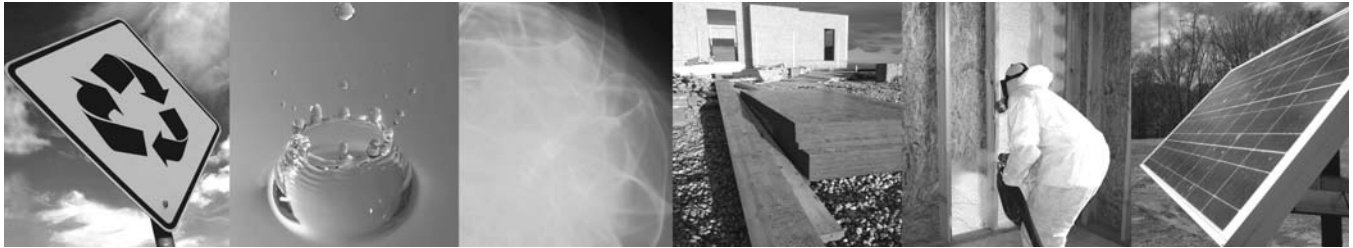
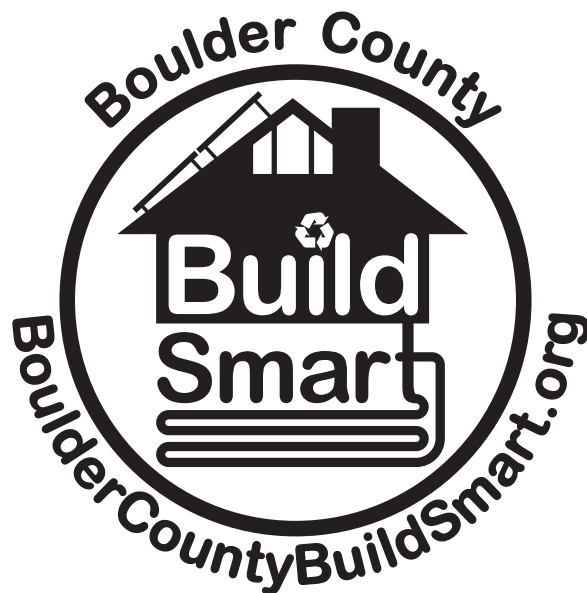


Boulder County

Boulder County BuildSmart Code



Resolution 2010-138: Boulder County BuildSmart (2009 IRC Chapter 11) Effective January 1, 2011



Land Use Department:

Courthouse Annex Building • 2045 13th Street • PO Box 471 • Boulder, CO 80302

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Office Hours: Monday – Friday 8:00 a.m. to 4:30 p.m. • Building Permits can be applied for and issued until 4:00 p.m.

International Residential Code: Chapter 11 • Energy Efficiency

Resolution 2010-30: IRC Chapter 11 (Boulder County BuildSmart) Effective January 1, 2011.

2009 IRC Chapter 11 has been re-written in its entirety. This new version will serve as Boulder County's energy code for one and two family dwellings and conditioned accessory buildings.

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IRC Chapter 11 • Energy Efficiency

2009 IRC Chapter 11 has been re-written in its entirety. This new version serves as Boulder County's energy code for one- and two-family dwellings and conditioned accessory buildings.

IRC Section N1101 General

N1101.1 Scope and Intent. This Chapter 11 implements the provisions of the “Boulder County BuildSmart” program. BuildSmart serves the County's stated goals of promoting and encouraging high performing, sustainable residential development and redevelopment in the unincorporated areas of Boulder County by: Promoting development that will create energy efficient structures that reduce both the production of greenhouse gases from residential buildings and the amount of material sent to landfills; Conserving water and other natural resources in the homebuilding process; and insuring proper indoor air quality. BuildSmart also furthers the goals and measures outlined in the Colorado Climate Action Plan and the County's Sustainable Energy Plan. The production and efficient use of energy will continue to play a central role in the future of Colorado and the nation as a whole. The development, production, and efficient use of renewable energy will advance the security, economic well-being, and public and environmental health of Colorado, as well as contributing to the energy independence of our nation. The 2010 revision to BuildSmart includes both a performance and a prescriptive option for compliance, providing additional flexibility in selection of the most cost-effective design for each project.

N1101.1.1 Requirements for all dwellings. Sections N1101.1 thru Section N1105.3 apply to the conditioned floor area for all one- and two-family dwellings and accessory buildings, as defined in IRC Section R202. Section N1105.2.5.3 provides a Performance Path Option for compliance. Section N1105.2.5.4 provides a Prescriptive Path Option for compliance.

N1101.2 Compliance. Compliance shall be demonstrated by meeting the requirements of this chapter for climate zone 5B.

N1101.2.1 Warm Humid Counties. This section has been deleted and is non-applicable.

N1101.3 Identification and definitions. Materials, systems, and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this chapter.

N1101.3.1 Definitions. Unless otherwise expressly stated, the following words and terms shall, for the purposes of this code, have the meanings indicated in this chapter.

Addition

The placement of or fabrication of a structure that adds floor area to an existing structure. (See definition of floor area in Section R202).

Certified or Accredited Home Energy Rater

A residential energy professional who is certified by the Residential Energy Services Network (RESNET); also referred to as an Energy Rater.

Conditioned Floor Area

The floor area of a building that is heated or cooled or that is constructed with rough-in ducts or piping with the intent of it becoming heated or cooled at a future date. This includes: floor area with a fixed opening (such as a door or doorway) into heated or cooled space and unfinished basement space. Unenclosed unconditioned covered porches, decks and unconditioned garages are not considered conditioned floor area.

Deconstruction

The dismantling of an existing building or portion thereof without the use of heavy machinery or the destruction of the materials. Deconstruction includes the salvage of materials from the existing structure for recycling, resale, or reuse as an alternative to sending them to a landfill. There are two types of deconstruction, structural and non-structural deconstruction.

Non-Structural Deconstruction (also referred to as soft-stripping) is the removal and reclaiming of the reusable non-structural components such as appliances, cabinets, doors, windows, flooring, fixtures, and finish materials.

Structural Deconstruction is the removal and reclaiming of the reusable structural components of a building, such as walls, floors, and roofs.

Deconstruction Professional

A professional engaged in the deconstruction field.

Demolition

The tearing down of an existing structure and the disposal of its components or materials without the implementation of deconstruction techniques.

Energy Efficiency Rating

An unbiased indication of a residential building's relative energy efficiency based on consistent inspection procedures, operating assumptions, climate data, and accepted calculation methods.

Energy Rater

See "Certified or Accredited Home Energy Rater."

Floor Area (as defined in IRC Section R202)

The area of the building, existing or new, under consideration, including basements and attached garages, calculated without deduction for corridors, stairways, closets, the thickness of interior walls, columns, or other features as measured from the exterior face of the exterior walls.

Gross Wall to Floor Area Ratio

The relationship of the total wall area and the total floor area of the conditioned space including the floor area within the outside face of the exterior wall and the wall area measured from the top of the foundation to the bottom of the ceiling including all door and window openings.

HERS Rating

Home Energy Rating System.

Home Energy Rating System

A nationally recognized and accepted method of providing a standardized evaluation of a dwelling's energy efficiency and projected energy costs resulting in a numerical rating based on standardized performances determined by the Residential Energy Services Network ("RESNET").

Performance Path Option

Construction of conditioned space where compliance is measured using the RESNET system to determine anticipated energy consumption and energy efficiency, (HERS Rating System).

Prescriptive Path Option

Construction of conditioned space where compliance is achieved by applying minimum standards to the dwellings thermal envelope, fenestration, lighting, and air leakage, (from Tables N1102.1 & N1102.1.3) Plus Either Table 3 or 4 if applicable.

Reconstructed Dwelling

A dwelling which has been completely deconstructed, deconstructed to the foundation level, or deconstructed to the first floor level.

Remodel/Renovation

Work within the conditioned spaces of an existing dwelling that requires a building permit but does not increase the floor area of the dwelling.

Renewable Energy Systems

Any renewable energy systems which meet the intent of the required on-site renewable energy offset required by other Sections of this code, including solar thermal systems, solar photovoltaic electric systems, geothermal heating systems, wood and pellet burning stoves, boilers, or furnaces, small scale wind generation systems, and other similar systems.

