Sleeping unit

A room or space in which people sleep, which can also include permanent provisions for living, eating, and either sanitation or kitchen facilities but not both. Such rooms and spaces that are also part of a dwelling unit are not sleeping units.

Solar heat gain coefficient (SHGC)

The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation which is then reradiated, conducted or convected into the space.

Standard reference design

A version of the proposed design that meets the minimum requirements of this code and is used to determine the maximum annual energy use requirement for compliance based on total building performance.

Sunroom

A one-story structure attached to a dwelling with a glazing area in excess of 40 percent of the gross area of the structure's exterior walls and roof.

Thermostat

An automatic control device used to maintain temperature at a fixed or adjustable set point.

U-factor (thermal transmittance)

The coefficient of heat transmission (air to air) through a building component or assembly, equal to the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films (btu/h • ft2 • °f) [w/(m2 • k)].

Ventilation

The natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.

Zone

A space or group of spaces within a building with heating or cooling requirements that are sufficiently similar so that desired conditions can be maintained throughout using a single controlling device.

ACCA
Air Conditioning
Contractors of America

2800 Shirlington Road
Suite 300
Arlington, VA 22206
Web Address: www.acca.org

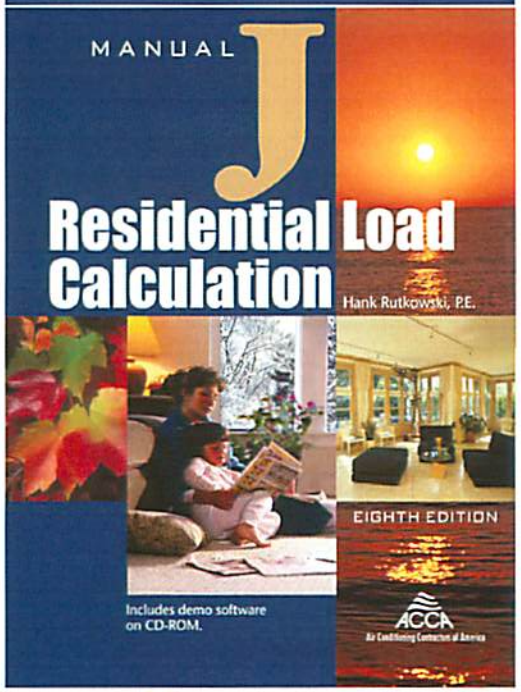
The Air Conditioning Contractors of America (ACCA) is dedicated to excellence in the heating, ventilation, air conditioning and refrigeration (HVACR) industry. As the largest HVACR contractor organization, ACCA is committed to helping its members succeed. Some of the fundamental ways in which our efforts are seen, are in the technical resources and industry standards, that guarantee quality HVACR design, installation and maintenance.

Sponsored by the ACCA Code Committee

The ACCA Code Committee was formed to address code issues and in particular, *to advise and assist ACCA in beneficially representing the contractors in the code processes that affect the HVACR industry*. This information has been provided for entities, seeking to verify that load calculations for an HVACR application have been correctly performed. For more information, contact:

Surumi Hudacsko
Phone: 703-824-8847
Fax: 703-575-9147

Verifying ACCA Manual J® Procedures



Includes load calculation checklist

ACCA
AIR CONDITIONING CONTRACTORS OF AMERICA

WHY ARE HEAT LOSS AND HEAT GAIN CALCULATIONS IMPORTANT

Achieving occupant satisfaction is the principal goal of any HVAC design. Primary factors impacting occupant satisfaction include: filtration, temperature and humidity control, air motion in the room, adequate ventilation, interior zoning needs and energy efficient operation. Occupant satisfaction is maximized when the heating and cooling system and equipment are the correct type and size and the air distribution system is properly designed and installed.

For residential applications, ACCA's Manual J, Eighth Edition (MJ8™) is the only procedure recognized by the American National Standards Institute (ANSI) and specifically required by residential building codes. Methods not based on actual construction details, nor founded on relevant physical laws and engineering principles, are unlikely to result in correct equipment sizing.

