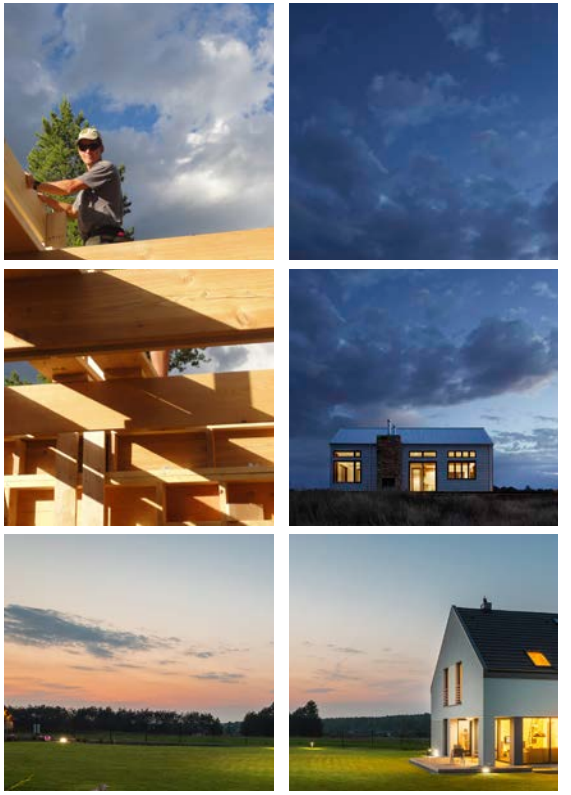
M O N T A N A

Residential Energy Code Handbook

2021 International Energy Conservation Code

As Amended



A Guide to Complying with Montana's Residential Energy Code

2021 Montana Residential Energy Code Handbook

Based on the 2021 International Energy Conservation Code (with amendments)

Prepared by

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2023

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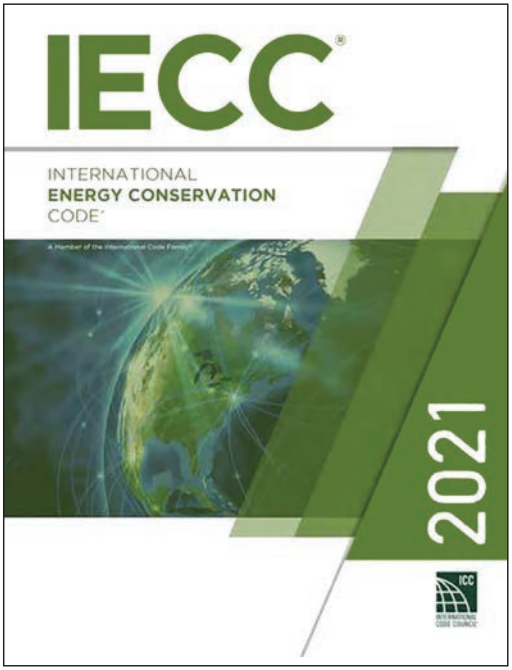

On June 11, 2022, Montana adopted the *2021 International Energy Conservation Code* (IECC) with several amendments. This adoption comes just 16 months after the adoption of the 2018 IECC on February 13, 2021, from the 2012 IECC. As before, the IECC includes provisions for both residential and commercial new construction. This *2021 Montana Residential Energy Code Handbook* aims to assist builders and designers in complying with the residential provisions of the new energy code. This handbook emphasizes the major changes, but it is not a substitute for the full text of the 2021 IECC or the Montana Amendments, Administrative Rules of Montana (ARM) 24.301.161. The Montana amendments will be noted throughout the summary of significant changes.

Code-level adoption provides a snapshot of the state's commitment to energy conservation. By adopting updated code, the state requires builders to keep up with proven and widely accepted building technologies and practices. By adhering to the energy code, homebuyers are assured that new homes will be safe, energy-efficient, and will not have costly future repairs. Code-compliant homes are healthier for occupants with improved indoor air quality, more energy-efficient with better thermal envelopes, and less likely to have costly future repairs due to common moisture-control issues.

THE FAMILY OF BUILDING CODES

The Montana Building Codes Program is part of the Building and Commercial Measurements Bureau within the Montana Department of Labor and Industry's Business Standards Division. The program adopts and amends statewide code, issues permits, and performs inspections. Additionally, cities and counties have the option to enforce local building, electrical, and mechanical codes (all or individually) and must be certified by the Montana Building Codes Program.

The IECC is a national model energy code adopted by many states and municipal governments in the United States. The purpose of the IECC is to provide minimum requirements for the design of new buildings and structures, and additions to existing buildings. The intent of this code is to ensure effective uses of energy by regulating exterior envelopes and heating, ventilating, air conditioning, water heating, electrical distribution, and lighting equipment of new homes. The Montana Building Codes Program encourages owners, design professionals, and builders to voluntarily implement greater levels of energy efficiency in building design and construction than those required by the IECC.

The IECC frequently refers to other codes, particularly the International Building Code (IBC), International Residential Code (IRC), and International Mechanical Code (IMC). Montana has adopted the 2021 editions of each of these codes. Wherever overlap in code occurs, the most stringent code is enforced. For example, Montana adopted the 2021 Uniform Plumbing Code (UPC), and all International Plumbing Code references have been amended by the state to reference the 2021 UPC code.

> Italics are used frequently in the International Code books to signify terms with explicit definitions. This handbook will also use italics to indicate terms with explicit definitions that can be found in R202.

WHAT BUILDINGS MUST COMPLY?

