U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

RESIDENTIAL ENERGY CONSERVATION CODE TRAINING

SIGNIFICANT CHANGES TO THE DC RESIDENTIAL ENERGY CONSERVATION CODE

(Versions 2013 to 2017)

dcra | GOVERNMENT OF THE DISTRICT OF COLUMBIA | DC MURIEL BOWSER, MAYOR

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Overview of Residential Code Requirements

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Some of the major changes in the 2017 DC Residential Energy Conservation Code (IECC)

- Netzero and passive house incentives
- Updated insulation requirements and U factors
- A new requirement for combustion closets
- Revisions to the building envelope air leakage testing requirements
- Energy Rating Index (ERI)
- Additional efficiency package (2017)
- Combustion Appliance Zone (CAZ) (2017)

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Administration and Enforcement

Alternative Paths for Compliance

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Administration and enforcement of the Energy Conservation Code-Residential Provisions shall be governed by Chapter 1 of the Building Code, Title 12-A DCMR.

Chapter 1 specifies alternative compliance pathways for the 2017 Residential Energy Code

- ERI Energy Rating Index
- DCRA Net-Zero Homes Program
- LBC certified (including energy petal) by ILFI (Living Building Challenge)
- Net Zero Energy certified by ILFI (International Living Future Institute)
- DOE Zero Energy Ready Home and on-site solar
- Passive House (PHIUS+ or PHI) and on-site solar
- LEED and LEED Zero Carbon
- LEED and LEED Zero Energy

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Alternative Paths for Compliance

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- ERI Energy Rating Index - Design and construct to an Energy Rating Index (ERI) of "54" in accordance with Section R406.4 of the Energy Conservation Code. Renewable energy id not allowed to meet the minimum requirement of 54.
- DCRA Net-Zero Homes Program - Achieve compliance with the requirements of DCRA's Residential Net-Zero Energy Program as set forth in an administrative bulletin.
- LBC certified (including energy petal) by ILFI (Living Building Challenge) No solar PV system required.
- Net Zero Energy certified by ILFI (International Living Future Institute) No solar PV system required.
- DOE Zero Energy Ready Home and on-site solar: The owner shall provide documentation to the code official confirming registration with the program prior to permit issuance. The owner shall have an 18-month period from the date of issuance of the first certificate of occupancy, or from approval of the final inspection, to submit official evidence of certification to the code official. The code official, for good cause and upon written request, is authorized to extend the period to submit evidence of certification. **Additionally, the owner must install a solar PV system on the roof that offsets the annual net energy use of the home.**

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Alternative Paths for Compliance

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- Passive House (PHIUS+ or PHI) and on-site solar -The owner shall have an 18-month period from the date of issuance of the certificate of occupancy, or approval of the final inspection, to submit official evidence of certification to the code official. Additionally, the owner must install a solar PV system on the roof that offsets the annual Net energy use. The code official, for good cause and upon written request, is authorized to extend the period to submit evidence of certification.
- LEED and LEED Zero Carboning Systems, and LEED Zero Carbon Rating System.
- LEED and LEED Zero Energy - The owner shall provide approved documentation to the code official, prior to permit issuance, (1) confirming registration with the programs, and (2) an approved pre-construction energy model that is consistent with achieving certification. Additionally, the owner must complete "Enhanced Commissioning" requirements during construction. The owner shall have an 18-month period from the date of issuance of a certificate of occupancy for the project or from approval of the final inspection, whichever is later, to submit official evidence of certification to the code official.

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IECC Compliance

Two Options

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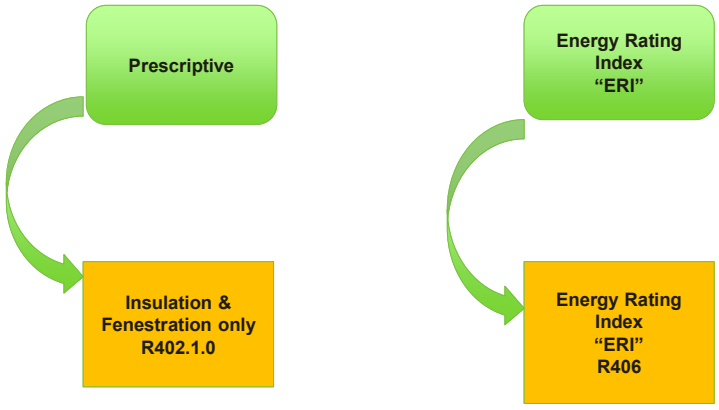

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Code Compliance Tools

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Prescriptive → **RESCheck**

Must be 2017 not 2015 version

Energy Rating Index "ERI" → **ERI* Computational Program (REM/rate, Energy Gauge, etc.)**

*The HERS rating is an acceptable ERI.