PROBLEMS WITH OVERSIZED EQUIPMENT

Oversized equipment results in marginal part load temperature control. While the temperature control at the thermostat may be satisfactory, equipment cycling may cause noticeable temperature swings in other rooms and larger temperature differences between rooms. Oversized equipment may cause degraded humidity control and increase the potential for mold growth, allergic reactions and respiratory problems. In these unfavorable conditions, occupants may experience additional discomfort and dissatisfaction. Other negative effects are higher installed costs, increased operating expenses, and increased maintenance costs. Furthermore, oversized equipment generally requires larger ducts, poses additional requirements on the power grid and may lead to more service calls.

REASONS FOR OVERSIZED EQUIPMENT

Three main reasons for oversized equipment are: (1) a guess is made on the load; (2) mistakes are made in the load calculation; (3) the equipment is selected for either unusual/extreme conditions such as abnormal temperatures or unusual occupancy loads (i.e. gatherings/parties). Other reasons include the use of inappropriate and inadequate "rules of thumb" such as '500ft²/ton', '400CFM/ton', or 'total cooling capacity = 1.3 x sensible cooling capacity'. Furthermore, seemingly trivial mistakes such as ignoring building efficiency upgrades and assuming that the original design and installation are correct, all contribute towards inappropriate equipment sizing.

MANUAL J® VERIFICATION

While it is not practical to verify every aspect of a submitted MJ8 calculation, it is a good practice to review key elements that indicate general integrity of the calculations i.e. the contractor has made a good faith effort to provide reasonably accurate loads.

ITEMS TO VERIFY

The key load elements, grouped in roughly decreasing levels of impact on the overall contribution to the loads, are:

IMPACT ON LOAD

HIGH	✓ Design Temperatures (Indoor and Outdoor) ✓ Windows, Glass Doors and Large Skylights (shading, overhangs, etc.) ✓ Ducts (location, leakage and duct wall R-values) ✓ Ceilings under an attic (R-values, roof material, roof color)
MEDIUM	✓ Small Skylights ✓ Infiltration ✓ Ventilation
LOW	✓ Appropriately Insulated Floors ✓ Appropriately Insulated Walls ✓ Internal Gains

It is also worth noting some unusual items that also contribute to the load. These include:

- Hot Tubs
- Whirlpool Tubs
- Three-season Porches

A NOTE ON UNDERSTANDING THE DESIGN PROCESS

Manual J allows contractors to perform a load calculation on a residential building/home. Apart from the load calculation being performed, the ducts must be sized and the correct size equipment must be selected. ANSI-recognized ACCA Manual D® for duct sizing and ACCA Manual S® for residential equipment selection provide guidance here.

The order of this checklist follows Form J1 of ACCA Manual J8®.