Residential buildings include one- and two-family dwellings and townhouses, as well as group R-2, R-3, and R-4 buildings that are three stories or less (in height) above *grade plane*. The *grade plane* is a reference plane that takes into consideration the ground around a building. Figure 1 shows three buildings with the same grade plane but with different ground levels and slopes. For the (a) building, the ground is level at the building and does not slope away; therefore, the *grade plane* is at ground level. For the (b) building, the ground is not level but does not slope away from the building; therefore, the *grade plane* is the average ground level at

the building. For the (c) building, the ground is not level and the ground slopes away from the building; therefore, the *grade plane* is the average level of the ground at the lowest finished ground level between the building and 6 feet away, or the lot boundary, whichever is less.

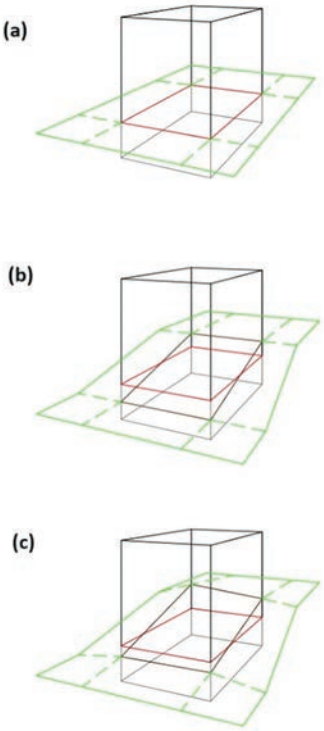

Figure 1. Grade Plane Examples for Various Ground Levels

Residential group "R" are buildings that contain *sleeping units.* Group R-2 are buildings that contain *sleeping units* or more than two *dwelling units* where the occupants are permanent or non-transient.

Sleeping Unit: A single unit that provides rooms or spaces for one or more persons, includes permanent provisions for sleeping. The single unit can include 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.

Dwelling Unit: A single unit providing complete, independent living facilities for one or more people. A dwelling unit includes permanent provisions for living, sleeping, eating, cooking, and sanitation, as long as cooking and sanitation are not contained in the same room.

Transient occupancy occurs at *sleeping units* for 30 days or less. Group R-2 occupancies include the following building types:

- Apartment houses
- *Congregate living facilities* with more than 16 occupants who stay longer than 30 days. *Congregate living facilities* contain *sleeping units* where residents share bathroom and kitchen facilities.
- *Boarding houses* with occupants who stay longer than 30 days. *Boarding houses* are buildings containing sleeping units and are not occupied as a single-family unit.
- Convents, Monasteries, Fraternities, Sororities, *Dormitories*
- Hotels, Motels, Live-units, and Work-units with non-transient occupants
- Vacation timeshare properties

Residential Group R-3 occupancies are buildings that do not contain more than two *dwelling units,* such as:

- Care facilities that accommodate five or fewer people receiving care (must contain an *automatic sprinkler system*)
- *Congregate living facilities* with 16 or fewer occupants who stay longer than 30 days, or with 10 or fewer occupants who stay less than 30 days
- *Boarding houses*
- Convents/Monasteries/Fraternities/Sororities/*Dormitories*
- *Lodging houses* with five or fewer guestrooms, a room for living or sleeping, and 10 or fewer occupants that stay for 30 days or less. The owner must occupy the *lodging house* and there must be an *automatic sprinkler system* installed.

Residential Group R-4 occupancy includes buildings, structures, or portions thereof, where there are more than five but not more than 16 persons, excluding staff, who reside on a 24-hour basis in a supervised residential environment and receive custodial care. This group includes, but is not limited to, the following:

- Alcohol and drug centers
- Assisted living facilities
- Congregate care facilities
- *Group homes*
- Halfway houses
- Residential board and care facilities
- Social rehabilitation facilities

Buildings or portions of building in these categories exempt from the energy code include low-energy buildings with a design peak energy use rate of 3.4 Btu/h (1.0 watt/ft²) per square foot of floor space, portions of buildings that are separate from the building's thermal envelope, and log homes designed in accordance with ICC 400. The code is not retroactive, and unaltered portions of a building do not need to comply with the current code.

Scope and Administration

Chapter 1 of the residential code specifies the responsibilities of the code official. It is up to the code official to ensure the proposed design complies with the intent of the code for material strength, effectiveness, and fire resistance. The 2021 IECC includes a requirement that the code official must also review material durability, the design's energy conservation measures, and safety. Section R103 now allows for digital submission of documents, as allowed by the code official.

The 2018 IECC had mandatory provisions and three compliance pathways: prescriptive, performance, and Energy Rating Index. The 2021 IECC has rearranged the mandatory provisions into the compliance pathways. To ensure that the compliance pathway is obvious for the code official, Section R103.2 requires the Energy Compliance Pathway to be included in the application. The new compliance pathways are perhaps the most significant change to the 2021 IECC and are the majority of Chapter 4.

R103.2 Information on Construction Documents

Details on the application shall include the following as applicable:

1. **Energy compliance path (new with 2021 IECC)**
2. Insulation materials and their *R*-values
3. Fenestration *U*-factors and *solar heat gain coefficients* (SHGC)
4. Area-weighted *U*-factor and *solar heat gain coefficients* (SHGC) calculations
5. Mechanical system design criteria
6. Mechanical and service water-heating systems and equipment types, sizes, and efficiencies
7. Equipment and system controls.
8. Duct sealing, duct and pipe insulation, and location
9. Air sealing details

Section R109 allows the code official to issue a "stop-work" order if the work is being performed "in a manner contrary to the provisions of this code or in a dangerous, unsafe manner." The stop-work order must state how to resolve the stop-work order. Any failure to comply with a stop-work order can result in fines; Section R110 details the means of appeals.