N1101.4 Building thermal envelope insulation. An R-value identification mark shall be applied by the manufacturer to each piece of building thermal envelope insulation 12 inches or more in width. Alternately, the insulation installers shall provide a certification listing the type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope. For blown or sprayed insulation, the initial installed thickness, settled thickness, settled R-value, installed density, coverage area, and number of bags installed shall be listed on the certification. For insulation, the installed thickness shall be listed on the certificate. The insulation installer shall sign; date and mail the certificate or electronically mail the certificate to the Building Division office at the completion of the work.

N1101.4.1 Blown or sprayed roof/ceiling insulation. The thickness of blown in or sprayed roof/ceiling insulation shall be written in inches on markers that are installed a minimum of one in each 300 sq. ft. throughout the insulated space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers a minimum of 1 inch high. Each marker shall face the attic access opening. Spray polyurethane foam thickness and installed R-value shall be listed on the certificate provided by the insulation installer.

N1101.4.2 Insulation mark installation. Insulating materials shall be installed such that the manufacturer's R-value mark is readily observable upon inspection.

N1101.5 Fenestration product rating. U-factors of fenestration products, including windows, doors, and skylights, shall be determined in accordance with NFRC 100 by an accredited, independent laboratory, and labeled and certified by the manufacturer.

Table N1101.5.2 Default Door U-Factors

Door Type	U Factor
Uninsulated metal	1.2
Insulated metal	0.6
Wood	0.5
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

N1101.6 Insulation product rating. The thermal resistance (R-value) of insulation shall be determined in accordance with Section N1105.2.5.3 and Section N1105.2.5.4.

N1101.7 Installation. All materials, systems, and equipment shall be installed in accordance with the manufacturer's installation instructions and the provisions of this code.

N1101.7.1 Protection of exposed foundation insulation. Insulation applied to the exterior of basement walls, crawl space walls, and the perimeter of slab-on-grade floors shall have a rigid, opaque, and weather-resistant protective covering to prevent the degradation of the insulation's thermal performance. The protective covering shall cover the exposed exterior insulation and extend a minimum of 6 inches below grade.

N1101.8 Above code programs. This section has been deleted and is non-applicable.

N1101.9 Certificate. A certificate bearing the address of the residence shall be completed by the installer. The certificate shall list the predominant R-values of the insulation installed in or on the ceiling/roof, walls, foundation, slab, basement slab, crawlspace wall or floor, and ducts outside conditioned spaces, U-factors for fenestration, and the solar heat gain coefficient of fenestration. Where there is more than one value for each component, the certificate shall list the value covering the largest area. The certificate shall be mailed or electronically mailed to the Building Division at the completion of the work.

Exception: Projects constructed in conformance with the Performance Path Option.

N1101.10 Renewable energy requirements. Whenever renewable energy systems are required by this chapter, those systems must be constructed on-site. If an applicant's property is situated in a part of the county where state law permits local utility companies to operate "solar gardens," "solar farms," or similar community renewable energy facilities, the renewable energy requirements of Chapter 11 may also be satisfied off site through the purchase of an adequate share in a community facility, at the discretion of the Chief Building Official. At a minimum, an "adequate" share in a community facility must (1) enable the production of an equivalent amount of power compared to what the applicant would otherwise be required to produce on-site; (2) be purchased from a facility located within Boulder County or a county contiguous to Boulder County; and (3) given that such shares do not automatically run with the applicant's land, include a mechanism that ensures the share cannot be sold or modified in any way without the consent of Boulder County, with the exception of legal transfer to the applicant's successors-in-interest for use on the same property. Written proof that these requirements are met must be filed with the Building Department before a Certificate of Occupancy will be issued.

IRC Section N1102 Building Thermal Envelope

N1102.1 Insulation and fenestration criteria. The building thermal envelope shall meet the requirements of Tables N1102.1 and N1102.1.2 or be constructed as prescribed by the Energy Rater.

IRC Table N1102.1

Insulation and Fenestration Requirements by Component	
Fenestration U-Factor	0.35
Skylight U-Factor	0.45
Ceiling R-Value	54
Wood Frame Wall R-Value	19+10 ^d
Mass Wall R-Value ^a	18/24
Floor ^f R-Value	42
Basement ^b Wall R-Value	15/20
Slab ^c Edge R-Value and Depth	15, 3 ft.
Crawl Space ^b Wall R-Value	15/20
Additional Requirements	
Maximum Glazing to Floor Area Ratio	18%
Maximum Air Leakage ⁱ	5 ACH at 50 Pascals
Appliances (New or Replaced)	Energy Star Certified
Lighting Fixtures	80% CFL or equal
Insulation Installation Standards	RESNET grade 1 standards
Furnaces And Boilers ^{g,h}	92% AFUE With ECM Blower Motors
Water Heaters ^{g,h}	82 EF

Note: R-Values are minimums. U-factors and solar heat gain coefficients (SHGC) are maximums. R-19 batts compressed in to nominal 2 x 6 framing cavity such that the R-value is reduced by R-1 or more shall be marked with the compressed batt R-value in addition to the full thickness R-value.

- a. The second R-value applies when more than half the insulation is on the interior.
- b. The first R-value applies to continuous insulation, the second to framing cavity insulation; either insulation meets the requirement.
- c. R-5 shall be added to the required slab edge R-values for heated slabs and the entire underside of the heated slab shall be insulated with a minimum R-Value of 10.
- d. "19 + 10" means R-19 cavity insulation plus R-10 insulated sheathing. If structural sheathing covers 25% or less of the exterior, R-10 sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-5.
- e. When more than half the insulation is on the interior, the mass wall U-factor shall be the same as the frame wall U-factor.
- f. Floors over conditioned space are exempt from this requirement.
- g. Permits issued for the replacement of existing furnaces, boilers, and water heaters are exempt from these requirements.
- h. For projects involving additions and remodels furnace and water heaters only need to meet these requirements if they are replaced.
- i. Seven (7) Air Changes per Hour (ACH) at 50 Pascals for additions and remodels.

N1102.1.1 R-value computation. Insulation materials used in layers, such as framing cavity insulation and insulating sheathing, shall be summed to compute the component R-value. The manufacturer's settled R-value shall be used for blown insulation. Computed R-values shall not include an R-value for other building materials or air films.

Exception: Where the energy efficiency is being determined by using the HERS the required insulation R-value shall be determined by the Energy Rater.

N1102.1.2 U-factor alternative. An assembly with a U-factor equal to or less than that specified in Table N1102.1.2 shall be permitted as an alternative to the R-value in Table N1102.1.

IRC Table N1102.1.2 Equivalent U-Factors

Equivalent U-Factors	
Ceiling U-Factor	0.020
Wood Frame Wall U-Factor	0.039
Mass Wall U-Factor*	0.056
Floor U-Factor	0.026
Basement Wall U-Factor	0.067/0.05
Slab U-Factor and Depth	0.067, 3 ft.
Crawl Space Wall U-Factor	0.05

Note: R-Values are minimums. U-factors and solar heat gain coefficients (SHGC) are maximums. R-19 batts compressed in to nominal 2 x 6 framing cavity such that the R-value is reduced by R-1 or more shall be marked with the compressed batt R-value in addition to the full thickness R-value.

* When more than half the insulation is on the interior, the mass wall U-factor shall be the same as the frame wall U-factor.

N1102.1.3 Total UA alternative. If the total building thermal envelope UA (sum of U-factor times assembly area) is less than or equal to the total UA resulting from using the U-factors in Table N1102.1.2 (multiplied by the same assembly area as in the proposed building), the building shall be considered in compliance with Table N1102.1. The UA calculation shall be done using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials. The SHGC requirements shall be met in addition to UA compliance.

N1102.2 Specific insulation requirements.

N1102.2.1 Ceilings with attic spaces. This section has been deleted and is non-applicable.

N1102.2.2 Ceilings without attic spaces. This section has been deleted and is non-applicable.

N1102.2.3 Access hatches and doors. Access doors from conditioned spaces to unconditioned spaces shall be weather stripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access shall be provided to all equipment, which prevents damaging or compressing the insulation. A wood framed or equivalent baffle or retainer is required to be provided when loose fill insulation is installed, the purpose of which is to prevent the loose fill insulation from spilling into the living space when the attic access is opened and to provide a permanent means of maintaining the installed R-value of the loose fill insulation.

N1102.2.4 Mass walls. Mass walls, for the purposes of this chapter, shall be considered above-grade walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick other than brick veneer, earth or compressed or rammed earth, and solid timbers or logs.

N1102.2.5 Steel-frame ceilings, walls, and floors. Dwellings constructed with steel-framed ceilings, walls, or floors must be constructed in accordance with Section N1105.2.5.3 in accordance with the Performance Path Option.