#	Key Item	Check	Questions to Ask	Circle Answer*		
1	Design Temperatures	✓ Indoor Design Temperatures	Is the indoor design temperature for *Heating*: per Local Code OR 70°F (21°C) at 30% RH?	YES	NO	-----
			Is the indoor design temperature for *Cooling*: per Local Code OR 75°F (24°C) at 50% RH? [or 55% for humid climate, 45% for dry climate?]	YES	NO	-----
		✓ Outdoor Design Temperatures	Is the outdoor design temperature per Table 1 of MJ8 or Local Code?	YES	NO	-----
2	Windows & Glass Doors	✓ U-values and SHGC values	Are the SHGC and U-values reasonable for the window types and frame constructions? (see Table 2 of MJ8)	YES	NO	-----
		✓ Shading Adjustments	Have window shading (curtains, drapes, insect screens, tinting, etc.) adjustments been made?	YES	NO	-----
		✓ Overhang Adjustments	Have roof overhang adjustments been made?	YES	NO	-----
		✓ Total Area	Is the total area for the windows & glass doors roughly equal to the area shown on the drawing plans?	YES	NO	-----
		✓ Exposure Directions	Do the exposure directions [North (N), North-East (NE), etc.] appear correct?	YES	NO	-----
3	Skylights	✓ U-values and SHGC values	Are the SHGC and U-values appropriate for the skylight types and frame constructions? (see Table 2 of MJ8)	YES	NO	N/A
		✓ Shading Adjustments	Have adjustments been made for drapes, tinting and reflective coatings?	YES	NO	N/A
		✓ Total Area	Is the total area for the skylights roughly equal to the area shown on the drawing plans?	YES	NO	N/A
		✓ Exposure Directions	Do the exposure directions [North (N), North-East (NE), etc.] appear correct?	YES	NO	N/A
4	Doors | Wood, Metal	✓ *None*	----------	-----	-----	-----
5	Walls | Above Grade, Below Grade	✓ Insulation	Are correct wall insulation R-values taken into account when the wall loads are calculated?	YES	NO	-----
		✓ Total Area	Is the total area for the walls equal to the area shown on the drawing plans?	YES	NO	-----
6	Ceilings	✓ Insulation	Is correct ceiling insulation R-value taken into account when the ceiling load is calculated?	YES	NO	N/A
		✓ Radiant Barrier	If applicable, does the load calculation take credit for a radiant barrier?	YES	NO	N/A
		✓ Roof color and material	Is correct roof color and material taken into account when the ceiling load is calculated?	YES	NO	-----
		✓ Total Area	Is the total area for the ceilings equal to the area shown on the drawing plans?	YES	NO	-----
7	Floors	✓ Insulation	Is the floor insulation and type of construction representative of what is built/planned?	YES	NO	-----
8	Infiltration	✓ Envelope Tightness	Is the listed envelope tightness (tight, semi-tight, average, semi-loose, loose) appropriate?	YES	NO	-----
		✓ Above grade volume	Is the total above grade volume equal to what is shown on the drawing plans?	YES	NO	-----
9	Internal Gains	✓ Appliances	Are the appliance gains 1200 Btuh, 2400 Btuh or a value recommended by MJ8?	YES	NO	-----
		✓ Occupants	*Is Maximum Number of Occupants = Number of Bedrooms + 1?*	YES	NO	-----
			- Is Btuh (cooling) = 230 x Number of Occupants? - Is Btuh (heating) = 200 x Number of Occupants?	YES	NO	-----
10	Ducts	✓ Duct Location	If located in an unconditioned space, are the ducts insulated (appropriate R-value)?	YES	NO	N/A
		✓ Duct Tightness	Is the duct tightness category 'average sealed' or higher (i.e. notably sealed, extremely sealed)?	YES	NO	-----
11	Ventilation	✓ Intermittent Fans	Are intermittent bathroom and kitchen fans excluded from the infiltration calculations?	YES	NO	N/A
		✓ Continuous Exhaust Fans	Are dedicated exhaust fans (continuous) included in the calculations?	YES	NO	N/A
		✓ Heat Recovery Equipment	Are the heat recovery equipment and/or a ventilating dehumidifier included in the calculations (if applicable)?	YES	NO	N/A

*Questions should be answered 'YES' (where applicable) to achieve representative load calculations.

Sponsored by the ACCA Code Committee

ACCA

Air Conditioning Contractors of America

2800 Shirlington Road

Phone: 703-575-4477

Fax: 703-575-9147

The Air Conditioning Contractors of America (ACCA) is dedicated to excellence in the HVACR industry. As the largest HVACR contractor organization, ACCA is committed to helping its members succeed. Some of the fundamental ways in which our efforts are seen, are in the technical resources and industry standards, that guarantee quality HVACR design, installation and maintenance.

The ACCA Code Committee was formed to address code issues and in particular, *to advise and assist ACCA in beneficially representing the contractors in the code processes that affect the HVAC industry*. This document has been written for Code Officials, seeking to verify that load calculations for an HVAC application have been correctly performed.