Definitions

Key concepts and definitions can be found in Chapter 2. Like most concepts in the code, these concepts often have nested references to other concepts. Any terms that are italicized in the code are explicitly defined in this section. The new definitions added to the 2021 IECC are:

Access (To): That which enables a device, appliance, or equipment to be reached by *ready access* or by a means that first requires the removal or movement of a panel or similar obstruction.

In this definition, *ready access* is another explicitly defined concept in this chapter. The second portion of the definition mentioning "panel" is intended to convey that an object can have a movable/removable panel and still be considered to have *access*.

Cavity Insulation: Insulating material located between framing members.

A framing member is a generalized term for structural components in an assembly. These can be studs in a wall or joists in the ceiling or floor.

Demand Recirculation Water System: A water-distribution system where one or more pumps prime the service hot water piping with heated water upon demand for hot water.

Dimmer: A control device that is capable of continuously varying the light output and energy use of light sources.

Dwelling Unit Enclosure Area: The sum of the area of ceiling, floors, and walls separating a *dwelling unit's conditioned space* from the exterior or from adjacent conditioned or unconditioned spaces. Wall height shall be measured from the finished floor of the *dwelling unit* to the underside of the floor above.

Fenestration: Products classified as either *vertical fenestration* or *skylights*.

Skylights: Glass or other transparent or translucent glazing material installed at a slope of less than 60 degrees (1.05 rad) from horizontal, including unit skylights, tubular daylighting devices, and glazing materials in solariums, sunrooms, roofs, and sloped walls.

High-Efficacy Light Sources: Any lamp with an efficacy of not less than 65 lumens per watt, or luminaires with an efficacy of not less than 45 lumens per watt.

The term “lamp” refers to a light bulb or tube. A “luminaire” is an entire light fixture, containing the lamp, or lamps, and/or frame, and/or lens.

Occupant Sensor Control: An automatic control device that detects the presence or absence of people within an area and causes lighting, equipment, or appliances to be regulated accordingly.

On-Site Renewable Energy: Energy from renewable energy resources harvested at the building site.

Ready Access (To): That which enables a device, appliance, or equipment to be directly reached without requiring the removal or movement of any panel or similar obstruction.

There is a difference between *access* and *ready access*. For a piece of equipment to be considered to have *ready access*, it cannot have a removable/movable panel. To be considered to have *access*, it can have a removable/movable panel.

Renewable Energy Certificate (REC): An instrument that represents the environmental attributes of one megawatt-hour of renewable energy. Also known as an Energy Attribute Certificate (EAC).

Renewable Energy Resources: Energy derived from solar radiation, wind, waves, tides, landfill gas, biogas, biomass, or energy extracted from hot fluid or steam heated within the earth.

Roof Recover: The process of installing an additional roof covering over an existing roof covering without removing the existing roof covering.

Solar-Ready Zone: A section or sections of the roof or building overhang designated and reserved for the future installation of a solar photovoltaic or solar thermal system.

Thermal Distribution Efficiency (TDE): The resistance to changes in air heat as air is conveyed through a distance of air duct. TDE is a heat-loss calculation evaluating the difference in the heat of the air between the air duct inlet and outlet caused by differences in temperatures between the air in the duct and the duct material. TDE is expressed as a percent difference between the inlet and outlet heat in the duct.

Total Building Thermal Envelope (UA): While this is not a definition in the 2021 IECC, it is a concept referenced by the different compliance pathways. A building’s designed or proposed total building thermal envelope, UAProposed, is each individual assembly’s U-factor multiplied by the respective area and then all summed together. The building’s reference total building thermal envelope, UAReference, is each assembly’s required U-factor multiplied by the respective area and then all summed together.

General Requirements

Chapter 3 of the code addresses requirements that are broadly applicable and do not belong in specific subsections. It lists the counties in the United States and their corresponding climate zone, and the climate zone definitions. The entirety of Montana remains at Zone 6B – Cold Dry. Figure 2 shows the current climate zone designations for the United States.

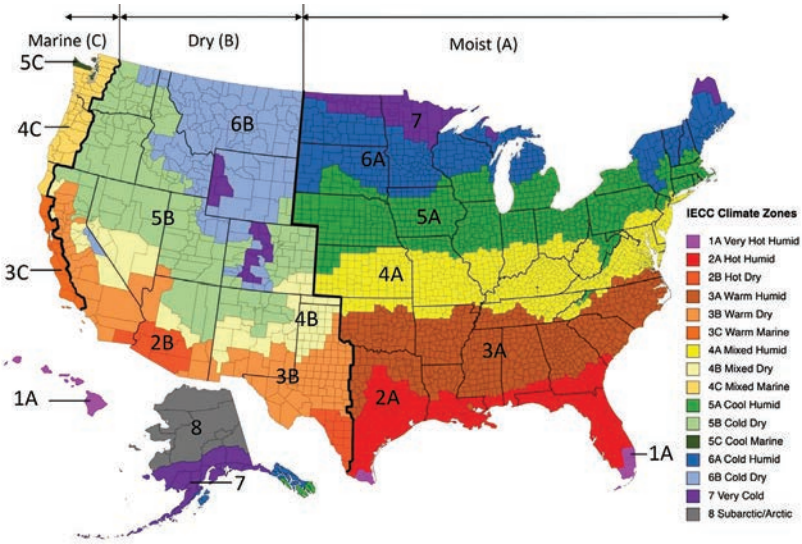

Figure 2. Climate Zones by County (2021 IECC FIGURE R301.1)

R-value mark is readily observable at inspection. For insulation materials that are installed without a readily observable manufacturer's R-value mark, such as blown or draped products, an insulation certificate by the installer of the type of insulation, R-value, and thickness, shall be left immediately after installation in a conspicuous location within the building.

Air-impermeable insulation is any insulation having an air permeability not greater than 0.004 cubic feet per minute per square foot [0.002 L/(s × m²)] under pressure differential of 0.3 inch water gauge (75 Pa) when tested in accordance with ASTM E2178.

