M O N T A N A

Residential Energy Code Handbook

2018 International Energy Conservation Code

As Amended

A Guide to Complying with Montana's Residential Energy Code

Montana Residential Energy Code Handbook

Based on the 2018 International Energy Conservation Code (with amendments)

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Acknowledgements

Funding for the printing of this publication has been provided through electric Universal System Benefits funds collected from NorthWestern Energy customers.

2021

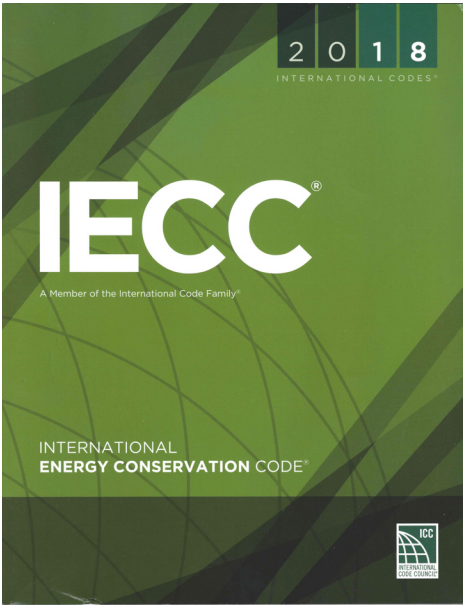
At the time of publication Montana is holding listening sessions for the 2021 IECC with adoption anticipated in early 2022. Check the NorthWestern Energy Efficiency Plus website for details.

Contents

Code Reference Notation

Unless otherwise noted, code references, such as R402.1, refer to the 2018 International Energy Conservation Code (IECC). References to the 2018 International Residential Code (IRC) are preceded with an *IRC,* as in *IRC R403.3*. References to the 2018 International Mechanical Code (IMC) are preceded with an *IMC,* as in *IMC 403.*

Introduction and General Provisions



On February 13, 2021, Montana adopted the 2018 International Energy Conservation Code (IECC) with a number of amendments. The previous state energy code was based on the 2012 IECC. The IECC includes energy provisions for both residential and commercial buildings. This *Montana Residential Energy Code Handbook* was developed to assist builders and designers in complying with the residential provisions of Montana's new energy code. Code-compliant homes are more energy-efficient, healthier for occupants, and more durable. This publication emphasizes changes in the 2018 IECC. An energy code checklist is included at the end of this publication. This handbook is not a substitute for the full text of the 2018 IECC and the related Montana amendments.

The IECC is the national model energy code adopted by many states and municipal governments in the United States. It regulates "the design and construction of buildings for the effective use and conservation of energy over the useful life of each building." The IECC applies to new buildings, as well as additions and renovations to existing buildings.

The Energy Code is Applicable Statewide

Homebuyers in the state have a right to expect a minimum level of energy efficiency in the homes they buy. That right is established by

Montana law. Within local government jurisdictions that choose to enforce the building code, these minimum energy-efficiency features are assured by the home inspection process. Outside local code enforcement jurisdictions, the energy code is enforced on residential buildings of less than five units, through Montana's self-certification program. In the self-certification areas, the builder is required to provide a signed statement to the homebuyer that the house complies with the state energy code. The Montana Department of Labor and Industry Codes and Permits Section enforces the energy code on residential buildings of five units or more that are located outside local code enforcement jurisdictions.

What Buildings Must Comply?

The energy code applies to all new residential buildings, additions, repairs, and renovations in Montana with exceptions noted below. Residential buildings (R-2, R-3, and R-4) with more than three floors above grade must comply with the commercial provisions of the energy code. The energy code is not retroactive. Unaltered portions of an original building do not need to comply. The following buildings are exempt from the energy code:

• Farm and ranch buildings, any private garage or private storage structure attached to a home, buildings that are classified or determined to be eligible for a listing in the National Register of Historic Places, and Housing and Urban Development manufactured homes (HUD Code).

• Low-energy-use buildings or portions of a building that have a peak design rate energy use of less than 3.4 Btu/h per square foot of floor area for space conditioning (heating and cooling) are only exempt from the building thermal envelope provisions of the code.

Major Energy Code Changes

The 2018 IECC clears up language many building professionals found confusing in earlier codes. It provides an opportunity for consumers to better understand the expected energy performance of their home through the addition of the Energy Rating Index (ERI). The ERI

compliance path also provides greater flexibility to builders in complying with the code. HERS ratings, similar to the ERI path, are used by almost one-third of homes built in the country. The 2018 IECC is more user-friendly and should make it easier to realize energy savings. Following is a list of the most significant changes in the new code. The 2018 IECC code references are shown in parenthesis.

- Construction document requirements (R103.2)
- Required energy code inspections (R105)
- ICC 400 Log Home Standard incorporated (R402.1)
- Window U-factor decreased from 0.32 to 0.30 (R402.1.2)
- Heated slab-on-grade must have R-5 insulation below full slab (R402.1.2)
- Vertical access door U-factor modified (R402.2.4)
- Air Sealing and Insulation Installation Table modified (R402.4.1.1)
- Building envelope tightness testing standards added (R402.4.1.2)
- Open (atmospherically vented) combustion appliances must be installed in insulated, sealed rooms (R402.4.4)
- Total Duct Leakage Test required for duct tightness test (R403.3.3)
- Building cavities may be used as return ducts only under a limited number of conditions (R403.3.5)
- Ductwork insulation requirements modified (R403.3.6.1)
- How ducts in attic can be considered as located in conditioned space for use in the ERI compliance path (R403.3.7)
- Whole-house mechanical ventilation fan efficacy table modified (R403.6.1)
- High-efficacy lighting required in 90% of fixtures (R404.1)
- Energy Rating Index (ERI) compliance path added (R406)
- Existing buildings chapter added (Chapter R5)
- Optional Solar-Ready Appendix added (Appendix RA)

Major Montana Amendments that Have Not Changed

An air barrier must be located on the warm side of the building cavities (Amended definition in R202).

Prescriptive frame-wall insulation requirement is R-21 cavity or R-13 cavity plus R-10 continuous (Amended Table R402.1.2).

Maximum allowable envelope air leakage rate is 4 ACH50 (Amended R402.4.1.2).

The Family of Building Codes

The family of model building codes are developed by the International Codes Council (ICC) to work together. There are many energy-related aspects of residential construction that are contained in the International Residential Code (IRC) and the International Mechanical Code (IMC). Montana adopts chapters 1 through 10 and chapter 44 of the IRC. The state also adopts Section M1505 of the IRC. Most importantly, Montana adopts the IECC with amendments.

Solar Ready Appendix

Local jurisdictions may choose to adopt and enforce the Solar Ready Appendix included in the 2018 IECC. This appendix specifies a number of new construction steps that will reduce the difficulty and cost of installing solar electric systems at some time in the future. If the roof of the dwelling is shaded for more than 70% of annual daylight hours, then the house is exempted from the following requirements:

- Identify Solar-Ready Zone on roof (at least 600 ft^2, between 110° and 270° of true North) with no obstructions
- Roof load documentation
- Interconnection pathway
- Reserve electrical service space in main panel
- Documentation posted near electric panel

Construction Document Requirements (R103.2)

The 2018 IECC requires that the construction documents submitted for a building permit include "sufficient clarity to indicate the location, nature and extent of work proposed." The documents must provide adequate information and details to address compliance with all code provisions. Minimum information that must be included in construction documents includes:

- Insulation materials and R-value
- Fenestration U-factors
- Mechanical system design criteria
- Mechanical and service water-heating system and equipment types, sizes, and efficiencies
- Equipment and system controls
- Duct sealing, duct and pipe insulation, and location
- Air-sealing details

Required Inspections (R105.2)

The 2018 IECC includes much more detail about the inspections mandated by the energy code. Following is an outline of the inspections and the items that are to be inspected. Refer to the code language for full details.

Footing/Foundation Inspection

- ☐ R-value
- ☐ Location
- ☐ Thickness
- ☐ Depth of Burial & Protection

Framing/Rough-in Inspection

- ☐ Types of Insulation
- ☐ R-values (Location & Installation)
- ☐ Fenestration U-factor
- ☐ Air Leakage Controls

Mechanical Rough-in

- ☐ HVAC Equipment Type & Size
- ☐ Required Controls
- ☐ System Insulation & R-value
- ☐ System Air Leakage Control
- ☐ Programmable Thermostats
- ☐ Dampers
- ☐ Whole-house Ventilation
- ☐ Minimum Fan Efficacy

Final Inspection (Verification)

- ☐ Required Building Systems
- ☐ Equipment & Controls
- ☐ Systems Proper Operation
- ☐ High-Efficacy Lighting

Approved Inspection Agencies (R105.4)

The code official is authorized to accept reports of approved third-party inspection agencies. This provision was added at the same time as the Energy Rating Index (ERI) compliance path.

Definition
Approved. Acceptable to the code official.

Insulation Identification (R303.1)

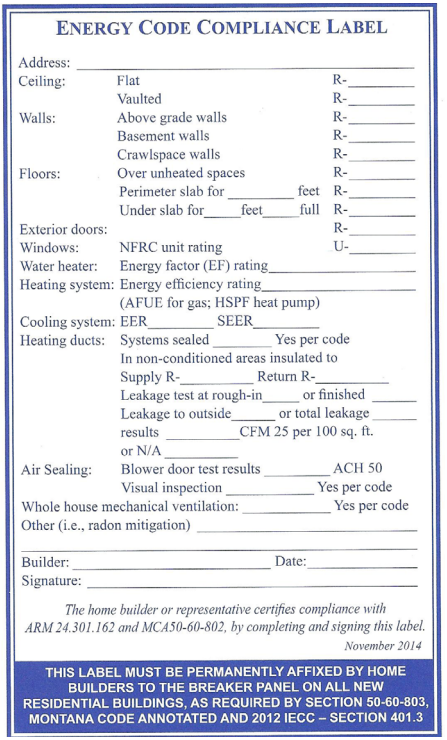
An R-value identification mark must be applied by the manufacturer to each piece of insulation 12 inches or greater in width. Insulation must be installed so that the manufacturer's R-value mark is readily visible. Blown or sprayed roof/ceiling insulation thickness must be written in inches on markers at least one every 300 square feet through the attic space in letters one inch high facing the attic access opening. Other insulation marking details can be found in the code.

Installation Per Manufacturer's Instructions (R303.2)

All materials, systems, and equipment must be installed according to the manufacturer's installation instructions. Manufacturer's installation specifications are an enforceable extension of the code.

Energy Label (R401.3)

The Energy Code Compliance Label (Certificate) is required in all new residential construction and is a way for the builder to certify that the house complies with the energy code. The label must be permanently affixed to the main electrical breaker panel by the builder. In self-certification areas of the state, the builder is required to provide a signed statement to the homebuyer that the house complies with the state energy code. A signed label developed by the Montana Energy Office can meet this requirement. Labels are available from the Montana Energy Office (406-444-6697). A copy may be downloaded at deq.mt.gov/energy and is shown on the following page.