For a more detailed analysis on the design process

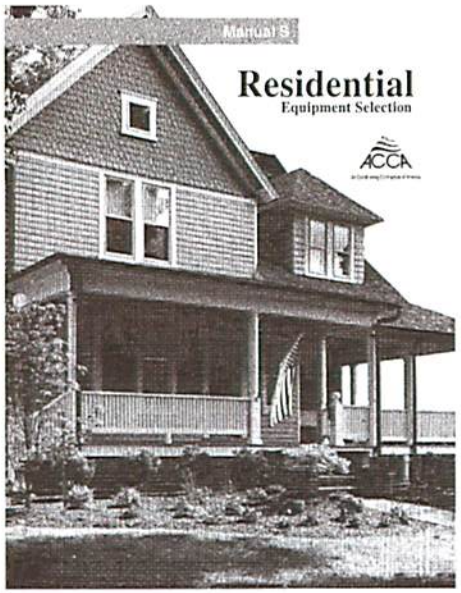
or visit

www.acca.org/tech/articles/

To order ACCA Manual S

888-290-2220

Verifying ACCA Manual S® Procedures



Includes Equipment Selection Checklist & Example

ACCA

AIR CONDITIONING CONTRACTORS OF AMERICA®

Verifying ACCA Manual S® Procedures

Why is proper equipment selection important?

Achieving occupant satisfaction is the principal goal of any HVAC design. Occupant satisfaction is maximized when the heating and cooling equipment are the correct type and size to meet the capacity requirements from the Manual J load calculation.

For residential equipment selections, ACCA's Manual S®, is the only procedure recognized by the American National Standards Institute (ANSI). If the Manual J load calculation is done then the next step is to select the equipment that will deliver the necessary heating and cooling.

ACCA'S
Design Manuals
Residential

What problems come from the wrong size equipment?

Undersized equipment will not meet the customer's comfort requirements at the design specifications.

Oversized equipment will create other problems:

- Degraded humidity control in the summer.
- Occupants may suffer the effects of an increased potential for mold growth. These same conditions also may contribute to asthma and other respiratory conditions.
- The temperature may feel right at the thermostat but the temperature in other rooms will suffer from the oversized equipment going through short operation cycles. Short cycles can cause temperature swings as the equipment over-conditions, stops, then over-conditions, etc…
- Hot and cold spots between rooms because the thermostat is satisfied but the room is not.
- Oversized equipment generally requires larger ducts, increased electrical circuit sizing and larger refrigeration tubing. These cause higher installed costs and increased operating expenses.
- The equipment starts and stops more frequently, this causes excessive wear and can increase maintenance costs more service calls.

In these unfavorable conditions occupants will experience discomfort and dissatisfaction.

What are some reasons for oversized equipment?

Two main reasons for oversized equipment are either that: (1) a guess was made on the equipment's capacity at the design conditions or (2) that mistakes were made in the selection process. Manufacturers take great care in measuring and testing how well their equipment performs at different operating conditions. When contractors use this data to select the equipment they will meet the heating and cooling needs of their customers.

Equipment Selection Checklist

#	Key Item	Verify	Verification Questions
1	Design Conditions	The design conditions fall within specifications.	Do the design conditions fall within the minimum standards for this region as found in Manual J8 Table 1A or 1B? (A)
		The information from the Manual J load calculation was transferred accurately.	Was the Total Heat Gain / Loss information used to evaluate equipment candidates? (B)
2	Manufacturer's Performance Data	The equipment manufacturer's performance parameters match the design parameters used to calculate the heat load.	Does the manufacturer's performance parameters match the design parameters used to calculate the home's heat load (i.e., outdoor dry-bulb, indoor dry-bulb, and indoor wet-bulb)?
			If the performance data parameters are more than 5% greater or less than the design parameters then did the contractor interpolate the equipment manufacturer's performance parameters to match the design parameters used to calculate the heat load?
3	Equipment Performance	Estimated Cooling – CFM based on Temperature Difference	Was the Sensible Heat Ratio calculated? (Sensible Load / Total Load)? (C)
			Was the SHR used to find the proper air flow? (D)
		Equipment selected satisfies Total Btus (for cooling the Sensible and **Latent** load)	Is the total heating capacity of the selected equipment ≤140% of the designed total heating load? (If so reduce equipment size) (E)
			Is the total cooling capacity of the selected equipment ≤115% of the designed total cooling load ? (If so reduce equipment size) (F)
			Does the "Sensible" and/or "Latent" capacities of the selected equipment meet the load's requirements? (G)
			If a heat pump in a very cold climate (heating is primary concern) does the total cooling capacity of the selected equipment exceed 125% of the designed total cooling load?
4	Auxiliary Heat	Heat Pump Balance Point	Does the electric auxiliary heat provide the necessary BTUs to makeup difference in capacity from the heat pump's balance point to the design load conditions? (H)