Maintenance instructions shall be furnished for equipment and systems that require preventive maintenance. Required regular maintenance actions shall be clearly stated and incorporated on a readily visible label. The label shall include the title or publication number for the operation and maintenance manual for that model and type of product.

Residential Energy Efficiency

Chapter 4 of the code contains the provisions for new residential buildings and the various compliance pathways. The compliance pathways in the 2021 IECC are the Prescriptive Compliance option, Total Building Performance option, Energy Rating Index option, or Tropical Climate option. Depending on the compliance option, there is an additional energy efficiency provision that must be met.

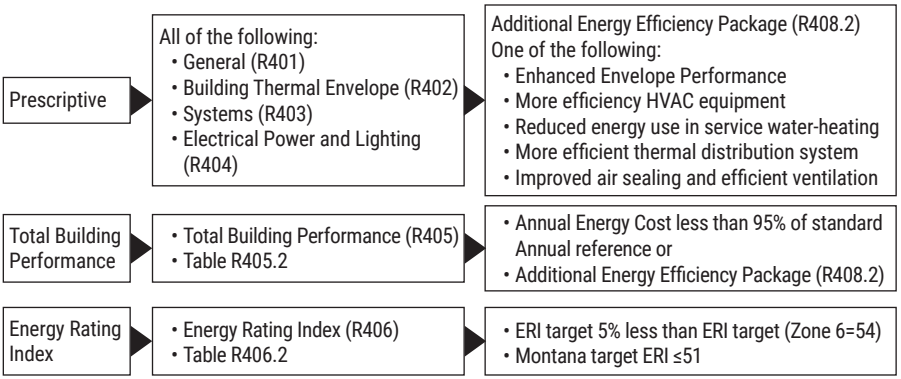

Figure 3: 2021 IECC Compliance Pathways and Additional Energy Efficiency Measures

Buildings complying with the Prescriptive Compliance option must also have one additional efficiency package. Choices for the additional package are: an enhanced envelope, more efficient HVAC equipment, reduced energy use in service water heating, more efficient duct thermal distribution system, or improved air sealing and efficient ventilation system. The rules for these additional efficiency packages are provided later in this section.

Buildings complying with the Total Building Performance option can have one of the additional efficiency packages listed above, or the proposed design of the building shall have an annual energy cost that is less than or equal to 95% of the annual energy cost of the standard reference design.

For buildings complying with the Energy Rating Index (ERI) option (R406), the additional energy efficiency package states that the ERI values shall be at least 5% less than the ERI target, or less than ERI-51 for climate

zone 6. The last compliance option is the Tropical Climate Region option (R407), which does not pertain to Montana.

Exceptions to the additional energy-efficiency package requirement are additions, *alterations*, repairs, and changes of occupancy to existing buildings complying with Chapter 5.

CERTIFICATE (R401.3)

A permanent certificate shall be completed by the builder or other approved party and posted on a wall in the space where the furnace is located, a utility room, or an approved location inside the building. If located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label, or other required labels. The certificate shall indicate the following:

- The predominant R-values of insulation of ceilings, roofs, walls, foundation components, and ducts outside conditioned spaces.
- U-factors of fenestration and the Solar Heat Gain Coefficient (SHGC) of fenestration. Where there is more than one value for any component of the building envelope, the certificate shall indicate both the value covering the largest area and the area weighted average value.
- The results from a required duct system and building envelope air leakage testing performed on the building.
- The types, sizes, and efficiencies of heating, cooling, and service water-heating equipment. Where a gas-fired unvented room heater, electric furnace, or baseboard electric heater is installed in the residence, the certificate shall indicate "gas-fired unvented room heater," "electric furnace" or "baseboard electric heater," as appropriate. Efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces, and electric baseboard heaters.
- Where on-site *photovoltaic panel* systems have been installed, the array capacity, inverter efficiency, panel tilt, and orientation shall be noted on the certificate.
- For buildings where an Energy Rating Index score is determined, the Energy Rating Index score with and without any on-site generation shall be listed on the certificate.
- The code edition under which the structure was permitted and the compliance path used.

Building Thermal Envelope

The assemblies in a building thermal envelope must have a U-factor equal to or less than that specified in Table R402.1.2. Table 1 contains these requirements for climate zone 6. For climate zone 6, there is not a SHGC requirement on glazed fenestration.

Table 1. Maximum Assembly U-Factors and Fenestration Requirements for Climate Zone 6 (2021 IECC Table R402.1.2)

Fenestration U-Factor	0.3
Skylight U-Factor	0.55
Ceiling U-Factor	0.026*
Wood Frame Wall U-Factor	0.045
Mass Wall U-Factor	0.06
Floor U-Factor	0.033
Basement Wall U-Factor	0.05
Crawlspace Wall U-Factor	0.055

For mass walls where more than half the insulation is on the interior, the U-factors must be less than 0.057 in climate zone 6.

Assemblies with R-value of insulation materials equal to or greater than that specified in Table R402.1.3 shall be an alternative to the U-factor in Table R402.1.2. In either the U-factor table or the R-value table, the maximum U-factor of 0.32 is applied to vertical fenestration products in climate zone 6 on buildings above 4,000 feet in elevation.