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Climate Zones for the 2017 IECC DMZ – 4A

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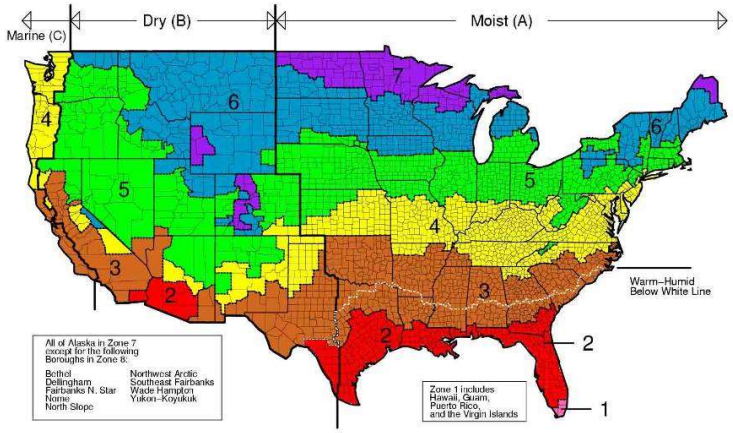

The entire code has been amended to only include information specific to climate zone 4A. You must use updated tables for compliance.

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Energy and Green Worksheet

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Here is the link to the 2017 and 2013 Energy and Green Worksheet.

  dcra.dc.gov/service/energy-and-green-building

- Here is a link to a few tutorials regarding the Energy and Green Worksheet. There are a few but you need to look at the "How you start your project" and "What's new for residential 2017".

  drive.google.com/drive/folders/1embkj8l6nJjY83VuLOkuF9m8K4s2d3SN?usp=sharing

- The sheet is setup such that all code citations for a particular code cycle are available for you to choose from. The ones that don't apply to your design you mark as N/A.
- Moving your cursor over the citation will reveal a popup with the full citation remarks displayed.
- Please ensure you share the link.

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Energy and Green Worksheet Shared Link

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B2101160

Energy and Green Worksheets

https://docs.google.com/spreadsheets/d/10JDd88SNtqNxt-L9i5JHV39pQbeq2OwmzmLpj5sr0B0/edit?usp=sharing

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Building Envelope Specific Requirements

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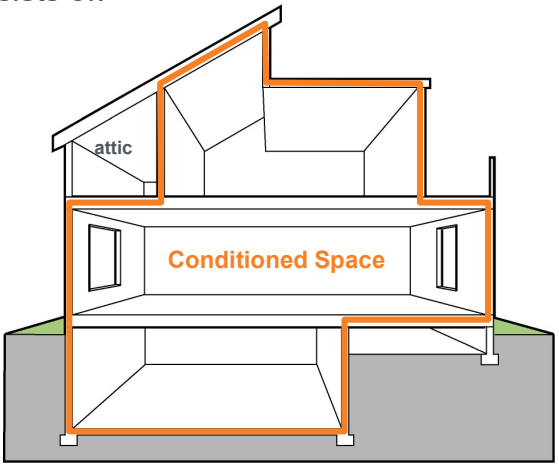
Building envelope consists of:

- Fenestration
- Ceilings
- Walls
  - Above grade
  - Below grade
  - Mass walls
- Floors
- Slabs
- Crawlspaces



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Existing Fenestration

Section R303.1.3

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Fenestration product rating. U-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100.

- Products lacking such a labeled U-factor shall be assigned a default U-factor from Table R303.1.3(1) or R303.1.3(2). The solar heat gain coefficient (SHGC) and visible transmittance (VT) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled SHGC or VT shall be assigned a default SHGC or VT from Table R303.1.3(3).