Equipment Selection Example using the Checklist

Design

Winter Design Conditions

Outdoor °F:	27°F (A)	From Manual J8 Table 1A or 1B
Indoor °F:	70°F	Manual J8 §3-6 defaults to 70°F
Total Calculated Heat Loss	50,981Btu/h (B)	Determined by Manual J8 load calculation

Summer Design Conditions

Outdoor°F:	85°F (A)	From Manual J8 Table 1A or 1B
Indoor °F:	75°F	Manual J8 §3-6 defaults to 75°F
Entering Wet Bulb (EWB):	63°F	Manual J8 §3-6 defaults to 63°F EWB (≈ 75°F / 50% RH)
Total Heat Gain	27,543Btu/h (B)	Determined by Manual J8 load calculation
Sensible Heat Gain	23,321Btu/h (G)	
Latent Heat Gain	4,222Btu/h (G)	
Sensible Heat Ratio (SHR)	85% (C)	See formula below
Design Air Flow	400cfm/ton (D)	See Chart below, nominally CFM is 350-450 CFM/Ton depending on design conditions

$$\text{SHR} = \frac{\text{Sensible Heat}}{\text{Total Heat Gain}} \quad (C) \qquad 85\% = \frac{23{,}321\text{Btu/h}}{27{,}543\text{Btu/h}}$$

Sensible Heat Ratio to CFM per Ton	
SHR	Recommended Air Flow
Below 0.80	350 cfm/Ton
0.80 – 0.85	400 cfm/Ton
Above 0.85	450 cfm/Ton

(D) 85% ≈ 400cfm/ton

Application Data: Equipment Capacity

A furnace was selected for comparing "heating only" design and performance. Other types of equipment may be used.

Furnace Model Number:	FU600300	Fictitious furnace
Output BTUH:	52,000Btu/h (E)	Furnace Btu/h Output: (≤ 140% of calculated loss)

A heat pump was selected for comparing cooling and heating design and performance. Other types of equipment may be used.

Outdoor Unit Model Number:	HP-030	Fictitious heat pump
Total Cooling Capacity (≤ 115%)	28,400Btu/h (F)	These capacities are from manufacturer's performance data at the **DESIGN CONDITIONS:** 85°F ODT, 1,000CFM, and 63°F EWB
Sensible Cooling Capacity (≈ Sensible Gain)	21,600Btu/h (G)	
Latent Cooling Capacity (≈ Latent Gain)	6,800Btu/h (G)	
Indoor Unit Model Number:	AH-030	Fictitious air handler
Indoor Blower CFM (CFM used to determine capacity in manufacturer's performance data):	1,000 (G)	Can the indoor blower deliver design airflow on Medium fan speed
Btuh Difference between Heat Pump Balance Point and Total Heat Loss	30,281 Btu/h (H)	This heat pump can only produce 20,700Btu/h at design conditions. More capacity is required. Air Conditioners do not have a balance point.
Auxiliary Heat (Circle): Electric Gas Oil	10 KW (H)	In this example the auxiliary heat is electric, the formula for electric heat is KW= Btu/h ÷ 3.413

From Manual J8 Tables | **From Manual J8 Load Calculation** | **From Equipment Performance Data**