ENERGY CODE COMPLIANCE LABEL

Address: _____

Ceiling:	Flat	R-_____
	Vaulted	R-_____
Walls:	Above grade walls	R-_____
	Basement walls	R-_____
	Crawlspace walls	R-_____
Floors:	Over unheated spaces	R-_____
	Perimeter slab for _____ feet	R-_____
	Under slab for____feet____full	R-_____
Exterior doors:		R-_____
Windows:	NFRC unit rating	U-_____
Water heater:	Energy factor (EF) rating_____	
Heating system:	Energy efficiency rating_____	
	(AFUE for gas; HSPF heat pump)	
Cooling system:	EER_____ SEER_____	
Heating ducts:	Systems sealed _____ Yes per code	
	In non-conditioned areas insulated to	
	Supply R-_____ Return R-_____	
	Leakage test at rough-in_____ or finished _____	
	Leakage to outside_____ or total leakage _____	
	results _____CFM 25 per 100 sq. ft.	
	or N/A _____	
Air Sealing:	Blower door test results _____ ACH 50	
	Visual inspection _____ Yes per code	

Whole house mechanical ventilation: _____ Yes per code

Other (i.e., radon mitigation) _____

_____

Builder: _____ Date: _____

Signature: _____

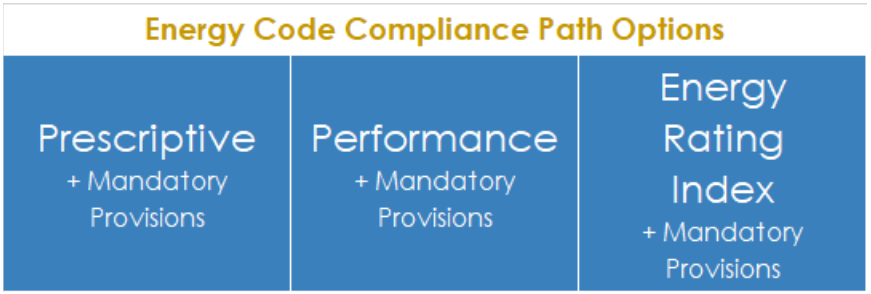
The home builder or representative certifies compliance with ARM 24.301.162 and MCA50-60-802, by completing and signing this label.

November 2014

THIS LABEL MUST BE PERMANENTLY AFFIXED BY HOME BUILDERS TO THE BREAKER PANEL ON ALL NEW RESIDENTIAL BUILDINGS, AS REQUIRED BY SECTION 50-60-803, MONTANA CODE ANNOTATED AND 2012 IECC – SECTION 401.3

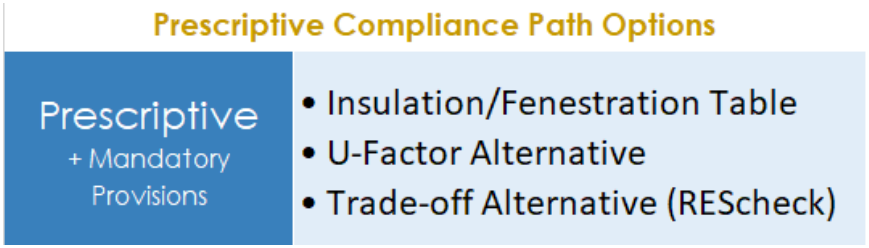
Compliance Path Options

New residential buildings must comply with all provisions of the energy code that are identified as *mandatory* in the IECC. In addition, the thermal envelope must comply with one of three compliance paths.



The *Prescriptive Path* includes three alternatives. The most familiar but least flexible prescriptive method is the *Insulation/Fenestration*

Table. Fenestration is just another word for windows and doors. The prescriptive Insulation/Fenestration Table is used for most new residential construction. This table lists the U-factor or nominal R-value for the building envelope components.



The *U-factor Alternative* method is based on a table comprised entirely of U-factors. Using the U-factor Alternative method, the entire component assembly must be considered in the calculations. When using the U-factor Alternative, the characteristics of the entire assembly are considered. For example, in a wall, the insulating characteristics of the air films, sheathing, framing members, and interior finish are included in the calculation.

The *Trade-off Alternative* method is also based on the table of U-factors but allows trade-offs between the different building envelope components. REScheck™ software is based on the Trade-off Alternative.

The *Performance* path is more flexible than the prescriptive path, but it requires very detailed inputs and analysis performed with a code-official-approved building simulation software. However, trade-offs between HVAC components and the building envelope are not allowed.

The *Energy Rating Index* (ERI) is a new compliance alternative that creates the option of complying with the code via a third-party inspection of the home. The RESNET Home Energy Rating System (HERS) already has such a rating tool. The ERI gives builders more flexibility in complying with the energy code and provides homebuyers with a better way to understand the energy efficiency of houses. The ERI is explained in more detail later in this publication. Trade-offs between HVAC and the building envelope are allowed.

Thermal Envelope

Prescriptive Insulation/Fenestration Table Compliance (R402.1.2)

The R-values in the Prescriptive Insulation/Fenestration Table refer only to the insulation and not to other components of the wall, ceiling, or floor assembly. Log, concrete block, and insulated concrete form walls must comply with the "mass" wall requirements.

Prescriptive Component Requirements

Component	Requirements	Remarks
Windows & Doors	**U-0.30**	
Skylights	**U-0.55**	
Ceiling	**R-49**	R-38 complies if uncompressed insulation extends over top of exterior wall top plates.
Wood Frame Wall	**R-21 or R-13+5**	First value is cavity insulation; second value, if present, is continuous insulation.
Mass Wall	**R-15/R-20**	Second value applies when more than half of R-value is on interior if mass wall.
Floor	**R-30**	Insulation that fills cavity (R-19 minimum) also complies.
Basement Wall	**R-15/R-19**	First value is continuous; second value is for framing cavity
Slab	**R-10, 4'**	Insulation must extend downward continuously from top of slab for 4 feet vertically or horizontally. For heated slabs-on-grade, R-5 required under full slab with R-10 at
Crawlspace Wall	**R-15/R-19**	First value is continuous inside or outside; second value is for insulation in framing cavity

R-value and U-factor Basics

R-values Measure Thermal Resistance

- R-values are additive (R-1 + R-1 = R-2)
- R-value is the inverse of U-factor (R=1/U and U=1/R)
- The higher the R-value, the greater the thermal resistance

U-Factors Measure Rate of Heat Loss

- The lower the U-factor, the greater the thermal resistance
- U-factors are not additive
- U-factors are used for windows, doors, and skylights

Window, Door, and Skylight U-Factors and Labels

In both the R-value and U-factor insulation and fenestration tables, window, door, and skylight values are given in terms of U-factor. The lower the U-factor, the better a product is at reducing heat loss. U-factor, when used for windows and skylights, takes into account more than conductive heat loss. It also includes air leakage. If a window, door, or skylight has no National Fenestration Rating Council (NFRC) label, then the code official is to assume the values given in the table in Section R303. The default values of this table do not meet the prescriptive requirements for fenestration or skylights. The maximum U-factor allowed for windows and doors in the 2018 IECC is 0.30. In addition to displaying the U-factor, the NFRC label includes several other characteristics. Only U-factor is a code requirement in Montana.

U-factor measures how well a product prevents heat from escaping or entering a home or building. The lower the U-factor, the better a product is at keeping heat in. U-factor is particularly important during the winter heating season.

Solar Heat Gain Coefficient (SHGC) measures how well glazing prevents the sun's heat from entering the house. SHGC is expressed as a number between 0 and 1. The lower the SHGC, the better a product is at blocking unwanted heat gain. Blocking solar heat gain is particularly important during the summer cooling season. Products with higher a SHGC may be preferred for passive solar designs.

Visible Transmittance (VT) measures how much light passes through glazing. VT is expressed as a number between 0 and 1. The higher the VT, the greater the potential for daylighting.

Air Leakage (AL) measures air leakage in a home or building through the product. AL rates typically fall in a range between 0.1 and 0.3. The lower the AL, the better a product is at keeping air out. AL is an optional rating, and manufacturers can choose not to include it on their labels.

Example NFRC Label

Frame Wall Insulation

The 2018 IECC requires a minimum of R-5 continuous insulation for frame walls. However, a Montana amendment allows either R-21 cavity insulation or R-13 cavity insulation plus R-5 continuous insulation in the prescriptive compliance path.

Definition

Continuous Insulation. Insulating material that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior, or is integral to any opaque surface, of the building envelope.

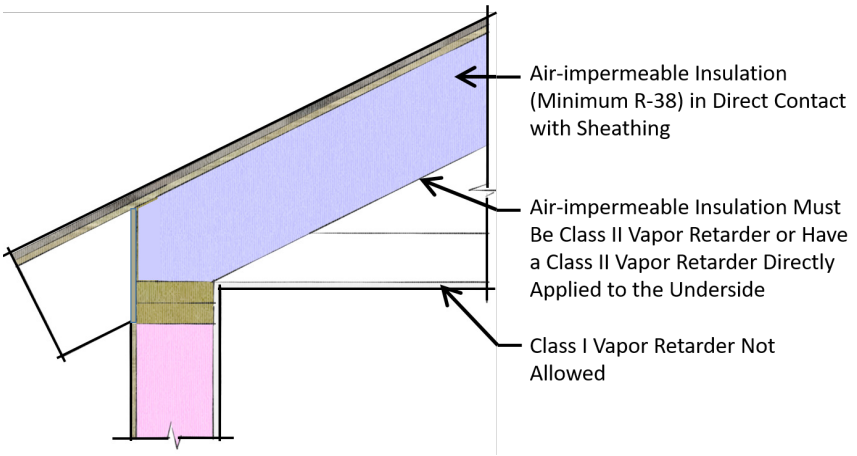
Vertical Access Doors (R402.2.4)

Vertical access doors, such as in attic knee walls, must comply with the fenestration requirements of Table R402.1.2 (U-0.30).

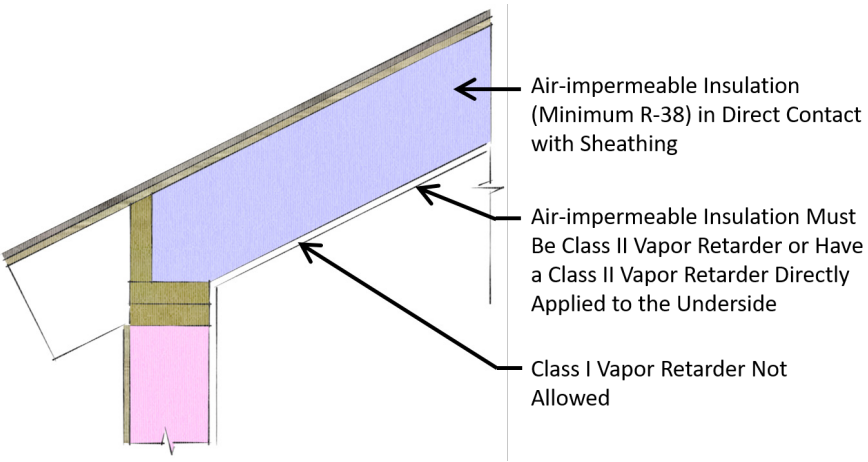
Unvented Attics and Cathedral Ceilings (IRC R806.5 and IECC R402)

Both the IRC and the IECC include provisions that affect unvented attics and cathedral ceilings. The following diagrams summarize those provisions. Examples of air-permeable insulation include fiberglass, cellulose, and low-density foam. An example of air-impermeable insulation is high-density foam. The IRC requires air-impermeable insulation of at least R-25 to control condensation. If the building is using the prescriptive compliance path, the total insulation R-value must comply with the prescriptive component requirement, either R-49 or R-38 if the full insulation R-value extends over the exterior walls.