Table 2. Insulation Minimum R-Values and Fenestration Requirements for Climate Zone 6 (2021 IECC Table R402.1.3)

Fenestration U-Factor	0.3
Skylight U-Factor	0.55
Ceiling R-Value	60
Wood Frame Wall R-Value	21* or 20+5ci or 13+10ci or 0+15ci*

Amended Values by ARM 24.301.161

Table 2 continued

Mass Wall R-Value	15/20
Floor R-Value	30
Basement Wall R-Value	15ci or 19 or 13+5ci
Slab R-Value & Depth	10ci, 4 ft
Crawlspace Wall R-Value	15ci or 19 or 13+5ci

SPECIFIC INSULATION REQUIREMENTS (R402.2)

For ceilings with attics installing R-49 over 100% of the ceiling or attic area, including extending insulation over the wall top plate at the eaves will satisfy the R-60 requirement. This reduction only applies if using the R-value alternative; if the plan is following the U-factor table, then this reduction does not apply.

For ceilings without attics, if the design of the roof/ceiling assembly does not allow sufficient space for the R-60 installation in the interstitial space above the ceiling and below the structural roof deck, then R-30 insulation can be installed over the top of the wall plate. This R-30 can be installed along the top plate limited to 250* ft2 or 10%* of the total insulated ceiling area, whichever is less. This reduction only applies if using the R-value alternative and does not apply to the U-factor requirements.

For air-permeable insulation in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain a net free area opening equal to or greater than the size of the vent. The baffle shall extend over the top of the attic insulation. The baffle shall be permitted to be any solid material. The baffle shall be installed to the outer edge of the exterior wall top plate to provide maximum space for attic insulation coverage over the top plate. Where soffit venting is not continuous, baffles shall be installed continuously to prevent ventilation air in the eave soffit from bypassing the baffle.

Steel-frame ceilings, walls, and floors shall comply with the insulation requirements of Table R402.2.6, with major changes outlined in Table 3.

*Amended Values by ARM 24.301.161

Table 3. Wood Frame and Steel Frame R-Value Equivalent (2021 IECC Table R402.2.6)

Wood Frame Wall R-Value	Steel-Frame R-Value Equivalent
Steel-frame wall, 16 inches on center	
R-13+5ci	R-15ci, R-13+9ci, R-15+8.5ci, R-19+8ci, or R-21+7ci
R-13+10ci	R-20ci, R-13+15ci, R-15+14ci, R-19+13ci, or R-21+13ci
Steel-frame wall, 24 inches on center	
Floor R-Value	30
Basement Wall R-Value	15ci or 19 or 13+5ci
Slab R-Value & Depth	10ci, 4 ft
Crawlspace Wall R-Value	15ci or 19 or 13+5ci

There are three options for installing floor cavity insulation:

- Insulation can be installed to maintain permanent contact with the underside of the subfloor decking.
- Insulation can be in contact with the top side of sheathing separating the cavity and the unconditioned space below, and the insulation must extend from the bottom to the top of all perimeter floor framing members and the framing members must be air sealed.
- Insulation can be a combination of cavity and continuous insulation and shall be installed so that the cavity insulation is in contact with the top side of the continuous insulation that is installed on the underside of the floor framing separating the cavity and the unconditioned space below. The combined R-value of the cavity and continuous insulation shall equal the required R-value for floors, and insulation shall extend from the bottom to the top of all perimeter floor framing members and the framing members shall be air sealed.

Basement walls shall be insulated in accordance with the R-value table or U-factor table, except when basements are unconditioned and there are no uninsulated ducts, domestic hot water, hydronic heating surfaces, or HVAC supply or return diffusers serving the basement. The walls

and stringers of the stairway serving the basement must be insulated, the door must be insulated and weather-stripped, and the floor above the basement must be insulated. The building thermal envelope must separate the basement from the conditioned space. Where basement walls are insulated, the insulation shall be installed from the top of the basement wall down to 10 feet (3048 mm) below grade or to the basement floor, whichever is less.

Crawlspace walls shall be insulated in accordance with the R-value table, except when the crawlspace is vented to the outside and is outside of the building thermal envelope. Temporary crawlspace vent openings are allowed during construction for crawlspaces that have insulated walls. These temporary crawlspace vent openings shall be closed, sealed, and insulated to the same R-value of the surrounding crawlspace wall insulation once construction is complete and prior to the time that the final building inspection would occur. Crawlspace wall insulation shall be permanently fastened to the wall and shall extend downward from the floor, the entire height of the crawlspace wall. Exposed earth in unvented crawlspace foundations shall be covered with a continuous Class I vapor retarder. All joints of the vapor retarder shall overlap 6 inches and be sealed or taped. The edges of the vapor retarder shall extend at least 6 inches up the stem wall and shall be attached and sealed to the stem wall.*

Sunrooms enclosing a conditioned space and heated garages shall meet the insulation requirements from the R-value table, except when they have thermal isolation from the building conditioned space and have their own enclosed conditioned space. Minimum ceiling insulation R-value shall be R-24 and minimum wall insulation R-value shall be R-13 in climate zone 6. Walls separating the sunroom or heated garage must comply with the R-value table.

FENESTRATION (R402.3)

Sunrooms and heated garages enclosing conditioned space shall comply with the fenestration requirements of this code, except those with *thermal isolation*. The fenestration U-factor shall not exceed 0.45 and the skylight U-factor shall not exceed 0.70. Fenestration separating a *sunroom* or heated garage with *thermal isolation* from *conditioned space* shall comply with the *building thermal envelope* requirements of this code.