N1102.2.6 Floors. Floor insulation shall be installed to maintain permanent contact with the underside of the sub floor decking.

N1102.2.7 Basement walls. Exterior walls associated with conditioned basements shall be insulated from the top of the basement wall down to 10 feet below grade or to the basement floor, whichever is less. Exterior basement wall insulation associated with conditioned space must be continuous from the top of the foundation wall to the top of the footing and protected as prescribed in Section N1101.8.1. Walls associated with unconditioned basements shall meet this requirement unless the floor above is insulated in accordance with Section N1102.2.6 and Table N1102.1.

N1102.2.8 Slab-on-grade-floors. Slab-on-grade floors with a floor surface less than 12 inches below grade shall be insulated on the perimeter in accordance with Table N1102.1. The insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall be extended the distance provided in Table N1102.1 by any combination of vertical insulation, or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by a minimum of 10 inches of soil. The top edge of the insulation installed between the exterior wall and the edge of the interior slab shall be permitted to be cut at a 45-degree angle away from the exterior wall.

N1102.2.9 Crawlspaces.

N1102.2.9.1 Crawlspace grade. Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder with a minimum thickness of 10 mils. All joints of the vapor retarder shall overlap by 6 inches and be sealed and taped. The edges of the vapor retarder shall extend at least 6 inches up the stem wall and shall be attached to the stem wall.

N1102.2.9.2 Crawlspace insulation.

N1102.2.9.2.1 Conditioned crawlspaces and unvented crawlspaces. Conditioned crawlspaces and unvented crawlspaces shall be provided with insulation in compliance with Table N1102.1. The insulation must be permanently fastened to the wall and extend downward from the floor to the finished grade level and then vertically and/or horizontally for at least an additional 24 inches.

N1102.2.9.2.2 Ventilated crawlspaces. Ventilated crawlspaces shall be provided with cavity insulation in accordance with Table N1102.1.

N1102.2.9.3 Crawlspace ventilation. Additions that result in an increase in conditioned floor area of 50% or more of the pre-existing dwelling and remodels/renovations where 50% or more of the existing finished wall membrane is removed shall have crawlspaces that are conditioned in accordance with IRC Section R408.3(2.)(2.2.).

Exception: For additions which do not result in an increase in conditioned floor area of 50% or more of the pre-existing dwelling and remodels/renovations where less than 50% of the existing finished wall membrane is removed, crawlspaces may be ventilated in compliance with any of the methods permitted under IRC Section R408.

N1102.2.10 Masonry veneer. Insulation shall not be required on the horizontal portion of the foundation that supports a masonry veneer.

N1102.2.11 Thermally isolated sunrooms. This section has been deleted and is non-applicable.

N1102.3 Fenestration.

N1102.3.1 U-factor. An area-weighted average of fenestration products shall be permitted to satisfy the U-factor requirements.

N1102.3.2 Glazed fenestration SHGC. This section has been deleted and is non-applicable.

N1102.3.3 Glazed fenestration exemption. This section has been deleted and is non-applicable.

N1102.3.4 Opaque door exemption. One side-hinged opaque door assembly up to 24 square feet in area is exempted from the U-factor requirement in Section N1101.5(2). This exemption shall not apply to the U-factor alternative approach in Section N1102.1.2 and the Total UA alternative in Section N1102.1.3.

N1102.3.5 Thermally isolated sunroom U-factor. This section has been deleted and is non-applicable.

N1102.3.6 Replacement fenestration. Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for U-factor in Table N1102.1.

N1102.4 Air leakage.

N1102.4.1 Building thermal envelope. The building thermal envelope shall be durably sealed to limit infiltration. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weather-stripped, or otherwise sealed with an air barrier material, suitable film, or solid material.

1. All joints, seams, and penetrations.
2. Site-built windows, doors, and skylights.
3. Openings between window and door assemblies and their respective jambs and framing.
4. Utility penetrations.
5. Dropped ceilings or chases adjacent to the thermal envelope.
6. Knee walls.
7. Walls and ceilings separating the garage from conditioned space.
8. Behind tubs and showers on exterior walls.
9. Common walls between dwelling units.
10. Attic access openings.
11. Rim joists junction.
12. Other sources of infiltration.

N1102.4.2 Air sealing and insulation. Building envelope air tightness and insulation installation shall comply with Section N1102.4.2.1.

N1102.4.2.1 Testing. Tested air leakage is less than 5 ACH when tested with a blower door at a pressure of 50 Pascals (7ACH at 50 Pa for additions and remodels). Testing shall occur after rough in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation, and combustion appliances.

During testing:

1. Exterior windows and doors, fireplace, and stove doors shall be closed, but not sealed.
2. Dampers shall be closed, but not sealed including exhaust, intake, makeup air, back draft, and flue dampers.
3. Interior doors shall be open.
4. Exterior openings for continuous ventilation systems and heat recovery ventilators shall be closed and sealed.
5. Heating and cooling systems(s) shall be turned off.
6. HVAC ducts shall not be sealed.
7. Supply and return registers shall not be sealed.

N1102.4.3 Fireplaces. This section has been deleted and is non-applicable.

N1102.4.4 Fenestration air leakage. Windows, skylights, and sliding glass doors shall have an air infiltration rate of no more than 0.3 cubic foot per minute per square foot, and swinging doors no more than 0.5 cubic foot per minute per square foot when tested according to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory, and listed and labeled by the manufacturer.

Exception: Site-built widows, skylights, and doors that serve unconditioned space.

N1102.4.5 Recessed Lighting. Recessed luminaires installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and labeled as meeting ASTM E 283 when tested a 1.57 psi pressure differential with not more than 2.0 cfm of air movement from the conditioned space to the ceiling cavity. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

IRC Section N1103 Systems

N1103.1 Controls. At least one thermostat shall be installed for each separate heating and cooling system.

N1103.1.1 Programmable thermostat. Where the primary heating system is a forced air furnace, at least one thermostat per dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55 degrees F or up to 85 degrees F. The thermostat shall initially be programmed with a heating temperature set point no higher than 70 degrees F and a cooling temperature set point no lower than 78 degrees F.

N1103.1.2 Heat pump supplementary heat. Heat pumps having supplementary electric-resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.

N1103.1.3 Equipment design. New equipment installed for heating, cooling, or ventilation must be designed and sized based on building loads in accordance with ACCA Manual J or other approved software or methodologies. Calculations must be provided to the Building Division prior to scheduling the rough inspection.

Exception: Submittal of calculations is not required for permits issued only for the replacement of existing equipment in existing dwellings.

N1103.2 Ducts. New ductwork installed in new dwellings, additions, and existing dwellings shall be located inside the buildings thermal envelope unless structural or design conditions make this type of installation impossible.

N1103.2.1 Insulation. Supply ducts in attics shall be insulated to a minimum of R-8. All other ducts shall be insulated to a minimum of R-6.

N1103.2.1.1 Duct design. New duct systems serving heating, cooling, and ventilation equipment shall be designed in accordance with ACCA Manual D or other approved software. Design calculations must be provided to the Building Division prior to scheduling the rough inspections.

Exception: Submittal of calculations for ductwork is not required for existing ductwork or for existing ductwork serving replacement appliances.

N1103.2.2 Sealing. Ducts, air handlers and filter boxes shall be sealed. Joints and seams shall comply with IRC Section M1601.4. Framed building cavities shall not be used as ducts. Duct tightness shall be verified by:

- 1. Post-construction test:** Leakage to outdoors shall be less than or equal to 8 cubic feet per minute (cfm) per 100 square feet of conditioned floor area or a total leakage less than or equal to 12 cfm of conditioned floor area when tested at a pressure differential of 0.1 inch w. g. (25 Pascals) across the entire system, including the manufacturer's air handler end closure. All register boots shall be taped or otherwise sealed during the test. If the air Handler is not installed at the time of the test, total leakage shall be less than or equal to 4 cfm of conditioned floor area.
- 2. Rough-in test:** Total leakage shall be less than or equal to 6 cfm per 100 ft.2 of conditioned floor area when tested at a pressure differential of 0.1 inch w.g. (25 Pascals) across the roughed in system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test. If the air handler is not installed at the time of the test, total leakage shall be less than or equal to 4 cfm per 100 ft2 of conditioned floor area.

N1103.2.3 Building Cavities. Building framing cavities shall not be used as supply or return ducts.