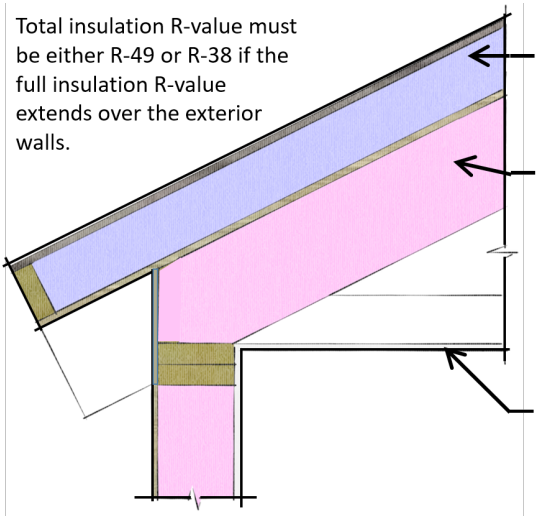
Unvented Attic: Air-impermeable Insulation Only (IRC R806.5)



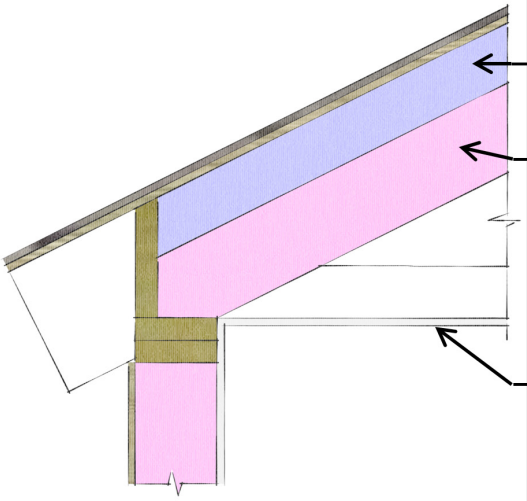
Unvented Rafter Space (IRC R806.5)



Unvented Attic: Air-impermeable Insulation Above Sheathing and Air-permeable Below Sheathing (IRC R806.5)



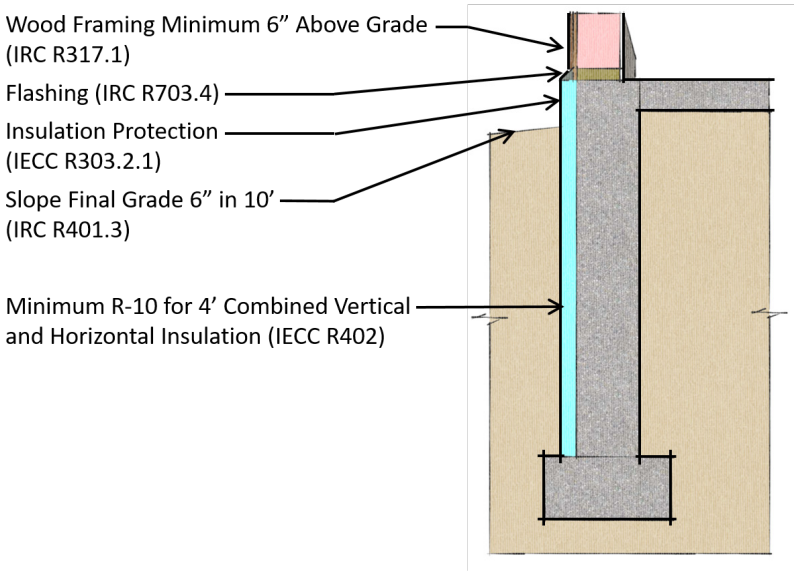
Unvented Attic: Air-impermeable Insulation Beneath Sheathing and Air-permeable Below (IRC R806.5)



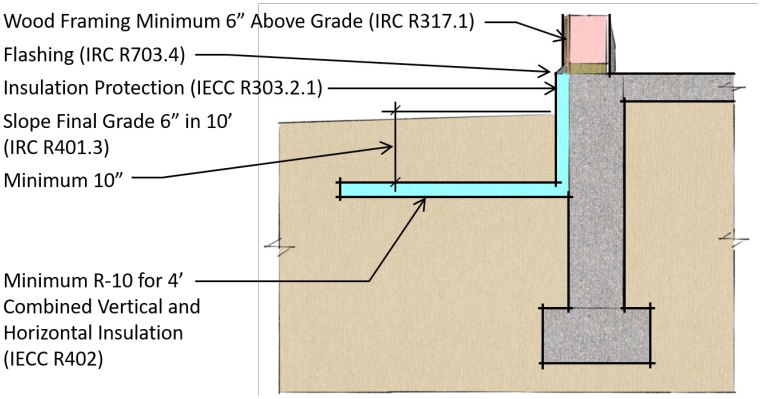
Conventional Slab-On-Grade Floors (R402.2.10 and Table R402.1.2)

The 2018 IECC establishes insulation values required for conventional slab-on-grade construction where the foundation wall extends below the frost line. The required R-10 insulation must extend down from the top of the slab on the inside or outside of the foundation wall. The insulation below grade must extend four feet vertically or horizontally or a combination of both, either under the slab or outward from the building. Insulation extending away from the building must be protected by pavement or a minimum of 10 inches of soil. The top edge of the insulation installed between the foundation wall and the edge of the interior slab may be cut at a 45° angle away from the exterior wall. The following figures illustrate conventional slab-on-grade approaches that comply with the code. Two of the figures illustrate how to provide the code-required insulation at concrete patio, porch, and walkway slabs. Heated slabs-on-grade must include R-5 insulation under the full slab and have R-10 insulation at the edge of the slab. Heated slabs include radiant heating systems with piping or electrical elements embedded in the slab itself. A slab-on-grade is 12 inches or less below grade.

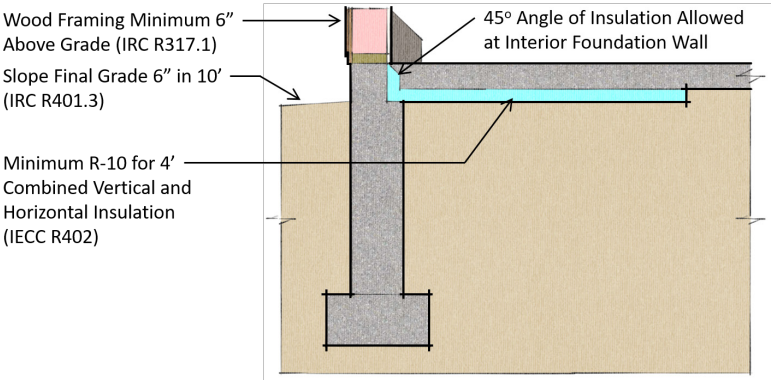
Slab-On-Grade: Exterior Vertical Insulation



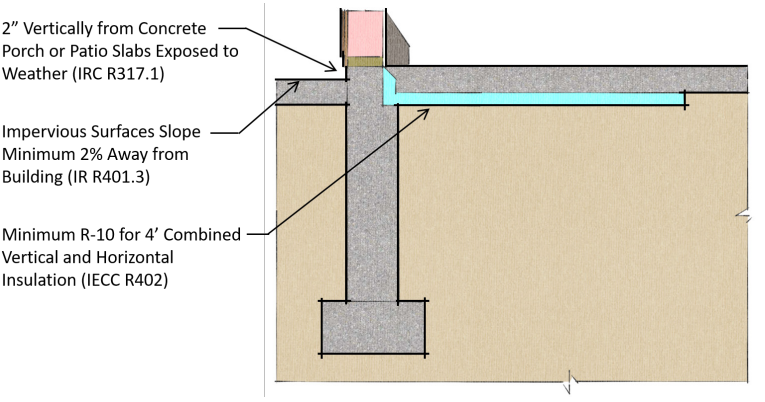
Slab-On-Grade: Exterior Vertical and Horizontal Insulation



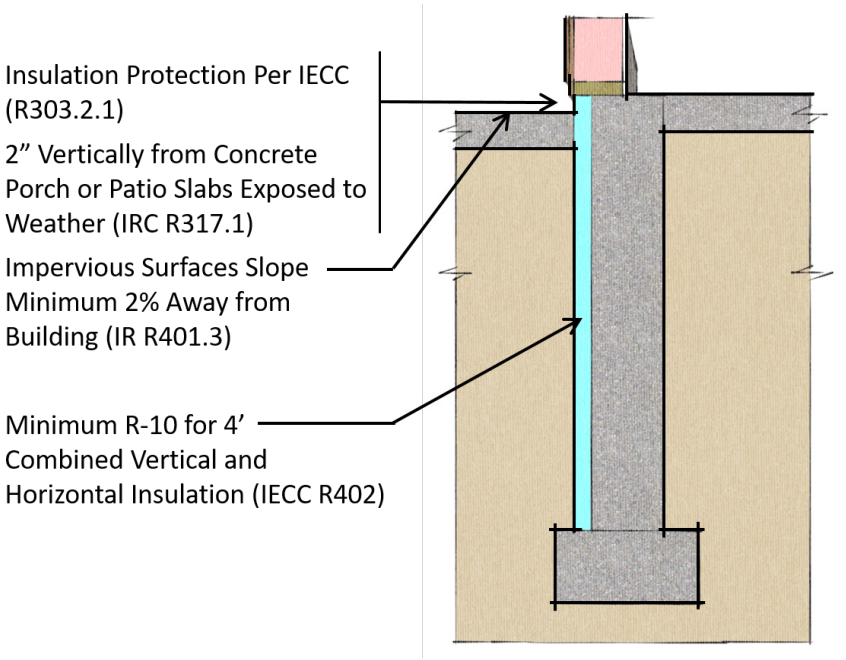
Slab-On-Grade: Interior Vertical and Horizontal Insulation



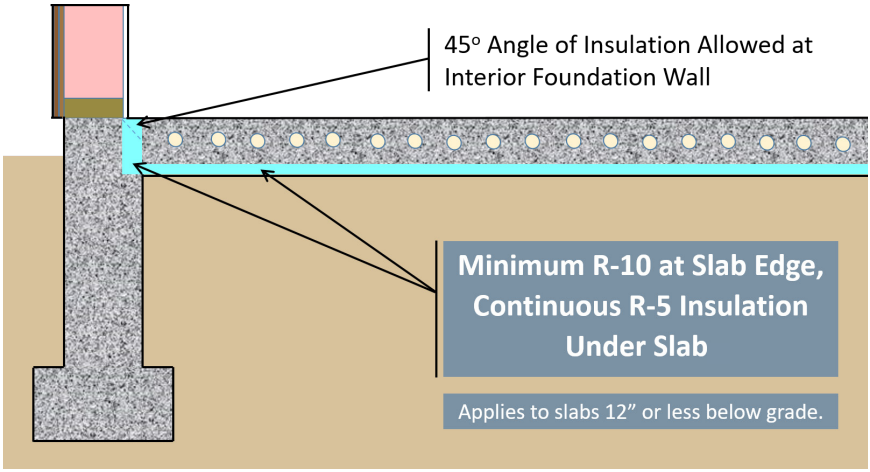
Slab-On-Grade: Exterior Vertical Insulation at Patio or Porch Slab



Slab-On-Grade: Exterior Vertical Insulation at Patio or Porch Slab



Heated Slab-On-Grade: R-5 Under Full Slab with R-10 Edge



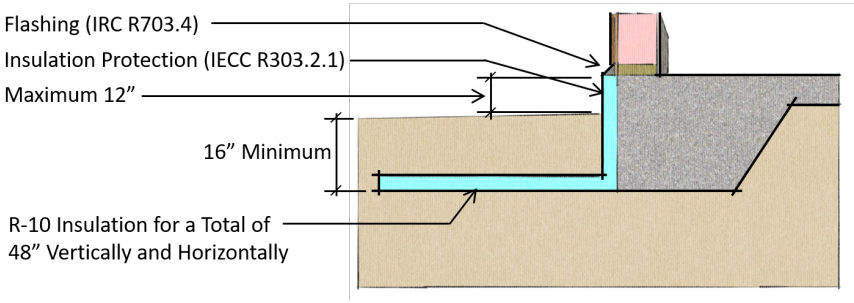
Frost-Protected Shallow Foundations (IRC R403.3)

A frost-protected shallow foundation (FPSF) is a practical alternative to conventional slab-on-grade construction. The conventional slab-on-grade requires a deeper, more-costly foundation in cold regions with seasonal ground freezing and the potential for frost heave. FPSF results in a shallower frost penetration depth around the building due to soil that has been warmed by both building and geothermal heat. The insulation around the foundation perimeter conserves and redirects heat loss through the slab toward the soil below the foundation. Geothermal heat from the underlying ground also helps to warm the soil and raise the frost depth around the building.