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Default Glazed Fenestration
U-FACTORS

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

TABLE R303.1.3(1)

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

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Default Door
U-FACTORS

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

TABLE R303.1.3(2)

DOOR TYPE	*U*-FACTOR
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

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Default Glazed Fenestration
SHGC AND VT

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

TABLE R303.1.3(3)

	SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
	Clear	Tinted	Clear	Tinted	
SHGC	0.8	0.7	0.7	0.6	0.6
VT	0.6	0.3	0.6	0.3	0.6

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Insulation and Fenestration Requirements by Component

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

TABLE R402.1.2

FENESTRATION U-FACTOR[b]	0.30 U-Factor
SKYLIGHT[b] **U-FACTOR**	0.55 U-Factor
GLAZED FENESTRATION SHGC[b]	0.40 Solar Heat Gain Coefficient (SHGC)
CEILING	R-49
WOOD FRAME WALL AND RIM JOISTS	R-19 in cavity + R-5 continuous on the exterior, **or** R-13 in cavity + R-10 continuous on the exterior, **or** R-15 continuous
MASS WALL[i]	R-15 continuous on the exterior, or R-20 continuous on the interior
FRAME FLOOR	R-25 + R-5 continuous
ELEVATED SLAB	R-15 continuous
BASEMENT WALL	R-19 cavity + R-5 continuous on the exterior, **or** R-13 in cavity + R-10 continuous on the exterior, **or** R-15 continuous
SLAB ON GRADE[d]	R-10 perimeter insulation for a depth of 2 ft.
CONDITIONED CRAWLSPACE WALL	R-19 cavity + R-5 continuous on the exterior, **or** R-13 in cavity + R-10 continuous on the exterior, **or** R-15 continuous

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Equivalent U-Factors

Section R402.1.4

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TABLE R402.1.4

FENESTRATION U-FACTOR	0.30 U-Factor
SKYLIGHT U-FACTOR	0.55 U-Factor
CEILING U-FACTOR	0.026 U-Factor
WOOD FRAME WALL U-FACTOR	0.045 U-Factor
MASS WALL U-FACTOR	0.060 U-Factor
FRAME FLOOR U-FACTOR	0.033 U-Factor
ELEVATED SLAB	0.066 U-Factor
MASS FLOOR U-FACTOR	0.058 U-Factor
BASEMENT WALL U-FACTOR	0.045 U-Factor
CONDITIONED CRAWLSPACE WALL U-FACTOR	0.045 U-Factor

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Effect of Uninsulated Pull-Down Stairs in Attic on R value

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A seemingly insignificant amount of uninsulated or under-insulated area can have a huge impact on the amount of heat that moves through the building enclosure, and thus on the energy bills. An attic, for example, with 99% insulated to R-38 and a measly 1% (the pull-down stairs) insulated to just R-1 reduces the average R-value to R-28. That 1% of the attic resulted in a 27% reduction in the R-value! If we have 1000 square feet total of ceiling area, and we put R-38 everywhere but the 10 square feet of the attic pull-down stairs, you may be surprised when you see the answer.

We've got 990 sf at R-38 and 10 sf at R-1. When you plug those numbers into the equation for average U-value and then convert to average R-value, the answer is R-28.

$$U_{avg} = \frac{\frac{1}{38} \times 990 + \frac{1}{1} \times 10}{1000} = 0.036$$

$$R_{avg} = \frac{1}{U_{avg}} = \frac{1}{0.036} = 27.7$$

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Typical Wall Assembly

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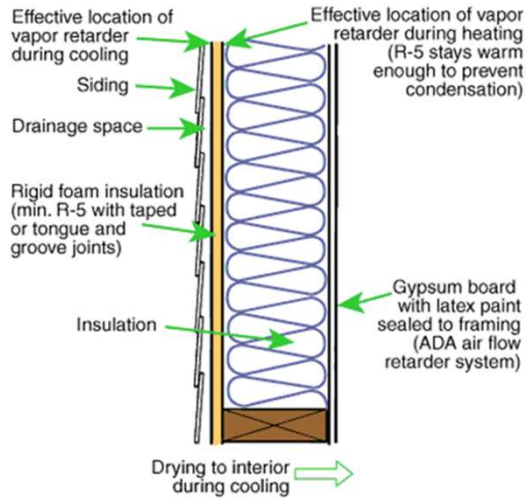

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Typical Wall Assembly
Mixed Humid Climate

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Mixed-Humid A mixed-humid climate is defined as a region that receives more than 20 inches (50 cm) of annual precipitation, has approximately 5,400 heating degree days (65°F basis) or fewer, and where the average monthly outdoor temperature drops below 45°F (7°C) during the winter months.