*Amended Values by ARM 24.301.161

AIR LEAKAGE (R402.4)

The building thermal envelope is now required to follow the requirements specified in three subsections that cover installation (R402.4.1.1), testing (R402.4.1.2), and leakage rate (R402.4.1.3). Major changes to air barrier installation, air sealing, and insulation installation in the 2021 IECC are:

- Rim boards must include an exterior air barrier, junctions of the rim board at the sill plate and subfloor must be air sealed, and insulation must have permanent contact with the rim board.
- Basement crawlspace and slab foundations:
  - In an unvented crawlspace, exposed earth must be covered with a Class I vapor retarder/air barrier.
  - Penetrations must be air sealed.
  - Class I vapor retarders cannot be used as an air barrier on below-grade walls and must be installed in accordance with IRC R702.7.
- Shafts/penetrations through the air barrier must be sealed and must allow for expansion/contraction of materials and mechanical vibration. Insulation around penetrations must be tightly fitted to the shaft or utility and maintain the required R-value.
- Narrow cavities must be air sealed and insulated so that the insulation conforms to the cavity space. Narrow cavities of one inch or less that cannot be insulated must be air sealed.
- Air sealing must be provided between the garage and conditioned space.
- All holes created by plumbing, wiring, or other obstructions in the air barrier must be air sealed, and insulation shall be installed to fill the available space around the obstruction unless the insulation requirement can be met by installing the insulation completely to the exterior side of the obstruction.

The maximum air leakage rate for any building or dwelling unit under any compliance path shall not exceed 4.0* air changes per hour per square foot of dwelling unit enclosure area. Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope have been sealed. During the air leakage testing, the following must be completed:

Amended Values by ARM 24.301.161

- Exterior windows and doors, fireplace and stove doors shall be closed but not sealed.
- Dampers shall be closed but not sealed, including exhaust, intake, makeup air, back draft dampers, and flue dampers.
- Interior doors shall be open.
- Exterior openings for continuous ventilation systems and heat recovery ventilators shall be closed and sealed.
- Heating and cooling system(s) shall be turned off.
- "B" or "L" vents, combustion air vents, and dryer vents shall be sealed. Supply and return registers, where installed at the time of test, shall be fully open.

If the building footprint is 1,500 ft² or smaller, then the air leakage rate cannot exceed 0.30 ft/min per square foot of the enclosure area. This makes it easier for smaller buildings to pass the air leakage test.

The air barrier can be installed behind electrical and communication boxes. If electrical and communication outlet boxes penetrate the air barrier, then the boxes must be sealed to limit air leakage. Electrical and communication outlet boxes shall be tested in accordance with NEMA OS 4. Electrical and communication outlet boxes shall be marked "NEMA OS 4" or "OS 4" in accordance with NEMA OS 4 and must be installed per the manufacturer's instructions and with any supplied components required to achieve compliance with NEMA OS 4.

Systems

CONTROLS (R403.1)

At least one thermostat shall be provided for each separate heating and cooling system. The thermostat controlling the primary heating or cooling system of the *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 day and different days of the week.

Heat pumps having supplementary electric resistance heat shall have controls to prevent supplemental heat operation when the heat pump compressor can meet the heating load (except during defrost).

HOT WATER TEMPERATURE RESET (R403.2)

All hot water boilers must have a temperature reset equipped by the manufacturer. The temperature reset will automatically adjust the water temperature supplied by the boiler to ensure that incremental change of the load will cause an incremental change of supply. This can be accomplished with outdoor reset, indoor reset, or water temperature sensing.

DUCTS (R403.3)

Supply and return ducts located outside conditioned space with 3-inch or larger diameter shall be insulated to at least R-8, and to at least R-6 for ducts smaller than 3 inches in diameter. Ducts buried beneath a building shall be insulated as required per this section or have an equivalent thermal distribution efficiency. Underground ducts utilizing the thermal distribution efficiency method shall be listed and labeled to indicate the R-value equivalency.

For ductwork to be considered inside a conditioned space:

- The duct system shall be located completely within the continuous air barrier and within the building thermal envelope.
- Ductwork in a ventilated attic space must be insulated to at least R-8 and the insulation above and below the duct, as well as duct insulation, must total at least R-19. The air handler must be located completely within the continuous air barrier and within the building thermal envelope. Duct leakage must be less than or equal to 1.5 CFM per 100 ft² of *conditioned floor area* served by the duct system, and the ceiling insulation R-value installed against and above the insulated duct must be greater than or equal to the proposed ceiling insulation R-value, less the R-value of the insulation on the duct.
- Ductwork in floor cavities located over unconditioned space must have a continuous air barrier installed between unconditioned space and the duct, and at least R-19 insulation separating the duct from unconditioned space.
- Ductwork in exterior walls of the building thermal envelope must have a continuous air barrier installed between unconditioned space and the duct, at least R-10 insulation separating the duct from the outside sheathing, and the remainder of the cavity shall be fully insulated to the interior side.

Ducts, air handlers, and filter boxes shall be sealed in accordance with either the *2021 International Mechanical Code* or *2021 International Residential Code.* A total duct leakage test can be performed during rough-in or post-construction. Montana removed the requirement of duct testing for ducts and air handlers if they are entirely within the thermal envelope. Additionally, the Montana amendment allows for building framing cavities to be used for return ducts if there is not an atmospherically vented furnace, boiler, or water heater located in the building. If there is an atmospherically vented furnace, boiler, or water inside of the building, it must be isolated from inside the thermal envelope and the duct system leakage rate cannot exceed 4 CFM/100ft². The room containing the atmospherically vented boiler must have insulated walls, floor, and ceiling.

MECHANICAL SYSTEM PIPING (R403.4) AND SERVICE HOT WATER SYSTEMS (R403.5)

Mechanical system and hot water piping shall be insulated in accordance with subsections 610.11 and L 501.2 of the Uniform Plumbing Code (UPC) 2021 edition. Service hot water systems shall be insulated in accordance with subsection L 503.3.3 of the Uniform Plumbing Code (UPC) 2021 edition.*

MECHANICAL VENTILATION (R403.6)

Due to building thermal envelope and air-sealing requirements, whole-house mechanical ventilation is required to comply with Section 1505 of the IRC or IMC. Because fans in whole-house mechanical ventilations systems operate continuously, or for a significant number of hours, the code includes minimum efficacy requirements. Table 4 summarizes changes to fan efficacy requirements.