N1103.3 Mechanical system piping insulation. Mechanical system piping capable of carrying fluids above 105 degrees F or below 55 degrees F shall be insulated to a minimum of R-3.

N1103.4 Circulating hot water systems. All circulating service hot water piping shall be insulated to at least R-2. Circulating hot water systems shall include an automatic or readily accessible manual switch that can turn off the hot water circulating pump when the system is not in use.

N1103.5 Mechanical ventilation. Mechanical ventilation. Mechanical ventilation of all habitable spaces is required for new dwellings and for additions and remodels/renovations in accordance with this subsection. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

N1103.5.1 Minimum required ventilation. In addition to and in lieu of the requirements of IRC Section R303.1, all residences must be provided with mechanical ventilation. All habitable rooms must be supplied with a mechanical ventilation system capable of producing an air flow in conformance with Table N1103.5.1.

Exception: Additions that result in an increase in conditioned floor area of less than 50% of the pre-existing dwelling and remodels/renovations where less than 50% of the existing finished wall membrane is removed.

IRC Table N1103.5.1 Ventilation Air Requirements in Cubic Feet Per Minute

Floor Area (square feet)	Bedrooms				
	0-1	2-3	4-5	6-7	>7
< 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	150
6,001-7,500	90	105	120	135	150
>7,500	105	120	135	150	165

* For SI: 1 square foot = 1 square foot=0.0929 m2.

Alternative Method of Calculating Ventilation Air Requirements:

$$Q_{fan} = 0.01 A_{floor} + 7.5 (N_{br} + 1)$$

Where:

Q_{fan} = fan flow rate in cubic feet per minute (cfm).

A_{floor} = floor area in square feet (ft²)

N_{br} = number of bedrooms; not to be less than 1

N1103.6 Equipment sizing. Heating and cooling equipment shall be sized as specified in IRC Sec M1401.3.

N1103.7 Snow melt systems.

N1103.7.1 Controls. Snow and ice melting systems supplied through energy service to the building shall include automatic controls capable of shutting off the system when the pavement temperature is above 50 degrees F. and no precipitation is falling and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40 degrees F.

N1103.7.2 Design. Energy use by snow and ice melt systems must be offset by on-site renewable energy generation equivalent to the energy used by the snow and ice melting equipment. Plans must be submitted that detail the type, size and location of the on-site renewable energy generation equipment.

Note: A separate building permit is required for on-site renewable energy generation equipment.

N1103.7.2.1 Design criteria for supporting on-site renewable energy equipment. On-site renewable energy generation equipment installed to offset the energy used by snow and ice melt systems must be designed to provide 34,425 BTUs per square foot per year.

N1103.8 Swimming Pools. Swimming pools must be provided with energy conservation measures in accordance with Section N1103.8.1 through N1103.8.6, or be unheated. Heated pools must be heated by solar thermal or other equipment that does not rely directly or indirectly on the burning of fossil fuels or they must have their energy use offset by on-site renewable energy generation equipment equivalent to the energy use by the swimming pool. The energy use shall be determined as follows:

Exception: Swimming pools less than 200 sq. ft. in area are exempt from the requirements to provide renewable energy.

N1103.8.1 Pool heaters. All pool heaters shall be equipped with a readily accessible on-off switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas or LPG shall not have continuously burning pilot lights.

N1103.8.2 Time switches. Time switches that can automatically turn heaters and pumps off and on according to a preset schedule shall be installed on swimming pool heaters and pumps.

Exception: Where pumps are required to operate solar and waste heat recovery pool heating systems.

N1103.8.3 Pool Covers. Heated pools shall be equipped with a vapor retardant pool cover on or at the water surface. Pools heated to more than 90 degrees F shall have a pool cover with a minimum insulation value of R-12.

N1103.8.4 Filters. Swimming pool filters must be cartridge-type filters.

N1103.8.5 Pumps. Swimming pool pumps must be multi-speed pumps.

N1103.8.6 Energy conservation design standards for swimming pools. For the purpose of calculating the energy use of swimming pools, the following are assumed.

Note: This Section is not intended to limit the season or temperature of swimming pools.

Swimming Pool Season:

Outdoor Pools	3 months
Indoor Pools	12 months

Pool Heating Temperature:

82 degrees Fahrenheit or less.

On-Site Renewable Energy Requirements:

29,000 BTUs per square foot of pool surface area per year.

N1103.9 Spas. Any energy use by indoor or outdoor spas must be offset by on-site renewable energy generation equivalent to the energy use by the spa. Plans must show the annual energy use of the spa, the calculation method used to determine the expected energy use, and the on-site renewable energy system(s) which will be used to offset the energy used by the spa. All spas must be equipped with an insulated cover that is listed to provide a minimum R-value of at least 12.

Exception: New Spas and hot tubs which have been tested and listed for compliance with the requirements of the California Energy Commission (CEC) Title 20 (Standby power for portable electric spas shall not be greater than $5[V^{2/3}]$ watts where V=the total volume of the spa in gallons), and are less than 64 square feet in surface area shall be exempted from the requirement to offset their energy usage by on-site renewable energy generation. Spas larger than 64 sq. ft. in surface area that are certified to meet the requirements of the CEC shall offset their requirements at the rate of 140,000 BTUs per square foot per year.

N1103.9.1 Design criteria for spas. The requirements of this Section apply to spas that do not meet the standards in Section N1103.9.

Spa Season:

Season	12 months
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On-Site Renewable Energy Requirements:

430,000 BTUs per square foot per year.

N1103.10 Other exterior energy uses. Exterior energy uses, with the exception of cooking appliances, must be offset with on-site renewable energy production.

IRC Section N1104 Lighting Systems

N1104.1 High-efficacy lamps. A minimum of 80 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps.

IRC Section N1105 Sustainability

N1105.1 Applicability. This Section implements the provisions of the Boulder County BuildSmart program. This Chapter applies to new one and two family dwellings and residential accessory buildings as defined in IRC Section R202, and all related residential construction work that requires a building permit including: renovated dwellings, remodeled dwellings, moved dwellings, additions to existing dwellings, and combined additions and/or remodels/renovations. Sections N1101.1 through Section N1105.3 apply to the conditioned floor area of all one- and two-family dwellings and accessory buildings as defined in IRC Section R202. Section N1105.2.5.3 provides a Performance Path Option for compliance. Section N1105.2.5.4 provides a Prescriptive Path Option for compliance. All work not constructed using the Performance Path Option shall be done in accordance with the Prescriptive Path Option.

Exception: Federally-certified manufactured dwellings and state-certified factory-built dwellings.

N1105.2 Required Elements.

N1105.2.1 Deconstruction. All existing buildings and portions thereof requiring removal of building materials must be deconstructed as defined in this Section. Demolition is not permitted.

N1105.2.1.1 Penalty. Buildings that are demolished or partially demolished rather than deconstructed will, at the discretion of the Building Official, be issued a Stop Work notice for a period not exceeding 30 days.

N1105.2.1.2 Documentation of Intent to Deconstruct. Documentation of intent to deconstruct. Documentation of intent to deconstruct consisting of a deconstruction plan, a written description of deconstruction work, or the County Deconstruction Checklist must be provided at building permit application. The documentation of intent to deconstruct must include: the name of the Deconstruction Contractor, a list of the materials to be recovered, donated, or reused, and the destination of the materials. The documentation must include both Nonstructural Deconstruction and Structural Deconstruction. Items which must be donated, sold, or re-used include: cabinets, dimensional lumber, flooring, and solid core doors.

N1105.2.1.3 Verification of deconstruction of a structure. The completion of deconstruction as approved on the deconstruction plan must be verified by the Building Division. The owner or deconstruction contractor shall provide written verification of deconstruction by means of receipts or a written log, maintained by the homeowner or general contractor, which includes the volume or weight of materials and the destination where they were transported to the Building Division office. Verification must be received prior to scheduling the rough inspections.

N1105.2.2 Construction Jobsite Waste Reduction and Recycling. All construction jobsite waste must be recycled including wood, scrap metal, cardboard, and concrete. Labeled containers must be provided at the construction-site for use in capturing recyclable material. A mixed load container may be used if that container is being sent to a waste/recycling center that will verify the weight of recycled material recovered from that mixed load.

N1105.2.2.1 Documentation of Intent to Recycle. Documentation of intent to recycle which consists of a recycling plan, a written description of recycling activity, or the submittal of the County Recycling Checklist must be provided at building permit application. The documentation must clearly show how the requirements of Section 1105.2.1 will be met and must specify the locations of recycling containers and the destination where material will be recycled.