The FPSF is a special case that is addressed in IRC Section R403.3. A FPSF is only allowed in buildings where a monthly mean temperature is maintained at a minimum of 64°F. The heated building requirement makes common sense, as this foundation strategy is dependent on heat generated by the building warming the ground below the footing. The IRC specifies the vertical R-value, minimum depth of insulation, and horizontal R-values at corners and at non-corner walls. If the IECC insulation requirements exceed the IRC values for FPSF design, the IECC values apply. In other words, the greater of the insulation requirements apply. The R-10 insulation requirement, per the IECC, becomes the minimum R-value allowed for most counties in Montana.

There are seven Montana counties (Daniels, Phillips, Richland, Roosevelt, Sheridan, Valley) with an Air Freezing Index of 4,000 or greater. Refer to IRC Table R403.3(1) for insulation requirements for these counties. The Air Freezing Index of other counties is less than 4,000. The insulation values shown below are applicable in these counties. Refer to Table 403.3(2) in the IRC for the Air Freezing Index of Montana counties. The figure on the following page illustrates the key factors used in FPSF insulation placement and R-value requirements.

Frost-Protected Shallow Foundation Detail



Insulation materials used below grade must be labeled as complying with ASTM C578. The discussion here addresses stand-alone structures. The IRC includes more details and specific requirements when a FPSF is adjacent to a heated structure and when a FPSF is adjacent to an unheated slab-on-grade structure. Refer to IRC R403.

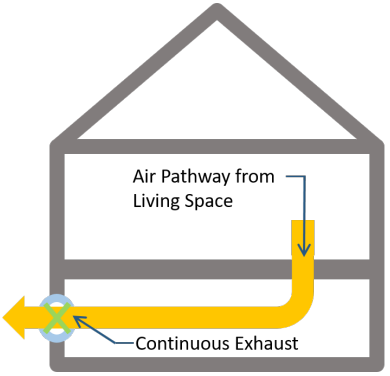
Unvented Crawlspaces (IRC R408.3)

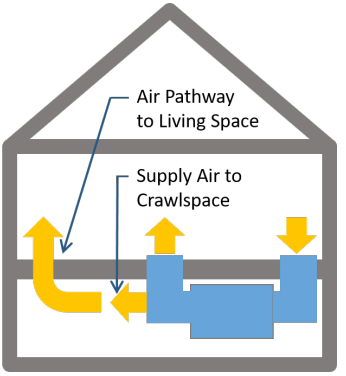
The IRC allows either vented or unvented crawlspaces. If the crawlspace is vented to the outside, the floor must be insulated. If the crawlspace is not vented to the outside, then the crawlspace walls must be insulated. The IRC goes on to allow two design options for an unvented crawlspace, either mechanically vented or minimally conditioned (a so-called *mini-basement*).

In either case, the required airflow is specified by the code and an air pathway to the house living space area is required. All unvented crawlspaces must have a continuous sealed Class I vapor retarder at exposed earth. This requirement is critical since radon, moisture, and other soil gases can find their way into the home without a sealed vapor retarder on the floor of the crawlspace. The vapor retarder must have six-inch overlaps that are sealed or taped and must extend six inches up the stem wall where it is mechanically fastened and sealed.

Unvented Crawlspace - Two Design Options

Continuous Exhaust to Exterior	Conditioned Air Supply
1 CFM/50 ft² Crawlspace Area Air Pathway from Living Space	1 CFM/50 ft² Crawlspace Area Air Pathway from Living Space





International Code Council (ICC) 400 Log Home Standard (R402.1)

The 2018 IECC exempts log homes from the envelope provisions of the IECC if the thermal performance provisions of ICC 400 are met. ICC 400 includes the thermal mass benefit of log walls. ICC 400 establishes the required thermal properties of building envelope components based on the average wall thickness and the specific gravity of a particular type of tree. The table that follows provides an example. The same testing (blower door) and air tightness requirements apply to log homes as for any other method of construction.

Insulation and Fenestration Requirements by Component
ICC 400 Table 305.1.2

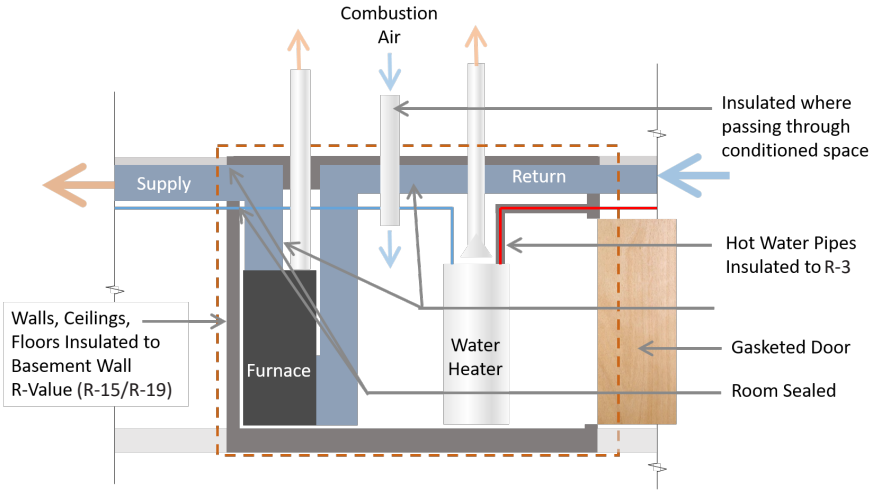
Log Wall Average Width	Fenestration U-Factor	Skylight U-Factor	Ceiling U-Factor	Wood Frame Wall R-Value	Floor R-Value	Basement/ Crawlspace Wall R-Value	Slab R-Value/ Depth	Heated Slab R-value
5" if SG ≤ 0.50 7" if SG ≤ 0.50	**0.33**	**0.6**	**49**	**20 or 13+5**	**30**	**15/19**	**15,4'**	**15**

Ponderosa Pine SG=0.4
Western Larch SG=0.52
Lodgepole Pine SG=0.41

Rooms Containing Fuel-Buring Appliances (R402.4.4)

Where open combustion air ducts provide combustion air to open combustion fuel burning appliances, the appliances must be enclosed within a sealed and insulated room. The walls, ceiling, and floor must, at a minimum, meet the basement wall R-value requirement (R-15 continuous or R19 caviy). The door must be fully gasketed. Water lines and ducts within the room must be insulated per R403. Where the combustion air duct passes through conditioned space it must be insulated to at least R-8.

Rooms Containing Fuel-Buring Appliances



Air Barrier and Insulation Installation (Table R402.4.1.1)

The air barrier and insulation installed in the building thermal envelope must comply with Table R402.4.1.1. The table details how insulation and the air barrier are to be installed. This table is included in the Energy Code Checklist at the end of this publication.

Building Air Leakage (R402.4)

All dwelling units must pass a building tightness (blower door) test, as well as comply with the air barrier provisions of the Insulation and Air Barrier Installation Table (Table R402.4.1.1). Montana amended the air

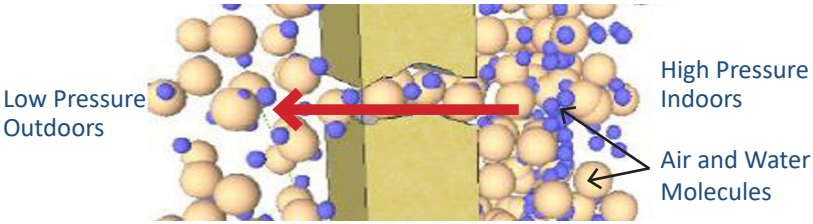
barrier definition by inserting the words “and into.” The purpose of this amendment is to require that an air barrier be installed on the warm side of the wall, ceiling, or floor.

Building Tightness Testing (R402.4.1.2)

The 2018 IECC requires that the building tightness test be performed according to one of three standards. ICC/RESNET Standard 380 is the most user-friendly of the three standards and also includes procedures for conducting duct tightness testing and for measuring exhaust ventilation airflow. The building tightness testing procedures required by the three standards are similar. All three standards require more detailed reporting and adjustments for outside air temperature and altitude under certain conditions.

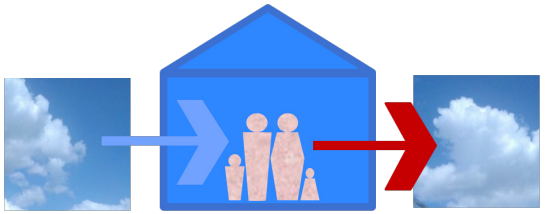
Air and Water Vapor Movement

Air and water vapor moves from areas of high pressure to areas of low pressure. During the heating season in Montana, less dense, warmer air in a home can create greater pressure inside the home than outside, causing house air, along with water vapor, to then move into building cavities. Water vapor moves into building cavities by air transport (air leaks) and diffusion (molecules of water vapor passing through seemingly solid materials). Air transport is many times more significant than diffusion. Vapor retarders minimize diffusion. Air barriers minimize air transport.



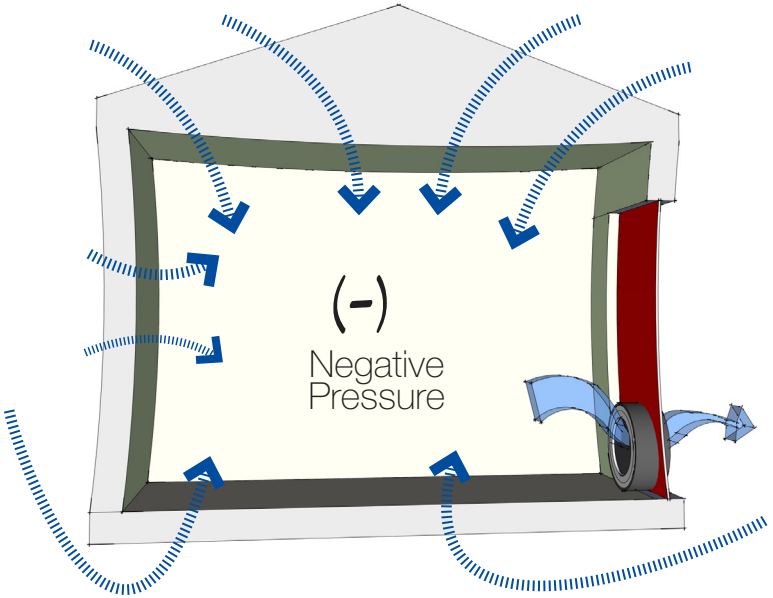
Air In = Air Out

A fundamental principal of physics is that the air exhausted from a volume is equal to the air entering the volume. This principle is the basis of house and duct tightness testing.