Table 4. Whole-Dwelling Mechanical Ventilation System Fan Efficacy (2021 IECC Table R403.6.2.)

Fan Location	Operating Airflow (CFM)	Minimum Efficacy
HRV, ERV	Any	1.2 cfm/watt
In-line fan	Any	3.8 cfm/watt
Other exhaust fan	< 90	2.8 cfm/watt
Other exhaust fan	≥ 90	3.5 cfm/watt
Air-handler	Any	1.2 cfm/watt

*Amended Values by ARM 24.301.161

Fans shall be tested in accordance with HVI 916 and efficacy for fully ducted HRV, ERC, balanced, and in-line fans shall be determined at a static pressure of not less than 0.2 inch water column (w.c.) (49.85 Pa). Fan efficacy for ducted range hoods and bathroom and utility room fans shall be determined at a static pressure of not less than 0.1 inch w.c. (24.91 Pa). Testing shall be performed according to the manufacturer's instructions, or by using a flow hood or box, flow grid, or other airflow measuring device at the mechanical ventilation fan's inlet terminals or grilles, outlet terminals or grilles, or in the connected ventilation ducts. Kitchen range hoods that are ducted to the outside with 6-inch or larger duct and do not have more than one 90-degree elbow or equivalent in the duct run do not require testing. Where required by the code official, testing can be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

Electrical Power and Lighting Systems

All permanently installed lighting fixtures, excluding kitchen appliance lighting fixtures, shall contain only high-efficacy lighting sources. There are no requirements on exterior lighting for detached one- and two-family dwellings, townhouses, solar-powered lamps not connected to any electrical service, luminaires controlled by a motion sensor, or high-efficacy lighting.

Otherwise, exterior lights located on a building must comply with commercial code provisions in C405.5.

Interior lighting fixtures must be controlled with a dimmer, an occupant sensor control, or other control that is installed or built into the fixture except for lights in bathrooms, hallways, exterior lighting fixtures, and lighting designed for safety or security. On exterior lighting where the total power is greater than 30 watts, manual control must also include automatic controls that turn lights off during the day and, in event the control is manually overridden, the automatic control will resume operation within 24 hours.

Total Building Performance

The 2018 IECC referred to this performance option as the "Simulated Performance Alternative." This section establishes criteria

for compliance using total building performance analysis, which includes heating, cooling, mechanical ventilation, and water-heating energy only. The pathway requires that the building comply with the sections and subsections in Table 5, that the building thermal envelope shall be greater than or equal to levels of efficiency coefficients in the R-value and U-factor tables, and that the annual energy cost is less than or equal to the annual energy cost of the standard reference design.

Compliance software tools shall generate a report that documents that the proposed design complies with the requirements. The report must be submitted with the building application and must include:

- Building street address or other building site identification.
- Name of the individual performing the analysis and generating the compliance report.
- Name and version of the compliance software tool used.
- Documentation of all software inputs used to produce the results for the reference design and proposed design.
- A certificate indicating that the proposed design complies with Section R405.3. The certificate shall document each of the building component's energy specifications that are included in the calculation.
- Where a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated home.

Upon completion of the building, a compliance report must be submitted to obtain the certificate of occupancy and must include:

- Building street address or other building site identification.
- Declaration of the total building performance path on the title page of the energy report and the title page of the building plans.
- A statement bearing the name of the individual performing the analysis and generating the report, indicating that the as-built building complies with Section R405.3.
- Name and version of the compliance software tool used.
- A site-specific energy analysis report.
- A final confirmed certificate indicating compliance based on inspection, and a statement indicating that the confirmed rated design of the built home complies with Section R405.3. The certificate shall report the energy features that were confirmed to be in the home.
- When on-site renewable energy systems have been installed, the certificate shall report the type and production size of the installed system.

Table 5. Combined Requirements for Total Building Performance and Energy Rating Index Pathways (2021 IECC Table R405.2 and Table R406.2)

Section/subsection	Title
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawlspace wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration U-factor and SHGC (required only for Total Building Performance pathway)
Mechanical	
R403.1	Controls
R403.3.1	Ducts located outside conditioned space
R403.3.4	Sealing
R403.3.5	Duct testing
R403.3.6	Building cavities
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat-recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snowmelt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas

Table 5 continued

Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R406.3	Building thermal envelope (required only for Energy Rating Index pathway)

Energy Rating Index (ERI) Compliance Alternative

The ERI rating provides a metric on a home's energy efficiency on a scale of 0 to 100, where 100 is a 2006 IECC home, and 0 is a net-zero energy home. The 2021 IECC requires Montana homes to have an ERI score of at least 54; however, the required additional energy-efficiency package requires the ERI be 5% less than this, so the actual minimum score requirement is 51. The ERI analysis must be performed in accordance with RESNET/ICC 301 by a verified approved agency.

Additionally, the building must also comply with IECC Table R406.2 Requirements for Energy Rating Index. This table is very similar to the IECC Table R405.2 Requirements for Total Building, recreated for this document in Table 5. The only difference is that for the ERI pathway, subsection R402.5 Maximum Fenestration U-factor and SHGC is not required, and subsection R406.3 Building Thermal Envelope is required.

BUILDING THERMAL ENVELOPE (R406.3)

For buildings without on-site renewable energy, the proposed total building thermal envelope must be less than or equal to the prescriptive reference total building thermal envelope multiplied by 1.15. Where on-site renewable energy is included, the total building thermal envelope must be greater than or equal to the prescriptive reference total building thermal envelope.