N1105.2.2.2 Verification. Field inspection will be made by the Boulder County Building Division during the construction process to assure that recycling containers have been placed on-site. Prior to the final inspection, documentation must be provided to the Building Division office by the owner or waste/recycling contractor indicating the weight or volume of materials diverted from the waste stream. Materials that must be recycled include: appliances, concrete, metals, cardboard, and wood (except pressure treated or painted wood), and thermostats and other devices containing mercury. Other materials which are accepted by the waste/recycling contractor must also be recycled.

N1105.2.3 Indoor water conservation.

N1105.2.3.1 Requirements. The following new and replacement plumbing fixtures must be labeled as meeting EPA Water Sense (www.epa.gov/WaterSense/) criteria: Bathroom sink faucets, shower heads, toilets, and urinals.

Exception: Showerheads with a maximum flow of 2.0 gpm, urinals with a flush rate of .5 gallons per flush.

N1105.2.4 Indoor air quality.

N1105.2.4.1 Attached garages. Doors between attached garages and living space shall be weather stripped to the degree necessary to make them airtight and shall be self-closing and self-latching.

N1105.2.5 Energy Conservation. The provisions of this Section apply to conditioned portions of one and two family dwellings and conditioned accessory buildings as defined in IRC Section R202. Dwellings and accessory buildings with new, remodeled/renovated, conditioned floor area as defined in Section N1101.4.1 shall be constructed in accordance with either the Performance Path Option in Section N1105.2.5.3.2 or in accordance with the Prescriptive Path Option in Section N1105.2.5.4.

Exception: Federally-certified manufactured dwellings and state-certified factory-built dwellings.

N1105.2.5.1 Construction. Conditioned floor area within new dwellings, additions to dwellings, remodeled dwellings, and accessory buildings that contain conditioned space shall be constructed in accordance with for the Performance Path Option in Section N1105.2.5.3.2 or in accordance with the Prescriptive Path Option in Section N1105.2.5.4. All work that is not done in accordance with the Performance Path Option must meet the requirements of the Prescriptive Path Option.

N1105.2.5.2 Calculation of energy usage for projects using the Performance Path Option. Energy conservation requirements of this Section will be calculated by using the HERS Index applicable on the date of the adoption of this Chapter.

Exception: Dwellings constructed in accordance with the Prescriptive Path in Section N1105.2.5.4.

N1105.2.5.3 Performance Path Option requirements. The provisions of this Section apply to the conditioned floor area of all new one- and two-family dwellings, additions of conditioned floor area to one- and two-family dwellings, and remodels of the conditioned floor area of one- and two-family dwellings unless the design and construction complies with the Prescriptive Path Option of Section N1105.2.5.4.

N1105.2.5.3.1 New dwellings and reconstructed dwellings. The requirements of this subsection apply to the conditioned floor area of new dwellings and reconstructed dwellings constructed in accordance with the Performance Path Option. New dwellings and reconstructed dwellings shall meet the HERS Index Rating shown on Table 1. A RESNET model prepared by an Energy Rater shall be provided with the building permit application showing compliance with the required HERS Index Rating.

N1105.2.5.3.2 Performance Path Option requirements for additions to existing dwellings. The requirements of this subsection apply to the total combined conditioned floor area of existing dwellings and the new conditioned floor area of additions. The required HERS rating will be first determined by applying Figure 1. The combined new and existing conditioned floor area must comply with Table 1 or Table 2 as indicated by Figure 1. A RESNET model prepared by an Energy Rater must be provided with the building permit application showing compliance with the required HERS Index rating.

N1105.2.5.3.3 Performance Path Option requirements for remodels. Remodel/renovations of conditioned interior spaces including basement spaces must meet the requirements of this subsection unless constructed in accordance with the Prescriptive Path Option in Section N1105.2.5.4. A RESNET model prepared by an Energy Rater must be provided with the building permit application showing that the entire dwelling can achieve a HERS rating of at least 80.

N1105.2.5.3.4 Performance path option requirements for basement finishes. Basement finishes (the finishing of previously unfinished conditioned basement space) must meet the requirements of this subsection unless constructed in accordance with the Prescriptive Path Option in Section N1105.2.5.4. A RESNET model prepared by an Energy Rater must be provided with the building permit application which demonstrates that the total conditioned floor area of the dwelling has achieved a HERS rating of 80.

N1105.2.5.3.5 Performance Path Option requirements for accessory buildings. Detached accessory structures as defined in IRC Section R202 that contain conditioned space that are constructed in accordance with the Performance Path Option must meet the HERS Rating shown on Table 1. As an alternative, an acceptable analysis may be presented by an Energy Rater demonstrating that the building design achieves the applicable percent above current code. The RESNET energy model or analysis must be provided with the building permit application.

N1105.2.5.3.6 Performance path option for relocated dwellings. Dwellings relocated from one building site to another, or to a new location on the same site shall meet the requirements of Section N1105.2.5.3.3 for renovations/remodels.

N1105.2.5.3.7 Inspection requirements for projects constructed under the performance path option.

N1105.2.5.3.7.1 During construction. An Energy Rater must perform a pre-drywall inspection including a duct blaster test (if applicable) to ensure the ability of the residence to achieve the required HERS Index rating. **Prior to the installation of the wall or ceiling finish materials,** the owner or contractor must submit verification of the Energy Rater's inspection to the Building Division office which certifies that the building has been constructed in conformance with the RESNET model.

N1105.2.5.3.7.2 Final inspection Upon completion of construction and prior to final building inspection approval, or (if applicable) issuance of a Certificate of Occupancy an Energy Rater must perform a final inspection which includes a blower door test and submit documentation to the Building Division office certifying that the residence meets the applicable HERS Index rating, (final HERS certificate).

N1105.2.5.4 Prescriptive Path Option requirements. As an alternative to compliance with the Performance Path Option requirements in Section N1105.2.5.3, the conditioned floor area of new dwellings, additions, remodels/ renovations, as well as combinations thereof, may be constructed in accordance with the Prescriptive Path Option. Dwellings constructed in compliance with the Prescriptive Path Option must conform to Tables N1102.1, N1102.1.2, and, as applicable, Tables 3 and 4.

Exceptions:

1. New dwellings with conditioned floor area exceeding 6,000 sq. ft. must be constructed in accordance with the Performance Path Option in Section N1105.2.5.3.
2. Additions where the combined new and existing conditioned floor area exceeds 6,000 sq. ft. must be constructed in accordance with the Performance Path Option in Section N1105.2.5.3.

N1105.2.5.4.1 New dwellings and reconstructed dwellings constructed using the prescriptive path option. Conditioned areas of new and reconstructed dwellings designed and constructed to meet the Prescriptive Path requirements must conform to the values in Table N1102.1 or Table N1102.1.2. Dwellings with conditioned floor area in excess of 3,000 sq. ft. must also comply with Table 3.

N1105.2.5.4.2 Additions to existing dwellings constructed using the prescriptive path option. Additions which result in a total conditioned floor area (new and existing) of 3,000 sq. ft. or less must conform to the values of Table N1102.1 or Table N1102.1.2. Additions which result in a total conditioned floor area of not more than 6,000 sq. ft. must also conform to the values of Table 4.

N1105.2.5.4.3 Remodels/renovations constructed using the prescriptive path option. Remodels/renovations in existing dwellings including basement spaces must conform to the values of Table N1102.1 or Table N1102.1.2.

N1105.2.5.4.4 Basement finishes constructed using the prescriptive path option. Basement finishes (the finishing of previously unfinished conditioned basement space) must conform to the values of Table N1102.1 or Table N1102.1.2.

N1105.2.5.4.5 Accessory buildings constructed using the prescriptive path option. Accessory buildings must conform to the values of Table N1102.1 or Table N1102.1.2.

N1105.2.5.4.5.1 Garages and shops. Garages and shops that contain conditioned floor area that are equipped with overhead doors must have fully weather stripped overhead doors with a minimum R-value of 13. Such doors must be weather stripped at the top, sides, bottom, and between the panels.

N1105.2.5.4.6 Relocated dwellings. Dwellings which have been moved to a new location on a parcel or dwellings which have been moved from one parcel to another must comply with the requirements of this Section.

N1105.2.5.4.6.1 New construction. New construction associated with the relocation of the building must conform to Table N1102.1 or Table N1102.1.2.

N1105.2.5.4.6.2 Existing building. The existing portions of the relocated building must conform to the requirements of Section N1105.2.5.4.7 for Requirements for the Existing Portions of Dwellings for Additions and Remodels/Renovations.