Air in = Air out

Depressurization Building Tightness Test



While the blower-door testing procedure is not complex, it requires care to properly set up the house and configure the digital manometer. The blower-door test procedure includes closing all exterior doors and windows and disabling all combustion appliances and exhaust fans.

In a blower door test, an exterior door is fitted with a nylon skirt that includes an opening for a large fan. For new construction, it is most common to perform a depressurization test. The blower door fan exhausts air from the house until the home has a negative pressure of 50 Pascals (Pa) with reference to the outside. Fan opening size and speed are used to create a 50 Pa pressure difference. The airflow out of the house through the blower door fan is equal to the amount of air leaking into the house through the envelope and exterior ducts. A digital manometer is used to measure the indoor pressure with reference to the outdoors and fan airflow. The airflow measurement at 50 Pa is used to calculate the air change rate for the house.

Blower Door Math

To calculate air changes per hour at 50 Pascals

$$ACH50 = \frac{CFM50 \times 60}{House\ Volume}$$

House volume is cubic feet enclosed by the thermal envelope including exterior walls.

Multi-Family Building Air Tightness Testing

In a building envelope tightness test of a single-family home, all measured air leakage is to the outside. In multifamily buildings, it is a challenge to measure leakage to the outside without including leakage to the adjacent interior spaces. It is air leakage to the outside that is important for energy use and code compliance.

The energy code offers no guidance on how to conduct multifamily building envelope air leakage tests. However, the Residential Energy Services Network (RESNET) has developed a document titled *RESNET Guidelines for Multifamily Energy Rating* that discusses the testing options. Any building, including apartments and condominiums, with more than three stories above grade must follow the IECC building tightness provisions for commercial buildings.

Systems

Thermostats (R403.1)

A separate thermostat must be provided for each heating and cooling system. A programmable thermostat must control the primary heating and cooling system.

Duct Insulation (R403.3.1)

Language in the 2018 IECC makes duct insulation requirements dependent on location and the diameter of the duct. The 2018 IECC requires that supply and return ducts in the attic must be a minimum of R-8 (where ≥ 3-inch diameter) and R-6 (where < 3-inch diameter). Supply and return ducts elsewhere outside the thermal envelope must be a minimum of R-6 (where ≥ 3-inch diameter) and R-4.2 (where < 3-inch diameter). There is an exception that allows for ducts, or portions of ducts, located completely inside conditioned space to be uninsulated. The 2018 IECC directly addresses ducts buried in insulation. Buried ducts can be considered in conditioned space, for purposes of the ERI, if the maximum leakage rate is less than or equal to 1.5 cfm/100 ft^2 and if the total ceiling insulation against and above the duct is equal to the prescriptive value for the attic insulation plus the required duct insulation.

Duct Insulation Requirements

	Duct Diameter	
Location	**≥ 3 inches**	**< 3 Inches**
Conditioned Space	NA	NA
Vented Attic	R-8	R-6
Vented Crawlspace	R-6	R-4.2
Conditioned Crawlspace	NA	NA
Conditioned Basement	NA	NA
Unconditioned Basement	R-6	R-4.2
Exterior Walls	R-6	R-4.2

Duct Sealing (R403.3.2)

Ducts, air handlers, and filter boxes must be sealed. Joints and seams must comply with the IMC. A common error is applying mastic too thin. Most manufacturers' instructions call for mastic to be applied about as thick as a nickel.

Duct Testing (R403.3.3)

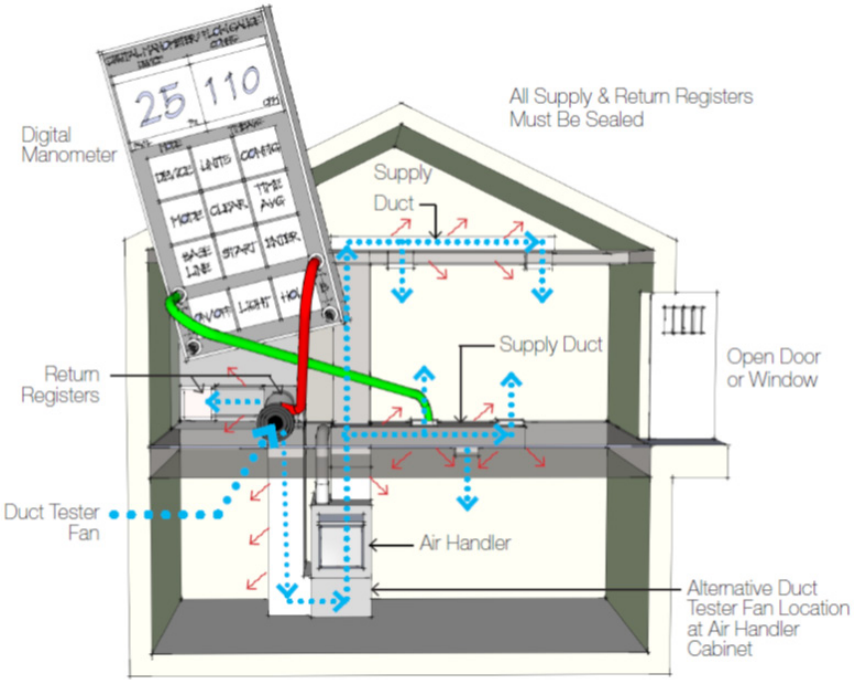
A duct tightness test involves using a fan to pressurize the duct system to measure how much air leaks out through cracks and holes. The supply and return registers are sealed for the test. In the industry, there are two types of duct tightness tests. The *Total Duct Leakage Test* measures leakage from the entire duct system regardless of whether it is located inside or outside the conditioned space. The Montana energy code now requires that a Total Duct Leakage Test be conducted to determine duct tightness. The other type of test that was allowed under the previous state energy code is the *Duct Leakage to the Outside Test*, which isolates leaks that are outside the thermal envelope and is required for an ERI energy code compliance analysis. The Total Duct Leakage Test is simpler and takes less time to perform than the Duct Leakage to the Outside Test.

A duct tightness test is not required by code if the air handler and all ducts are located inside the building thermal envelope. The code allows ducts to be located outside the building thermal envelope but installing all ducts inside eliminates the need for duct tightness testing and reduces energy use.

Total Leakage Test Procedure Summary

The IECC provides no instructions or reference standards about how to perform a duct tightness test. ICC/RESNET Standard 380 provides industry accepted best practice procedures. All supply and return registers are sealed. The tester fan is attached at the air-handler cabinet or the return register nearest the air handler. The airflow required to bring the duct system to 25 Pa pressure with reference to the house is equal to the air leaking out of the duct system at that pressure.

Total Duct Leakage Test Setup



The Total Duct Leakage Test may be performed after the system has been installed or during rough-in, with or without the air handler. The leakage limits are based on the conditioned floor area. The leakage limits are:

Rough-in Test with Air Handler Installed
≤ 4 CFM/100 ft^2 at 25 Pa

Rough-in Test without Air Handler Installed
≤ 3 CFM/100 ft^2 at 25 Pa

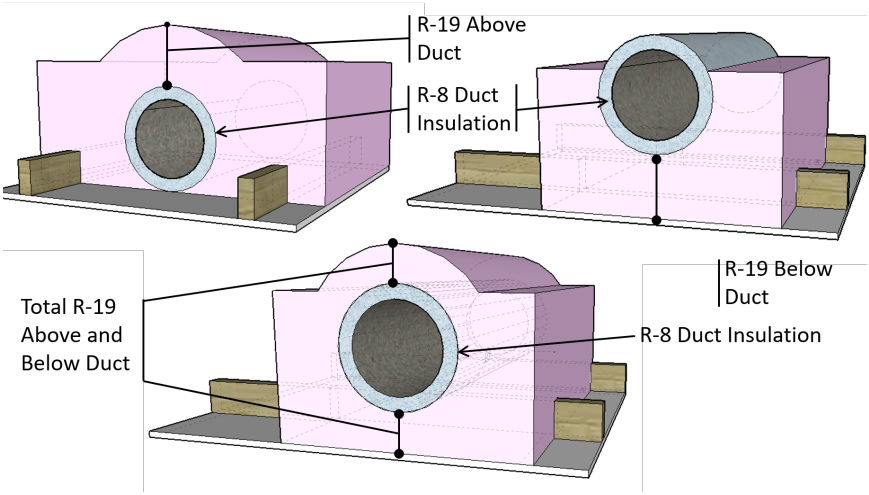
Postconstruction Test
≤ 4 CFM/100 ft^2 at 25 Pa

Note: Testing is not required if ducts and air handler are located entirely within the building thermal envelope.

Buried Ducts within Ceiling Insulation (R403.3.6)

Prior to the 2018 edition, the IECC did not prohibit buried ducts, but neither did it define the practice or make specific allowance for it. New 2018 IECC provisions detail duct insulation when ducts are buried in insulation. The diagram that follows illustrates the new provisions under three configurations.

Ducts Buried Within Ceiling Insulation



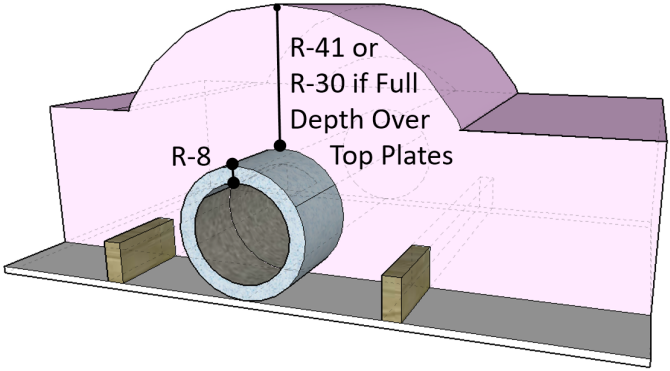
Ducts Considered in Conditioned Space (R403.3.7)

There are two conditions in which ducts may be considered within conditioned space for purposes of the ERI compliance path analysis:

1) Buried ducts can be considered in conditioned space if the air handler and ducts are entirely within the air barrier and thermal envelope.

2) Buried ducts can be considered in conditioned space if installed according to the buried duct requirements illustrated by the figure on the following page, the maximum leakage to the outside rate is less than or equal to 1.5 cfm/100 ft^2 served by the duct system, and the total ceiling insulation R-value against and above the duct is equal to the prescriptive value for the attic plus the required duct insulation.

Duct Considered in Conditioned Space



Building Cavities Used as Ducts (R403.3.5 as amended)

Building framing cavities may not be used as supply ducts, but may be used as return ducts if there is no atmospherically vented furnace, boiler, or water heater located in the house outside a sealed and insulated room complying with R402.4.4 and if the total duct system leakage has been tested to no greater than 4 cfm/ft^2.