Mixed-humid climate ideal wall assembly:

In a mixed-humid climate, moisture flow changes direction in cooling and heating seasons. In summer, it flows from outside to inside; in winter, from inside to outside. As a result, in mixed climates, the wall should be able to dry in both directions, changing with the season. Therefore, the ideal frame wall assembly for a mixed, humid climate locates an air barrier toward the interior side, a permeable interior finish and a water vapor retarder (not barrier) that adapts to the seasons

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Typical Wall Assembly
Mixed Humid Climate

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- A seasonally adaptable vapor retarder assembly can be achieved with either of the following:
- R-5 or higher insulating foam sheathing on the exterior side functions as an exterior vapor retarder in summer. Yet, in winter, its inside surface acts as a warm "middle of the wall" vapor retarder that does not get cold enough to cause condensation.
- Kraft paper-faced insulation toward the interior acts as a vapor retarder in winter (in drier conditions) but becomes more permeable in summer (when there is more water vapor).
- “Smart vapor retarder” technology is now available in a membrane form that is installed on the interior side of the studs and insulation. The membrane changes properties with the season, becoming a true vapor barrier in winter (when relative humidity is low) and fully permeable in summer (when relative humidity is high).
- The air barrier system is best located toward the interior, but any location is better than none. The interior side of the wall should be permeable -- meaning no vinyl wallpaper, no oil-based interior paints no plastic or no foil vapor barrier on the inside of the wall assembly -- so it can dry to inside in summer.

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Dew Point and Humidity

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What is dew point?

- Dew point is defined as the temperature at which a given volume of air at a certain atmospheric pressure is saturated with water vapor, causing condensation and the formation of dew.
- Dew is the condensed water that a person often sees on flowers and grass early in the morning. Dew point varies depending on the amount of water vapor present in the air, with more humid air resulting in a higher dew point than dry air.

What is humidity?

- Humidity is defined as the amount of water vapor (gaseous phase of water) in the air. It is an indicator of the presence of dew, frost, fog, and precipitation.

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Moisture and Mold

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Moisture/Mold

- During the summer months, negative pressures inside the home can draw in warm moist air from outside. When this moist air comes in contact with surfaces that are below the dew-point temperature, condensation often forms, providing an excellent breeding ground for mildew and other molds, which are known respiratory irritants. The same is true during the winter if the house is pressurized, driving moisture-laden air out of the building.

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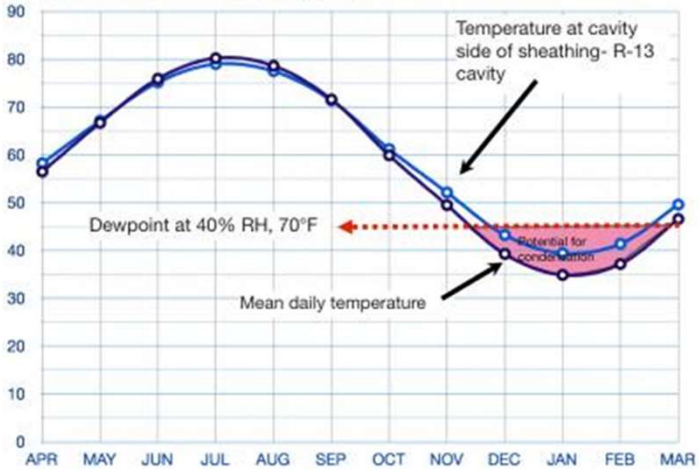
Dew Point - No Exterior Insulation

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Climate Zone 4 - 2 x 4 wall , R-13 cavity insulation with no exterior insulation



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Dew Point with Exterior Insulation