DOCUMENTATION (R406.7)

Compliance software tools shall generate a report that documents the ERI score of the proposed design that will be submitted with the application for the building permit. Compliance reports submitted with the application for a building permit shall include the following:

- Building street address or other building site identification.
- Declaration of ERI on title page and on building plans.
- Name of the individual performing the analysis and generating the compliance report.
- Name and version of the compliance software tool used.
- Documentation of all inputs to the software used to produce the results for the reference design and/or the rated home.
- A certificate indicating that the proposed design has an ERI less than or equal to the appropriate score. The certificate shall document the building component energy specifications that are included in the calculation.
- When a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated home.

A confirmed compliance report will be submitted to obtain the certificate of occupancy and will include the following:

- Building street address or other building site identification.
- Declaration of ERI on title page and on building plans.
- Name of the individual performing the analysis and generating the report.
- Name and version of the compliance software tool used.
- Documentation of all software inputs used to produce the results for the reference design and/or the rated home.
- A final confirmed certificate indicating that the confirmed rated design of the built home complies with the requirements. The certificate shall report the energy features confirmed to be in the home.

Where on-site renewable energy is included in the calculation of an ERI, a document must be provided to the substantiate that the Renewable Energy Certificate (REC) associated with the on-site renewable energy are owned by, or retired on behalf of, the homeowner, or a contract that conveys to the homeowner the RECs associated with the on-site renewable energy, or conveys to the homeowner an equivalent quantity of RECs associated with other renewable energy.

Additional Efficiency Package Options

The additional energy-efficiency package options are new to 2021 IECC. The Prescriptive Compliance pathway requires one of the follow five options for additional energy efficiency. The Total Building Performance Compliance pathway requires one option, or the simulated annual energy costs must be 95% or less than that of the standard reference design.

The enhanced envelope performance option requires the proposed total building thermal envelope (UA) to be less than or equal to 95% of the reference total building thermal envelope (UA). Additionally, the area weighted average SHGC of all glazed fenestration shall be less than or equal to 95% of the required maximum glazed fenestration SHGC.

More efficient HVAC equipment performance option requires that heating and cooling equipment be at least a 95 AFUE natural gas furnace and 16 SEER air conditioner, or at least a 10 HSPF/16 SEER air source heat pump, or at least a 3.5 COP ground-source heat pump. If there are multiple heating and cooling systems, all systems must meet or exceed the minimum efficiency requirements in this section.

Reduced energy use in service water heating option requires that the hot water system must be least a 0.82 EF fossil fuel service water-heating system, or at least a 2.0 EF electric service water-heating system, or at least a 0.4 solar fraction solar water-heating system.

More efficient duct thermal distribution system option requires the thermal distribution system to have all ducts and air handlers located entirely within the building thermal envelope, or all ductless thermal distribution system or hydronic thermal distribution system located completely inside the building thermal envelope, or all duct thermal distribution system located in conditioned space.

Improved air sealing and efficient ventilation system option requires the measured air leakage rate to be less than or equal to 3.0 ACH50, Air Changes per Hour at 50psi pressure differential, with either an Energy Recovery Ventilator (ERV) or Heat Recovery Ventilator (HRV) installed. Minimum HRV and ERV requirements, measured at the lowest tested net supply airflow, must be greater than or equal to 75% Sensible Recovery Efficiency (SRE), less than or equal to 1.1 ft3/min/watt and shall not use recirculation as a defrost strategy. In addition, the ERV shall be greater than or equal to 50% Latent Recovery/Moisture Transfer (LRMT).

Existing Buildings

Chapter 5 of the code contains the provisions for alterations, repairs, additions, and change of occupancy of existing buildings and structures. When altering an unconditioned or low-energy space into a conditioned space, such as turning a garage into an apartment, the altered space must comply with the entire code except if:

- The simulated annual energy cost of the altered space is less than 110% of the energy cost of the standard reference design.
- The total thermal envelope of the altered space and altered existing building is less than or equal to the original existing building's total thermal envelope.
- The simulated annual energy cost of the altered space and altered existing building is less than the simulated annual energy cost of the original existing building.

If the exceptions are not met, then the alteration, repair, addition, or change of occupancy is required to follow the energy code compliance pathways detailed in Chapter 4 of the IECC. However, new building thermal envelopes of additions are not required to be tested for air leakage. New ducting in an addition or alteration is required to comply with the ducting provisions in the 2021 IECC, except if ducts are extended from the existing building's system.

Appendix RA: Board of Appeals

A board of appeals will be established within the jurisdiction for the purpose of hearing applications for modification of the requirements of the code. The board shall be established and operated in accordance with this section and shall be authorized to hear evidence from appellants and the code official pertaining to the application and intent of this code. The board will be composed of five individuals who will serve a term determined by the jurisdiction.

Any person shall have the right to appeal a code official's decision to the board. An application for appeal shall be based on a claim that the rules and intent of this code have been incorrectly interpreted, that the provisions of this code do not fully apply, or that the proposed form of construction is equally good or better. The rest of the appendix establishes how the board will operate, meet, and resolve issues.

Appendix RB: Solar-Ready Provisions

This appendix existed in the 2018 IECC as Appendix RA. Montana law states that Appendix RB may be adopted by a certified city, county, or town building code jurisdiction. The Montana Department of Labor and Industry shall not apply or enforce Appendix RB. This appendix does not require solar power generation systems to be installed, but it does establish spaces for installing systems, pathways for connections, and structural capacities for roof systems.

References and Resources

Energy Star New Homes
U.S. Environmental Protection Agency
Energy Efficient New Homes | ENERGY STAR
Recommended Home Insulation R–Values | ENERGY STAR

International Code Council, Inc.
www.iccsafe.org

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

Efficient Windows Collaborative
www.efficientwindows.org

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

NCAT NATIONAL CENTER FOR APPROPRIATE TECHNOLOGY

NorthWestern Energy | Efficiency Plus