N1105.2.5.4.7 Prescriptive path option requirements for additions and remodels/renovations. Existing portions of dwellings shall be upgraded in accordance with this subsection:

Exception: The following projects are not required to comply with items 1 - 5 of Section N1105.2.5.4.7.1 or items 1 - 3 of Section N1105.2.5.4.7.2:

1. Window replacements.
2. Bathroom remodel/renovation projects limited to the replacement of fixtures and cabinets.
3. Kitchen remodel/renovation projects limited to the replacement of cabinets, counter tops, fixtures and appliances.

N1105.2.5.4.7.1 Additions that result in an increase in conditioned floor area of 50% or more of the pre-existing dwelling and remodels/renovations where 50% or more of the existing finished wall membrane is removed:

1. The insulation in the existing attic must be upgraded to a value of R-38. Vaulted or cathedral ceiling cavities must be completely filled with insulation.
2. The existing dwelling must achieve a maximum air leakage of 7 air changes per hour measured at 50 pascals.
3. Mechanical ventilation is required in compliance with Section N 1103.5.
4. Crawlspace walls must be insulated in compliance with Table N1102.1 or Table N1102.1.2.
 - a. A Class 1 vapor retarder shall be placed on the crawlspace grade with joints sealed and overlapped a minimum of 6 inches and edges extending at least 6 inches on to the stem wall and sealed.
 - b. The crawlspace must be provided with continuously-operated mechanical exhaust ventilation at a rate of 1 cu. ft./minute for each 50 sq. ft. of crawlspace floor area including an air pathway to the common area such as a duct or transfer grill. (see IRC Section R408) As an alternative to the continuously operated mechanical exhaust ventilation, a conditioned air supply of at least 1 cu. ft./minute for each 50 sq. ft. of crawlspace area and a return air pathway to the common area may be provided (see IRC Section R408).
5. A minimum of 50 percent of the lamps in existing permanently installed lighting fixtures shall be high-efficacy lamps.

N1105.2.5.4.7.2 Additions that result in an increase in conditioned floor area of less than 50% of the pre-existing dwelling and remodels/renovations where less than 50% of the existing finished wall membrane is removed:

1. The insulation in the existing attic must be upgraded to a value of R-38. Vaulted or cathedral ceiling cavities must be completely filled with insulation.
2. The existing dwelling must achieve a maximum air leakage of 7 air changes per hour measured at 50 pascals.
3. A minimum of 50 percent of the lamps in existing permanently installed lighting fixtures shall be high-efficacy lamps.

Exception: Additions and remodels/renovations which result in less than 500 sq. ft. of conditioned floor area must be caulked and weather stripped, but need not be tested for air leakage.

N1105.2.5.4.8 Inspection requirements for projects constructed under the prescriptive path option.

During construction

1. An Energy Rater must perform an insulation inspection. Insulation must meet RESNET Grade 1 Standard.
2. An Energy Rater must perform a duct blaster test (when applicable). Duct leakage must not exceed 8 cfm per 100 sq. ft. of conditioned floor area or a total leakage less than or equal to 12 cfm of conditioned floor area when tested at a pressure differential of 0.1 inch w. g. across the entire system (25 Pascals), including the manufacturer's air handler enclosure.
3. An Energy Rater must verify the installation of the mechanical ventilation equipment and the ventilation rate of flow.

Exception: For additions and renovations/remodels that result in less than 500 sq. ft. of conditioned floor area, an insulation certificate shall be posted in compliance with Section N1101.9, but a duct blaster test will not be required.

Upon completion of construction and prior to final building inspection approval, an Energy Rater must perform a blower door test and submit documentation to the Building Division office verifying that air leakage does not exceed 5 air changes per hour at 50 pascals of pressure.

Exception: Air leakage not exceeding 7 air changes per hour (ACH50) at 50 Pascals (PA) of pressure is permitted for additions and remodels/renovations.

N1105.3 Modifications. The Chief Building Official may make modifications to the requirements of this Chapter as allowed in Section 104.10 of the Boulder County Building Code if it is determined that strict application of the requirements of this Chapter:

1. Creates practical difficulties or excessive expense in the upgrade of an existing residential structure.
2. Requires alteration to either a structure greater than 50 years in age or any structure in a historic district or site which would materially alter the historic integrity of that structure or adversely affect the historic integrity of the district or site.
3. Creates practical difficulties in meeting on-site renewable energy requirements due to topographic constraints associated with the lot or location of the structure.

In assessing whether a request for a modification should be granted, the Chief Building Official shall, in consultation with the staff and/or an Energy Rater retained by the Building Official at the applicant's expense, determine whether the strict application of this Chapter creates a situation described in items 1 through 3 listed above. If it is determined that the request warrants a modification on this basis, the Chief Building Official shall determine what appropriate mitigation measures shall be required to ensure that the structure meets the intent and spirit of this Chapter. Appropriate mitigation measures may include requiring additional energy-saving or resource-efficient construction methods or materials, sustainable framing techniques, use of environmentally friendly materials, adoption of water-saving landscaping and irrigation, or similar conservation measures.

How To Use Figure 1:

First, calculate the Total Conditioned Floor Area of your project by adding the area of the addition to the area of the existing dwelling, then calculate the Percent of Increase to the Existing Structure by dividing the area of the addition by the area of the existing dwelling.

Take the results of these two calculations and plot their intersecting point on Figure 1 to determine the next steps for compliance.