Hot Water Pipe Insulation (R403.5.3)

R-3 Insulation is required for the following:

- Piping 3/4 inch and larger in diameter
- Piping serving more than one dwelling unit
- Piping located outside conditioned space
- Piping from the water heater to a distribution manifold
- Piping located under a floor slab
- Buried piping

- Supply and return piping in recirculating systems other than demand recirculation systems

Whole-House Mechanical Ventilation (R403.6, IRC M1505)

The 2018 IECC requires whole-house mechanical ventilation, as well as local ventilation. In some cases, exhaust fans or a heat recovery ventilator may serve both purposes. Montana allows either Section 1505 of the IRC or IMC Section 403 to be used in complying with the mechanical ventilation code requirements. The requirements of both are similar, but IRC Section 1505 is more user-friendly.

Since the fans associated with a whole-house mechanical ventilation system will be operating continuously or for a significant number of hours, the code requires the use of efficient fans. The table below specifies the efficacy of the fans that provide the required whole-house mechanical ventilation. The 2018 IECC added minimum efficacy values for heat recovery ventilators (HRV) and energy recovery ventilators (ERV).

Whole-House Ventilation Fan Efficacy

Fan Location	Minimum Airflow Rate (CFM)	Minimum Efficacy	Maximum Airflow Rate (CFM)
HRV or ERV	Any	1.2 CFM/Watt	Any
Range Hoods	Any	2.8 CFM/Watt	Any
In-line Fan	Any	2.8 CFM/Watt	Any
Bathroom, Utility Room	10	1.4 CFM/Watt	< 90
Bathroom, Utility Room	90	2.8 CFM/Watt	Any

IRC Table M1505.4.3(1) specifies the minimum required whole-house continuous ventilation airflow based on floor area and number of bedrooms in the house. The code states that the ventilation may be either exhaust or supply airflow. It should be noted that a supply-only ventilation system is inappropriate for the Montana climate. Exhaust air may not discharge into the attic, crawlspace, or other spaces inside the building. Whole-house mechanical ventilation systems must be provided with manual override controls.

Continuous Whole-House Mechanical Ventilation System Airflow Requirements (Table M1505.4.3(1))

DWELLING UNIT FLOOR AREA (Square Feet)	NUMBER OF BEDROOMS				
	0-1	2-3	4-5	6-7	> 7
	Airflow in CFM				
< 1,500	30	45	60	75	90
1,501 - 3,000	45	60	75	90	105
3,001 - 4,500	60	75	90	105	120
4,501 - 6,000	75	90	105	120	135
6,001 - 7,500	90	105	120	135	150
> 7,500	105	120	135	150	165

For example, a house with conditioned floor area of 2,500 ft^2 that has three bedrooms would require 60 CFM of continuous ventilation, based on the table above.

The minimum ventilation table values did not change in the 2018 IRC, but a formula was added to allow a more precise calculation option.

Ventilation Rate (CFM) = (0.01 x Floor Area in ft^2) + [7.5 x (Number of Bedrooms + 1)]

Using this formula instead of the table, the 2,500 ft^2, three-bedrooom house would require 55 CFM of whole-house mechanical ventilation.

CFM = (0.01 x 2,500 ft^2) + [7.5 x (3 Bedrooms +1)] = 55 CFM

Intermittent Whole-House Ventilation

If the home uses intermittent whole-house mechanical ventilation, then the capacity of the ventilation system must be increased. For example, if the ventilation system will operate only 50% of the time, the capacity of the system must be increased by a factor of 2, per the following table. The ventilation must operate at least 25% of each four-hour period.

Intermittent Whole-House Mechanical Ventilation Rate Factors

(Table M1505.4.3(2))

Run-Time Percent in Each 4-Hour Segment	25%	33%	50%	66%	75%	100%
Factor	4	3	2	1.5	1.3	1.0

Local Exhaust Ventilation

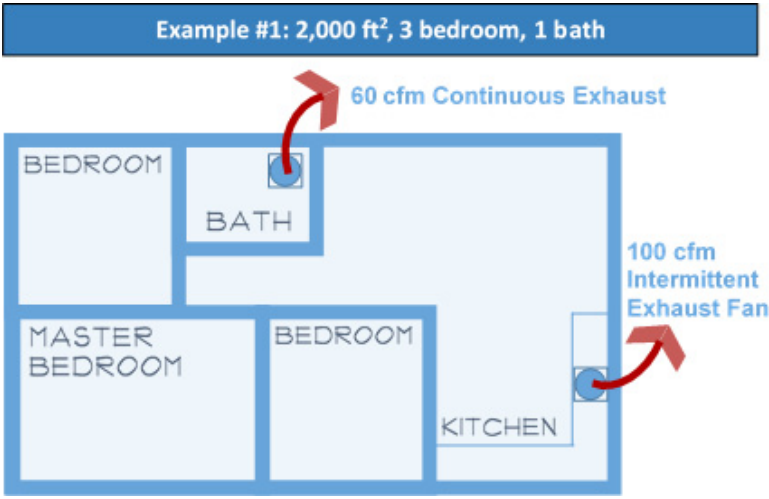
In addition to the whole-house mechanical ventilation, the code also requires local exhaust in kitchens and bathrooms. Kitchens must have either a 100-CFM intermittent exhaust fan or a 25-CFM continuous exhaust fan. Each bathroom must have either a 50-CFM intermittent exhaust fan or a 20-CFM continuous exhaust fan. If continuous exhaust is used to also comply with the local exhaust requirement, it may also be counted toward whole-house mechanical ventilation. Intermittent local exhaust fans may be controlled manually by an on-off switch, a crank timer, or other controls, such as a dehumidistat.

Minimum Required Local Exhaust Rates

Area to Be Exhausted	Exhaust Rates
Kitchens	100 CFM intermittent or 25 CFM continuous
Bathrooms-Toilet Rooms	Mechanical exhaust capacity of 50 CFM intermittent or 20 CFM continuous

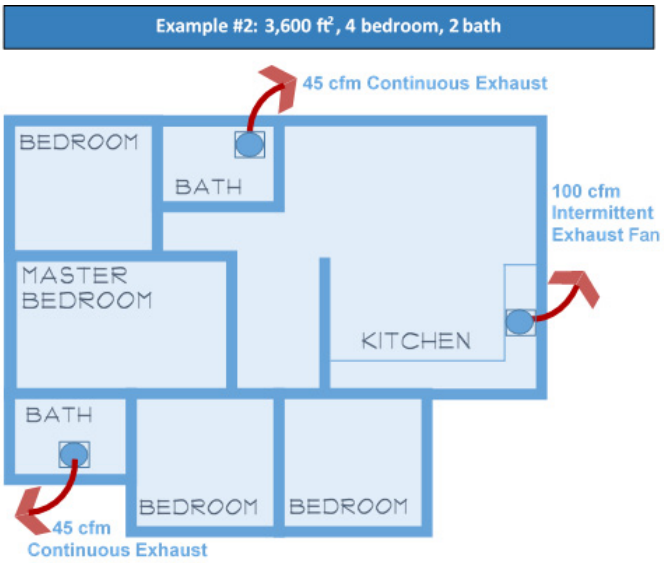
Ventilation Example #1: 2,000 ft^2, 3 Bedrooms, 1 Bath

Assume a 2,000 ft^2 single-story, three-bedroom house. This house requires 60 CFM of continuous whole-house ventilation based on the minimum ventilation table. The house could comply with code by installing a continuous 60-CFM exhaust fan in the bathroom and a 100-CFM intermittent exhaust fan in the kitchen. The bathroom fan provides both the whole-house ventilation and the local exhaust ventilation required for the bathroom.



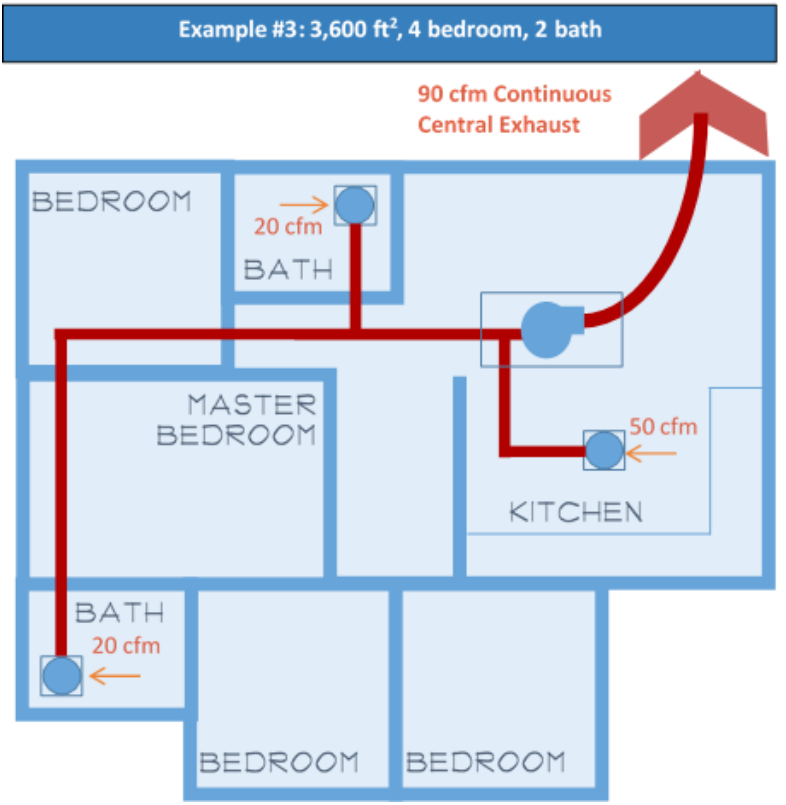
Ventilation Example #2: 3,600 ft², 4 Bedroom, 2 Bath

Assume a four-bedroom, 3,600 ft², single-story house. This house requires 90 CFM of continuous whole-house ventilation, according to the ventilation table. One way to accomplish this is to install a continuous 45-CFM exhaust fan in each of the two bathrooms and a 100-CFM, manually controlled exhaust fan in the kitchen. The bathroom exhaust fans provide both the required whole-house ventilation and the required bathroom local exhaust.



Ventilation Example #3: 3,600 ft^2, 4 Bedroom, 2 Bath

Example #3 illustrates another code-compliant ventilation solution for the same four-bedroom, 3,600 ft^2, single-story home. A central-exhaust system would continuously exhaust 20 CFM from each of the two bathrooms and 50 CFM from the kitchen. This satisfies both the whole-house airflow requirement and the local exhaust requirement. A central-exhaust system could include heat recovery with an HRV.

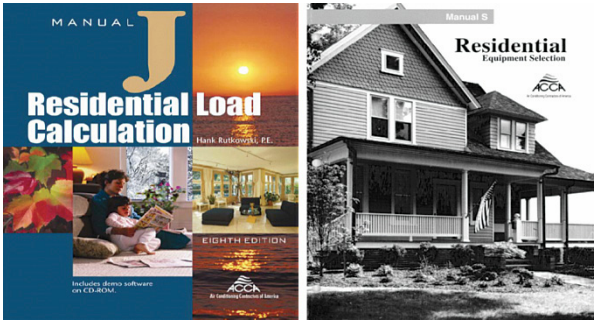


Equipment Sizing (R403.7)

Heating and cooling equipment must be sized in accordance with Air Conditioning Contractors of America (ACCA) *Manual S* based on loads calculated according to ACCA *Manual J*. The 2018 IECC requires that mechanical equipment type, sizes, and efficiencies be included in

construction documents submitted for the building permit. Oversizing equipment results in short cycling, which can reduce equipment life, reduce efficiency, reduce filter effectiveness, and result in poor dehumidification during the cooling season.