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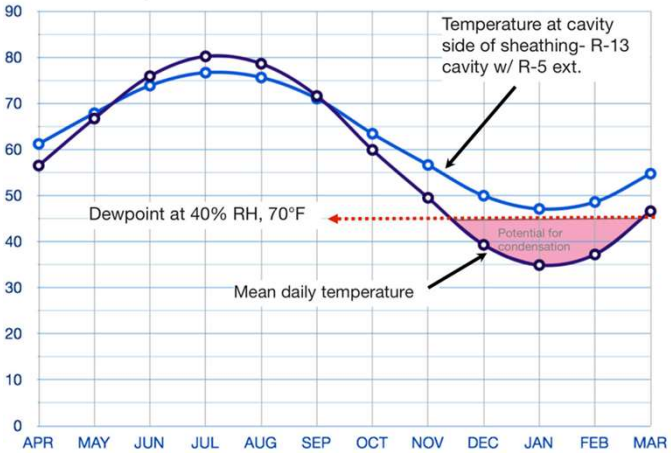
Climate Zone 4 - 2 x 4 wall , R-13 cavity insulation plus R- 5 exterior insulation



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Steel Frame Ceiling, Wall & Floor Insulation (R-Value)

TABLE R402.2.6

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

WOOD FRAME *R*-VALUE REQUIREMENT	COLD-FORMED STEEL EQUIVALENT *R*-VALUEa
Steel Truss Ceilingsb	
R-30	R-38 or R-30 + 3 or R-26 + 5
R-38	R-49 or R-38 + 3
R-49	R-38 + 5
Steel Joist Ceilingsb	
R-30	R-38 in 2 × 4 or 2 × 6 or 2 × 8 R-49 in any framing
R-38	R-49 in 2 × 4 or 2 × 6 or 2 × 8 or 2 × 10
Steel-Framed Wall, 16" on center	
R-13	R-13 + 4.2 or R-19 + 2.1 or R-21 + 2.8 or R-0 + 9.3 or R-15 + 3.8 or R-21 + 3.1
R-13 + 3	R-0 + 11.2 or R-13 + 6.1 or R-15 + 5.7 or R-19 + 5.0 or R-21 + 4.7
R-20	R-0 + 14.0 or R-13 + 8.9 or R-15 + 8.5 or R-19 + 7.8 or R-19 + 6.2 or R-21 + 7.5
R-19 + 5	R-15 continuous or R-13 + 12.2 or R-15 + 11.8 or R-19 + 11.2 or R-21 + 10.9 or R-25 + 10.5
R-21	R-0 + 14.6 or R-13 + 9.5 or R-15 + 9.1 or R-19 + 8.4 or R-21 + 8.1 or R-25 + 7.7
Steel Framed Wall, 24" on center	
R-13	R-0 + 9.3 or R-13 + 3.0 or R-15 + 2.4
R-13 + 3	R-0 + 11.2 or R-13 + 4.9 or R-15 + 4.3 or R-19 + 3.5 or R-21 + 3.1
R-20	R-0 + 14.0 or R-13 + 7.7 or R-15 + 7.1 or R-19 + 6.3 or R-21 + 5.9
R-19 + 5	R-15 continuous or R-13 + 11.1 or R-15 + 10.4 or R-19 + 9.7 or R-21 + 9.2 or R-25 + 8.7
R-21	R-0 + 14.6 or R-13 + 8.3 or R-15 + 7.7 or R-19 + 6.9 or R-21 + 6.5 or R-25 + 5.9
Steel Joist Floor	
R-13	R-19 in 2 × 6, or R-19 + 6 in 2 × 8 or 2 × 10
R-19	R-19 + 6 in 2 × 6, or R-19 + 12 in 2 × 8 or 2 × 10
R-25 + 5	R-15 + 15

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Table R402.4.1.1

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Component	Criteria
Air barrier and thermal barrier	A continuous air barrier shall be installed in the building envelope. Exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed. Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier sealed. Access openings, drop down stair or knee wall doors to unconditioned attic spaces shall be sealed.
Walls	Corners and headers shall be insulated, and the junction of the foundation and sill plate shall be sealed. The junction of the top plate and top of exterior walls shall be sealed. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier. Knee walls shall be sealed.
Windows, skylights and doors	The space between window/door jambs and framing and skylights and framing shall be sealed.
Rim joists	Rim joists shall be insulated and include the air barrier.
Floors (including above-garage and cantilevered floors)	Insulation shall be installed to maintain permanent contact with underside of subfloor decking. The air barrier shall be installed at any exposed edge of insulation.