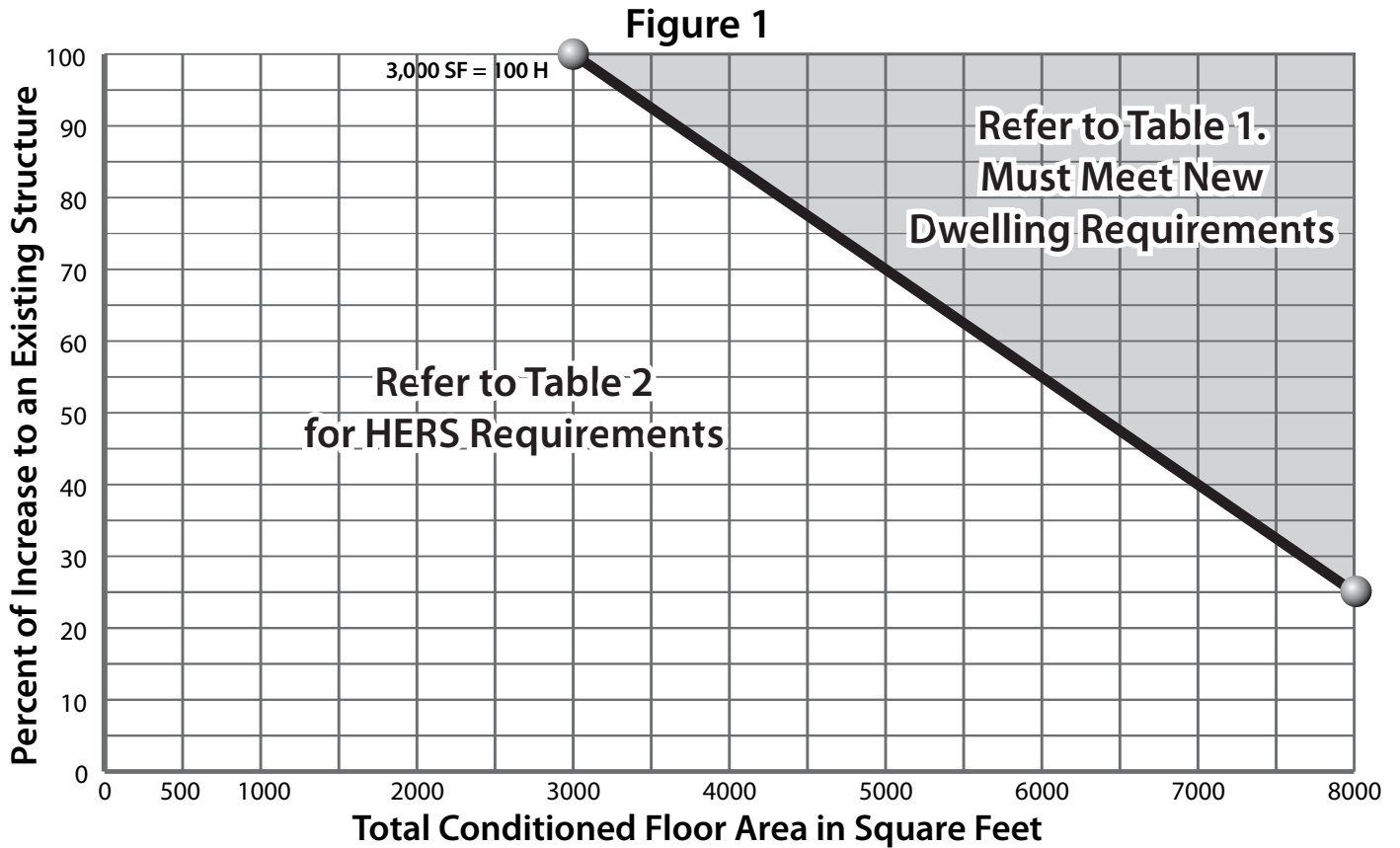


Table 1 HERS Rating Requirements for New Construction

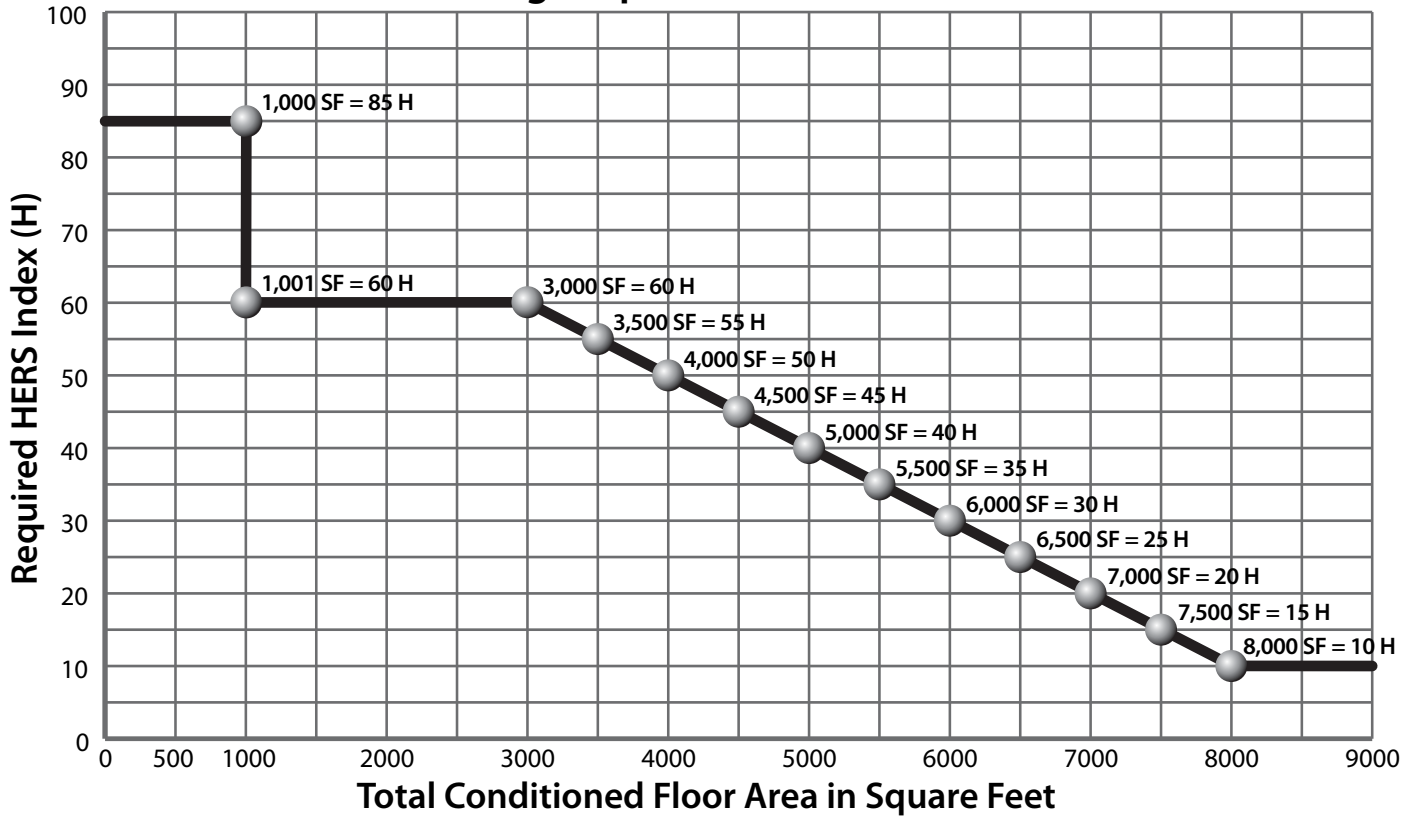


Table 2: HERS Rating Requirements for Additions

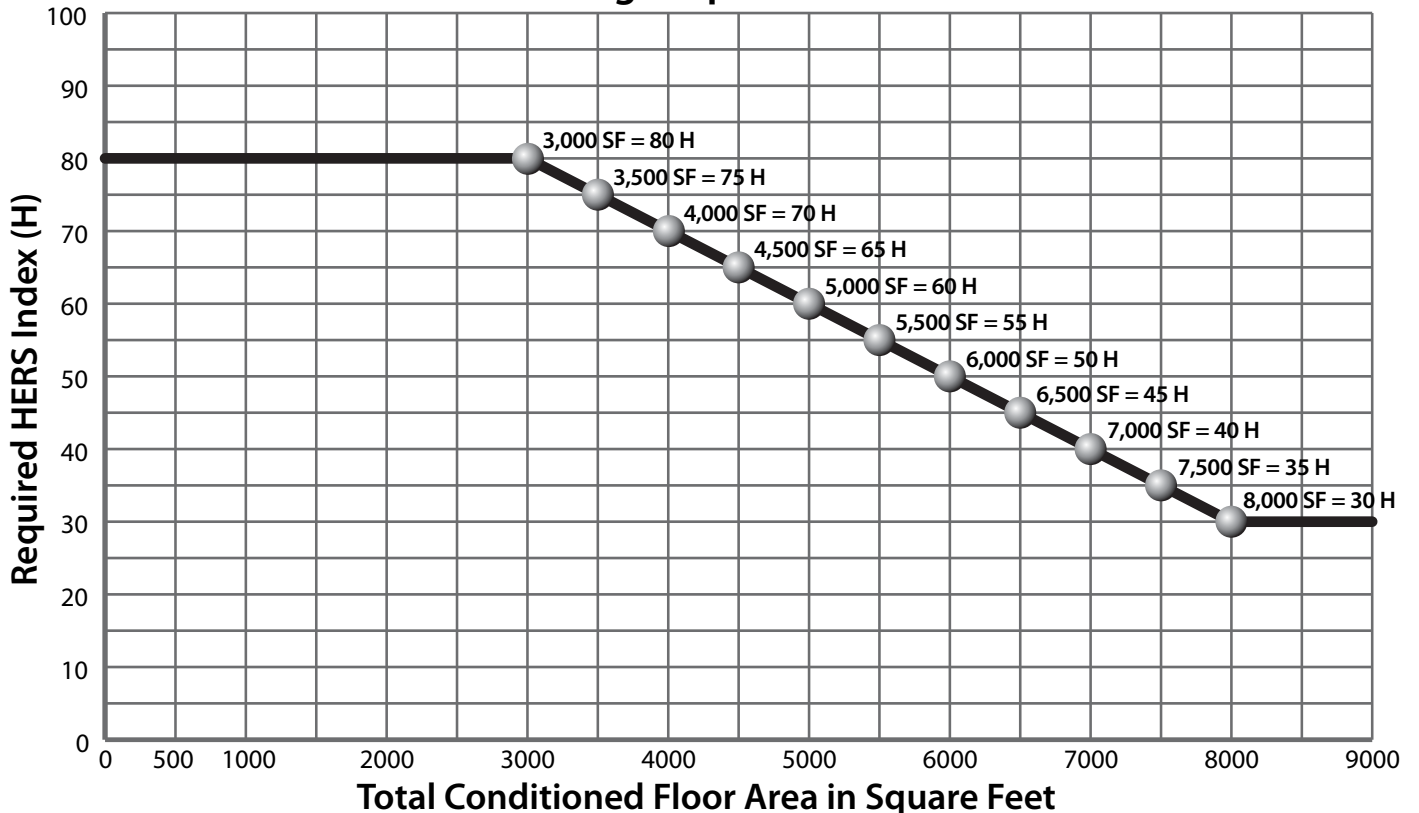
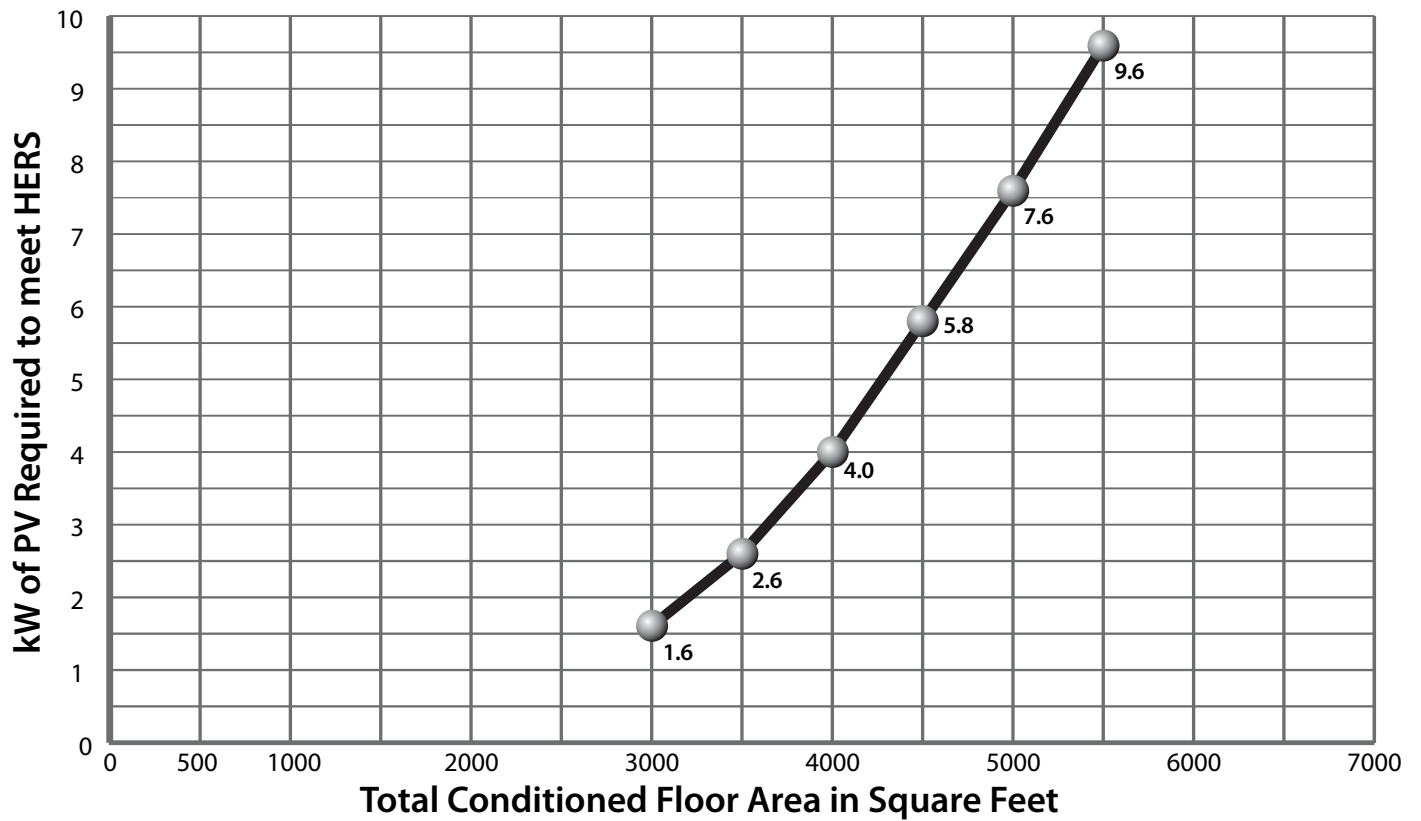