ACCA Manuals J and S



Mechancial Systems Serving Multiple Dwelling Units (R403.7)

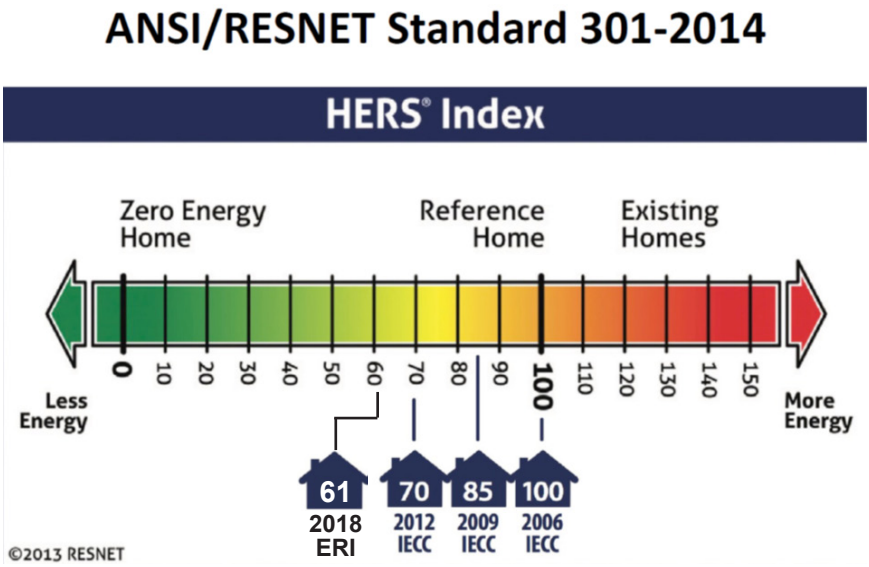
Systems serving multiple dwelling units must comply with Sections C403 and C404 in the commercial portion of the IECC, rather than Section R403 of the residential provisions.

Lighting

The lighting provisions of the energy code have changed. The 2018 IECC requires that a minimum of 90% of all permanently installed lighting fixtures contain only high-efficacy lamps. The language of this provision is now based solely on fixtures and not on lamps. The low-voltage lamps exception has been eliminated from the code. As the cost of LED lamps and fixtures has decreased, compliance with the lighting requirements of the energy code has become less challenging.

Energy Rating Index (ERI)

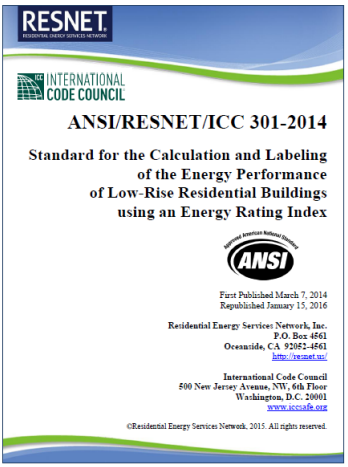
The Energy Rating Index (R406) may be the most significant change in the 2018 IECC for Montana builders and designers. The ERI compliance path is a major step toward a performance-based energy code. The ERI is an optional compliance alternative that allows compliance via a third-party analysis and inspection of the home to assess its efficiency. The Residential Energy Services Network Home Energy Rating System (RESNET HERS) is already used on nearly one-third of all new homes built in this country. The ERI compliance alternative is based on the HERS system, but the code does not preclude an alternative system being developed in the future. The ERI provides builders more flexibility in complying with the energy code and gives homebuyers a better way to understand the energy efficiency of houses. Due to differences in how ventilation is treated, an ERI score may not agree with a traditional HERS Rating score.



The *Simulated Performance Compliance Alternative*, which has been available for many years in the energy code, provides greater flexibility than the prescriptive compliance approach, but does not allow trade-offs between the heating and cooling systems and the building envelope, as the ERI does. Unlike the Simulated Performance approach, the final ERI score is based on field verified inspections and tests.

Mandatory Provisions. In addition to meeting the ERI score, the building must comply with all provisions in Sections R401 through R404 that are labeled *mandatory.* (R406.2)

ERI Standard. The ERI must be performed in accordance with *RESNET/ICC 301-2019 Standard for the Calculation and Labeling of the Energy Performance of Dwelling and Sleeping Units Using an Energy Rating Index.*


RESNET
RESIDENTIAL ENERGY SERVICES NETWORK
INTERNATIONAL CODE COUNCIL
ANSI/RESNET/ICC 301-2014
Standard for the Calculation and Labeling of the Energy Performance of Low-Rise Residential Buildings using an Energy Rating Index
ANSI
First Published March 7, 2014
Republished January 15, 2016
Residential Energy Services Network, Inc.
P.O. Box 4561
Oceanside, CA 92052-4561
http://resnet.us/
International Code Council
500 New Jersey Avenue, NW, 6th Floor
Washington, D.C. 20001
www.iccsafe.org
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Maximum Rating Score. The ERI provides a metric of a home's energy efficiency on a scale from 0 to 100, where 0 is a net-zero energy home and 100 is a home that complies with the 2006 IECC. Homes following this compliance path in Montana must achieve an ERI of 61 or lower. The lower the ERI values, the more efficient the home.

Building Envelope Backstop. For buildings using the ERI for compliance that do not take credit for on-site renewable energy, the building envelope characteristics may not be less efficient than the prescriptive values of the 2009 IECC. For ERI buildings that do take credit for on-site renewable energy, the building envelope characteristics may not be less efficient than the prescriptive values of the 2015 IECC.

Approved Third Party. The ERI verification must be completed by an third party approved by the building official. (R406.5)

Compliance Software. The software used for determining the ERI must comply with RESNET/ICC 301. (R406.6.1)

Compliance Report. The compliance report and other necessary documentation is specified in R406.6.2 and R406.6.3.

Existing Buildings

Existing Buildings – Additions, Alterations, and Repairs (Chapter 5)

The 2018 IECC includes a separate chapter that addresses existing buildings, including additions, alterations, and repairs. The new language clarifies how the energy code applies to existing buildings. These clarifications are especially useful as they apply to roof repair, roof recover, and roof replacement.

This new chapter has separate sections that address additions, alterations, and repairs. The chapter also addresses a change of occupancy. Although the addition of this chapter is a significant organizational change for the IECC, it did not change the intent of the code or the actual code requirements. It simply restructured those requirements to make them easier to understand and apply. Following are some of the most significant provisions of the Existing Buildings chapter.

What Must Comply? The energy code does not apply retroactively to existing buildings. It permits additions and alterations without requiring the existing building to comply with the current code. However, the additions and alterations themselves must comply. There are some exceptions. (R501.2)

Compliance in Historic Buildings. Alteration, repair, or change of occupancy to an historic building must comply with the energy code unless the code provision would threaten or destroy the reason the building is historic. Where there is such a finding, only that provision may be waived. The remainder of the energy code still applies. (R501.6)

Additions. All additions to an existing building must comply with the energy code. Additions and alterations may not cause the existing portion of the building to be any less in compliance than before the changes. The code considers any increase in conditioned space to be an addition. This includes additional conditioned floor area or increased enclosed space height. The enlarged portion of a room must comply with the code. An unconditioned space, such as a garage or attic or basement, that is remodeled as living space is considered an addition. (R502.1)

An Addition's Building Envelope. The building envelope of an addition must comply with the energy code. The existing portion of the building is not required to comply with the code. However, the code provides an alternative compliance path where the Total UA (combined U-factor of all building envelope components multiplied by their area) of the building, including the addition, does not exceed the Total UA of the existing building. (R502.1.1.1)

Heating and Cooling Systems in Additions. The heating and cooling systems in additions must comply with the energy code including duct tightness testing. There is an exception to the duct tightness testing requirement if there is less than 40 linear feet of duct located outside the thermal envelope that is an extension to the existing system. If the addition requires the replacement or increased size of the existing

heating or cooling equipment, then the new or modified equipment must comply with the code. (R502.1.1.2)

Alterations. Alterations must comply with the energy code as new construction. Alterations are changes in the building that include renovations, such as rearrangement of interior partition walls. Replacement of damaged materials is considered a repair and is not subject to the energy code in general.

Alteration Exceptions. The following are alterations that **do not** have to comply with the energy code. These exceptions apply only if the use of energy in the building does not increase. (R503.1.1)

1. Storm windows installed over existing windows.
2. Existing ceiling, wall, or floor cavities exposed during construction if the cavities are filled with insulation.
3. Construction where the existing roof, wall, and floor cavity is not exposed.
4. Reroofing (roof recover).
5. Roofs without insulation in the cavity and where the sheathing or insulation is exposed shall be insulated above or below the sheathing. This exemption addresses roofs that have insulation directly above or below the roof sheathing.
6. Window film applied to existing windows.

Lighting in Alterations. In alterations, the 90% high-efficacy lighting requirement for fixtures does not take effect unless 50% or more of existing light fixtures are replaced. (R503.1.4)

Change of Occupancy. If a building or a space within the building undergoes a change of occupancy that results in an increase in energy demand, then the building or space within the building must comply with the energy code. An exception is made for projects using the Simulated Performance compliance option, such that a building or space within a building is allowed a 10% increase in annual energy cost. (R505)

Montana Energy Code Checklist (Based on the 2018 IECC)

☑ Approved at plan review. ☒ Approved By field inspection N/A Does not apply to this project.

Date Builder

House Address City

Type: ☐ New Construction ☐ Addition ☐ Renovation/Alteration

Compliance: ☐ Prescriptive Table ☐ Prescriptive UA Tradeoff (RESCheck) ☐ Performance ☐ ERI

☑ ☒ N/A	Component	Code Provision	Prescriptive Code Value	RESCheck Tradeoff Value	2012 IECC Code Section
		Pre-Inspection/Plan Review			
☐ ☐ ☐	Construction Documents	Construction drawings sufficiently demonstrates energy code compliance			R103.2
☐ ☐ ☐	HVAC Load Calculations	HVAC loads sized according to *ACCA Manual J*			R403.7
		Footing and Foundation Inspection			
☐ ☐ ☐	Unheated Slab	Unheated slab edge insulation R-value	R-10		R402.1. R402.2.10
☐ ☐ ☐		Vertical + horizontal from top of slab	4 ft		
☐ ☐ ☐	Heated Slab-On-Grade	Heated slab (Slab edge/Below full slab)	R-10/R-5		R402.2.10
☐ ☐ ☐	Basement Wall Exterior Insulation	Continuous exterior insulation	R-15		R402.2.9
☐ ☐ ☐		Insulation depth (or to basement floor)	10 ft		
☐ ☐ ☐	Crawl Space	Continuous, exterior	R-15		R402.2.11
		Framing and Rough-in Inspection			
☐ ☐ ☐	Insulation Labeling	Installed insulation labeled and observable for inspection			R303.1
☐ ☐ ☐	Windows & Doors	Area weighted average (max. value)	U-0.30		R402.3.5
☐ ☐ ☐	Skylight	U-factor (max. value)	U-0.55		R402.3.5
☐ ☐ ☐	Fenestration	Windows, doors, and skylights certified and labeled			R402.3.5
☐ ☐ ☐	Fenestration	Infiltration rate maximum for windows, skylights, and sliding doors	0.3 CFM/ft^2		R402.4.3
☐ ☐ ☐	Fenestration	Infiltration rate maximum for swinging doors	0.5 CFM/ft^2		R402.4.3
☐ ☐ ☐	Fenestration	Windows, doors, and skylights air leakage listed and labeled			R402.4.3
☐ ☐ ☐	Ceiling Insulation	Ceiling insulation R-value	R-49		R402.2.1
☐ ☐ ☐		If full thickness over wall top plates	R-38		R402.2.1
☐ ☐ ☐	Attic Access Hatch	Hatch door insulation	R-49		R402.2.4
☐ ☐ ☐	Framed Wall Insulation	Framed wall	R-21		R402.1
☐ ☐ ☐		Exterior framed wall + continuous	R-13+R-5		R402.1
☐ ☐ ☐	Exterior Wall	Vapor retarder installed per IRC R702.7			402.1.1
☐ ☐ ☐	Mass Wall	More than 50% of insulation on interior	R-20		R402.2.5
☐ ☐ ☐		Less than 50% of insulation on interior	R-15		R402.2.5