(partial table)

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Access Hatches and Doors

Section R402.2.4

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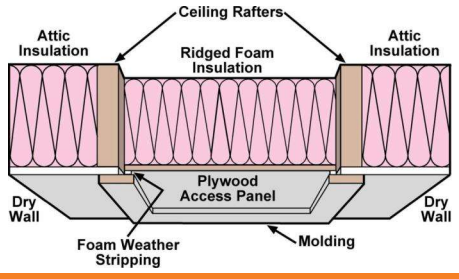
Weather-strip and insulate doors from conditioned spaces to unconditioned spaces *(e.g., attics and crawl spaces)*

- Insulate to level equivalent to surrounding surfaces, e.g., required ceiling insulation = R-38, then attic hatch must be insulated to R-38

- A new exception has been added to Section R402.2.4—"Access hatches and doors." This exception allows vertical doors that provide access from conditioned to unconditioned spaces to meet the fenestration requirements in Table R402.1.2.



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Ceilings with Attics
Section R402.2.1

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Ceiling insulation requirements in R-value table assume standard truss systems.

Where Section R402.1.2 would require R-49 insulation in the ceiling but the depth of the roof rafters does not allow R49, the ceiling insulation value may be reduced to R-38. This reduction shall not apply to the U-factor alternative approach in Section R402.1.4 and the total UA alternative in Section R402.1.5.

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Ceilings with Attics
Section R402.2.1

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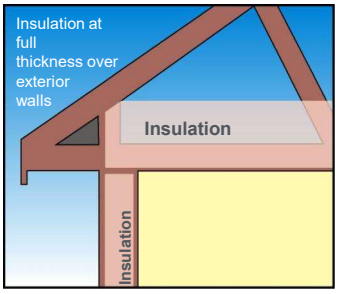

Prescriptive R-value path encourages raised heel truss *(aka energy truss)*

If insulation is full height over exterior wall top plate:

- R-30 complies where R-38 is required
- R-38 complies where R-49 is required

Note: this reduction ONLY applies to the R-value prescriptive path, not the U-factor or total UA alternatives

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Unvented Attic Assemblies

IRC 806.5

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

IRC 806.5 - when there is no attic ventilation either the top or underside of the roof deck must be insulated with a minimum of R15 air impermeable insulation.

- You must indicate on the drawings the R value per inch of the air impermeable insulation and the R value of any batt insulation being installed within the cavity.
- If you are installing R15 air impermeable insulation in combination with batt insulation between the roof rafters, you must have enough space for the insulation you are installing.
- Please provide the height of the roof rafters to ensure the insulation can fit without compression.

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Unvented Roof/Ceiling Assembly

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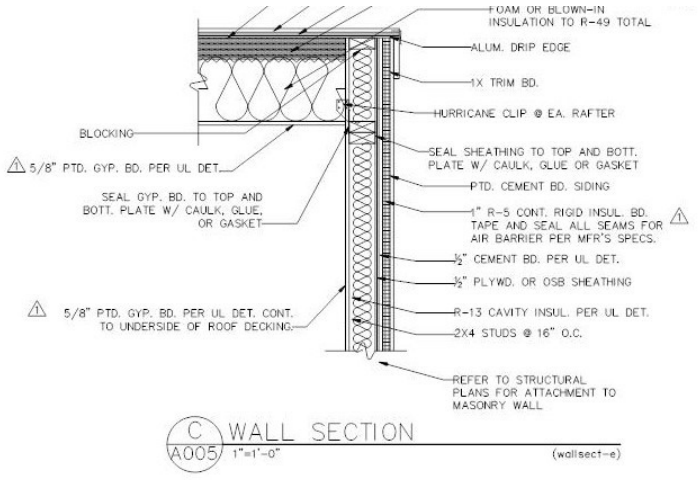

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R402.1.2 Insulation and Fenestration Criteria – Duct Runs

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- R402.1.2 Insulation and fenestration criteria. The building thermal envelope shall meet the requirements of Table R402.1.2.
- Ducts runs are not allowed in roof assemblies where such runs would compromise the integrity of the thermal envelope.
- If the design of the roof/ceiling assembly is such that drywall is attached to the underside or bottom of the roof rafters and the depth of the rafters along with the insulation installed between the rafters does not allow the space required for duct runs, such cavities shall not contain any ducts.