Table 3: PV Requirements for New Residences Prescriptive Path Option 3,000 sq. ft. to 6,000 sq. ft.

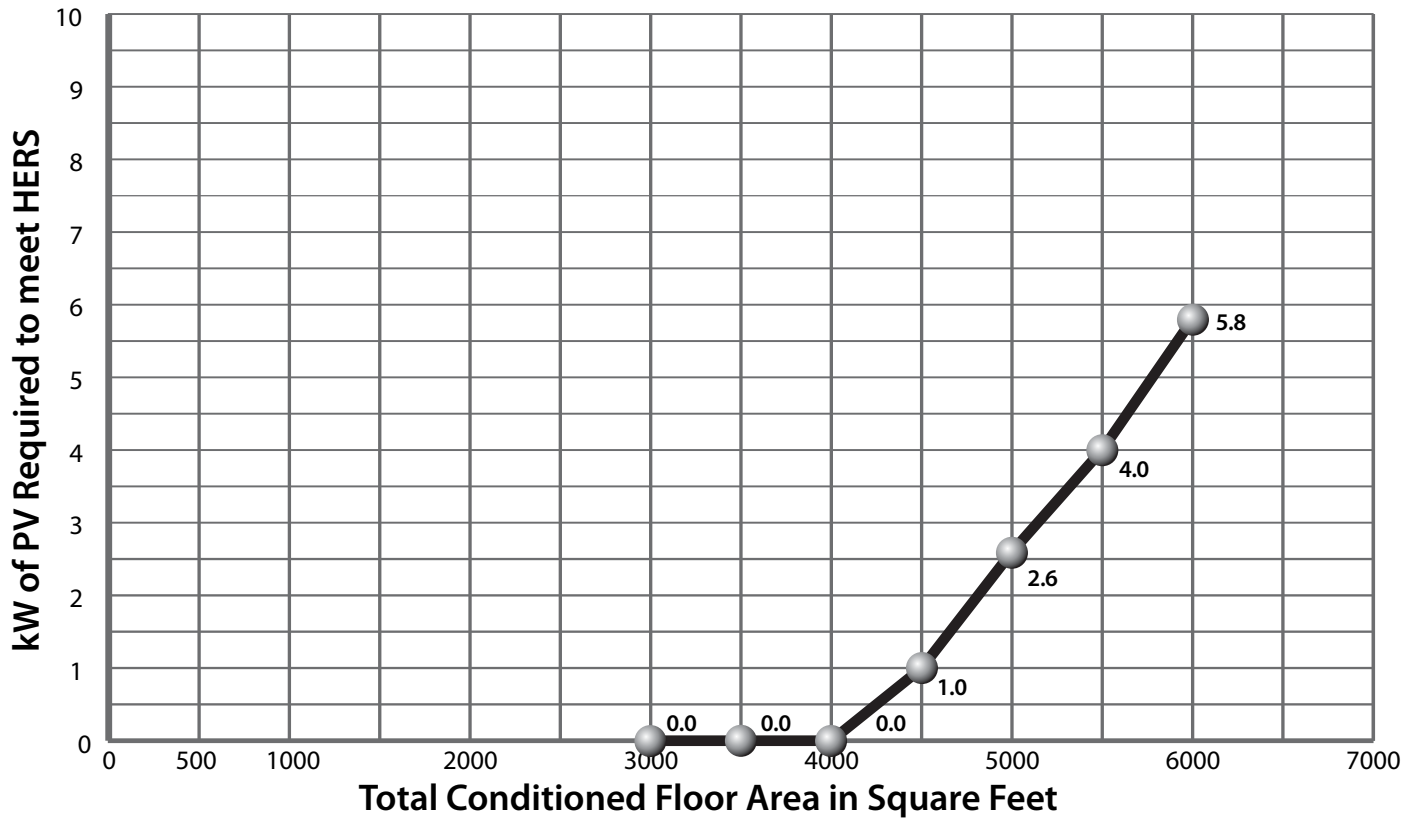


If the gross wall to floor area ratio is greater than one, the Performance Path Option must be used.

In calculating the wall to floor area ratio the following must be included:

- The entire floor area within the outside face of the exterior wall.
- The wall area measured from the top of the foundation to the bottom of the ceiling including all door and window openings.
- The gross wall area is divided by the gross floor area.

Table 4: PV Requirements for Additions Prescriptive Path Option 3,000 sq. ft. to 6,000 sq. ft.



If the gross wall to floor area ratio is greater than one the Performance Path Option must be used.

In calculating the wall to floor area ratio the following must be included:

- The entire floor area within the outside face of the exterior wall.
- The wall area measured from the top of the foundation to the bottom of the ceiling including all door and window openings.
- The gross wall area is divided by the gross floor area.



Land Use Department

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