Notes _____

Montana Energy Code Checklist (Based on the 2018 IECC)

Date | Builder

House Address | City

☑ ☒ N/A	Component	Code Provision	Prescriptive Code Value	RESCheck Tradeoff Value	2012 IECC Code Section
☐ ☐ ☐	Floor Insulation	Must be in contact with floor sheathing	R-30		R402.2.8
☐ ☐ ☐	Basement Insulation	Continuous Insulation	R-15		R402.2.9
☐ ☐ ☐		Framed wall	R-19		R402.2.9
☐ ☐ ☐		Basement wall exposed insulation protected			R303.2.1
☐ ☐ ☐	Crawlspace	Cavity insulation	R-19		R402.1.1 R402.2.11
☐ ☐ ☐		Continuous, interior	R-15		
☐ ☐ ☐		Continuous Class 1 vapor retarder, joints overlapped 6" and sealed, extending 6" up the stem wall			
☐ ☐ ☐	Rooms Containing Fuel-Burning Appliances	Open fuel-burning appliances must be intalled in insulated (walls, ceiling, floor) and sealed rooms	Basement Wall R-Value		R402.4.4
☐ ☐ ☐	Sunroom (Thermally Isolated)	Glazing U-factor	U-0.45		R402.3.5
☐ ☐ ☐		Skylight U-factor	U-0.70		R402.3.5
☐ ☐ ☐		Wall insulation at conditioned space	R-13		R402.2.13
		Wall insulation at conditioned space	R-21 or R-13+5		R402.2.13
☐ ☐ ☐		Ceiling insulation	R-24		R402.2.13
☐ ☐ ☐	Duct Insulation	Ducts in unconditioned attic ≥ 3" dia.	R-8		R403.3.1
		Ducts in unconditioned attic < 3" dia.	R-6		
		Vented crawlspace, unconditioned basement, exterior walls ≥ 3" dia.	R-6		
		Vented crawlspace, unconditioned basement, exterior walls < 3" dia.	R4.2		
☐ ☐ ☐	Recessed Light Fixtures	IC-rated fixtures that meet infiltration criteria			R402.4.5
☐ ☐ ☐	Duct Sealing	Sealed with approved tapes, mastics, and gaskets			R403.3.2
☐ ☐ ☐		Building cavities not used for ducts			R403.3.5
	Mechanical Rough-In Inspection				
☐ ☐ ☐	Mech Sys Piping Insul	Carrying fluids ≥ 105 degrees F or ≤ 55 degrees F	R-3		R403.4
	Plumbing Rough-In Inspection				
☐ ☐ ☐	Service Hot Water	HW piping insulation under specific conditions	R-3		R403.5

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Montana Energy Code Checklist (Based on the 2018 IECC)

Date | Builder

House Address | City

☑ ☒ N/A	Component	Code Provision	Prescriptive Code Value	RESCheck Tradeoff Value	2012 IECC Code Section
		Final Inspection			
☐ ☐ ☐	Energy Certificate	Permanent energy label posted on electrical panel			R401.3
☐ ☐ ☐	All Components	All materials, systems, and equipment Installed per manufacturer's instructions and building code			R303.2
☐ ☐ ☐	Air Sealing	Tested by blower door (ACH50)	≤4		R402.4.1.2
☐ ☐ ☐		Per Air Barrier and Insulation Installation Table			R402.4.1.1
☐ ☐ ☐		Report submitted in accordance with referenced standard			R402.4.1.2
☐ ☐ ☐	Wood Fireplace	Gasketed doors, outdoor combustion air			R402.4.2
☐ ☐ ☐	Forced Air Furnace	Programmable thermostat installed			R403.1.1
☐ ☐ ☐	Exhaust Openings	Dampers on all outdoor intake & exhaust openings			R403.6
☐ ☐ ☐	Pools and In-ground Spas	Heater accessible manual controls + time switch + cover			R403.10
☐ ☐ ☐	Duct Tightness Test (Not required if ducts & air handler are entirely within conditioned space)	**Postconstruction**	≤4 CFM/100 ft^2		R403.3.4
☐ ☐ ☐		**Rough-in,** furnace installed	≤4 CFM/100 ft^2		R403.3.4
☐ ☐ ☐		**Rough-in,** furnace not installed	≤3 CFM/100 ft^2		R403.3.4
☐ ☐ ☐		Written report submitted			R403.3.3
☐ ☐ ☐	Service Hot Water	Circulating HW systems have automatic or accessible manual controls			R403.5.1
☐ ☐ ☐	Snowmelt	Snow-melt controls			R403.9
☐ ☐ ☐	Lighting	% of fixtures with high-efficacy lamps	90%		R404.1

Duct Tightness Test Results

Test Date: _____ House Floor Area ft^2: _____ Leakage Limit CFM25: _____

_____ CFM25: Rough-in Total Duct Leakage CFM/100 ft^2 of cond. floor area, furnace not installed, or

_____ CFM25: Rough-in Total Duct Leakage CFM/100 ft^2 of cond. floor area, furnace installed, or

_____ CFM25: Postconstruction Total Duct Leakage CFM/100 ft^2 of conditioned floor area.

Building Tightness Test Results*

Test Date: _____ House Volume ft^3: _____ House Floor Area ft^2: _____

Referenced Standard Used in Testing: ☐ RESNET/ICC 380 ☐ ASTM E779 ☐ ASTM E1827

Measured airflow at 50 Pascals (CFM50): _____

Air Change at 50 Pascals (ACH50 = (CFM50 x 60)/Volume): _____

* This abbreviated test information form is insufficient to comply with the more detailed information required by the referenced standards per R402.4.1.2.

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Montana Energy Code Checklist (Based on the 2018 IECC)

Date	Builder	
House Address		City

TABLE R402.4.1.1 Air Barrier and Insulation Installation

☑ ☒ N/A	Component	Air Barrier Installation Criteria
☐ ☐ ☐	General requirements	A continuous air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed.
☐ ☐ ☐	Ceiling/attic	The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop-down stairs, or knee wall doors to unconditioned attic spaces shall be sealed.
☐ ☐ ☐	Walls	The junction of the top plate and the top of exterior walls shall be sealed. The junction of the foundation and sill plate shall be sealed. Knee walls shall be sealed.
☐ ☐ ☐	Windows, skylights, and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.
☐ ☐ ☐	Rim joists	Rim joists shall include the air barrier.
☐ ☐ ☐	Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.
☐ ☐ ☐	Crawl space walls	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.
☐ ☐ ☐	Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.
☐ ☐ ☐	Garage separation	Air sealing shall be provided between the garage and conditioned spaces.
☐ ☐ ☐	Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be sealed to the finished surface.
☐ ☐ ☐	Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.
☐ ☐ ☐	Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.
☐ ☐ ☐	HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering, or ceiling penetrated by the boot.
☐ ☐ ☐	Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.

Notes _____

Montana Energy Code Checklist (Based on the 2018 IECC)

Date	Builder	
House Address		City

TABLE R402.4.1.1 Air Barrier and Insulation Installation

	Component	Insulation Installation Criteria
☐ ☐ ☐	General requirements	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, R-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
☐ ☐ ☐	Ceiling/attic	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
☐ ☐ ☐	Walls	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, R-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
☐ ☐ ☐	Rim joists	Rim joists shall be insulated.
☐ ☐ ☐	Floors, including cantilevered floors and floors above garages	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing; and shall extend from the bottom to the top of all perimeter floor framing members.
☐ ☐ ☐	Crawl space walls	Crawl space insulation, where provided instead of floor insulation, shall be permanently attached to the walls.
☐ ☐ ☐	Narrow cavities	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
☐ ☐ ☐	Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be airtight and IC-rated.
☐ ☐ ☐	Plumbing and wiring	In exterior walls, batt insulation shall be cut neatly to fit around wiring and plumbing, or insulation, that on installation readily conforms to available space, shall extend behind piping and wiring.
☐ ☐ ☐	Shower/tub on exterior wall	Exterior walls adjacent to showers and tubs shall be insulated.

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References and Resources

References

2018 International Energy Conservation Code, International Code Council, Inc. www.iccsafe.org

2018 International Residential Code, International Code Council, Inc. www.iccsafe.org

ASTM E779 -10 Standard Test Methods for Determining Air Leakage Rate by Fan Pressurization, ASTM International, www.astm.org

ASTM E1827 - 11 Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door, ASTM International, www.astm.org

RESNET Guidelines for Multifamily Ratings, Residential Energy Services Network, Inc.
www.resnet.us/wp-content/uploads/archive/resblog/2014/08/Adopted-RESNET-Guidlines-for-Multifamily-Ratings-8-29-14.pdf

RESNET/ICC 380 ANSI/RESNET/ICC 380-2016 with Addendum A-2017 Standard for Testing Airtightness of Building Enclosures, Airtightness of Heating and Cooling Air Distribution Systems, and Airflow of Mechanical Ventilation Systems

Residential Energy Services Network, Inc., www.resnet.us

International Code Council, Inc., www.iccsafe.org

Other Useful Publications

Volume 12. USDOE Building America Best Practices Series: Builders Challenge to 40% Whole-House Energy Savings in the Cold and Very Cold Climates, Prepared by PNNL and ORNL, 2011. Available online from the Building America website.

Builder's Guide to Cold Climates, By Joseph Lstiburek Building Science Press, 2006.

Internet Resources

ENERGY STAR New Homes
U.S. Environmental Protection Agency
www.energystar.gov/newhomes

Indoor airPlus
U.S Environmental Protection Agency
www.epa.gov/indoorairplus

International Code Council, Inc.
www.iccsafe.org

Residential Energy Services Network (RESNET)
http://resnet.us

National Fenestration Rating Council (NFRC)
www.nfrc.org

Efficient Windows Collaborative
www.efficientwindows.org/

Building America Program
U.S. Department of Energy
www.energy.gov/eere/buildings/building-america-bringing-building-innovations-market

Energize Montana (Energy Codes)
Montana Department of Environmental Quality
deq.mt.gov/energy

"Man wanted a home, a place for warmth, or comfort, first of physical warmth, then the warmth of the affections."

Henry David Thoreau, Walden

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At the time of publication Montana is holding listening sessions for the 2021 IECC with adoption anticipated in early 2022. Check the NorthWestern Energy Efficiency Plus website for details.