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Ducts in Unvented Roof Assembly

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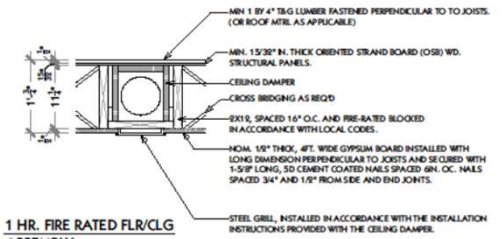
1 M100 MECHANICAL NOTES & LEGENDS N.T.S.



1 HR. FIRE RATED FLR/CLG ASSEMBLY
UL#L503 (W/ DAMPER)

NOTE: CEILING DAMPER - MAX NOM AREA SHALL BE 198 SQ IN. MAX RECTANGULAR SIZE SHALL BE 12 IN. BY 16½ IN. MAX HEIGHT OF DAMPER SHALL BE 8⅝ IN. AGGREGATE DAMPER OPENINGS SHALL NOT EXCEED 99 SQ IN. PER 100 SQ FT OF CEILING AREA. DAMPER INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS INSTALLATION INSTRUCTIONS PROVIDED WITH THE DAMPER. STEEL GRILL SHALL BE INSTALLED IN ACCORDANCE WITH INTALLATION INSTRUCTIONS.

2 M100 MECHANICAL DUCT DETAIL N.T.S.

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Slab Edge Insulation

Section R402.2.10

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Applies to slabs with a floor surface < 12 inches below grade

- R-10 (typically 2 inches) insulation in Zones 4
- Must extend downward from top of slab a minimum of 24" (Zones 4)
- Insulation can be vertical or extend horizontally under the slab or out from the building
- Insulation extending outward must be under 10 inches of soil or pavement
  - An additional R-5 is required for heated slabs

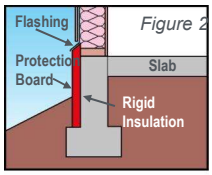

Figure 2

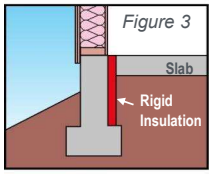

Figure 3

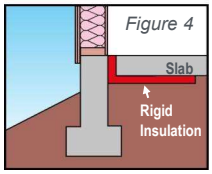

Figure 4

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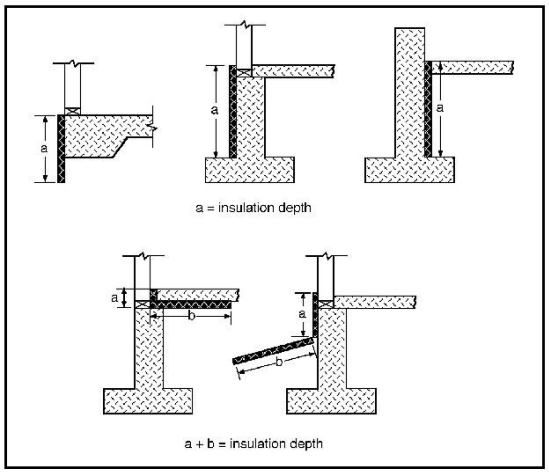
Slab Insulation

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



Slab Insulation Depth

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Slab Edge Insulation
Section R402.2.10

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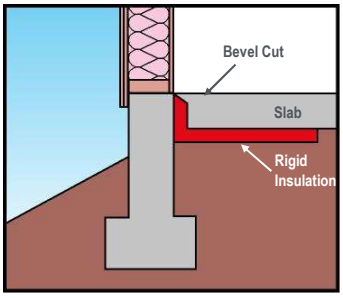

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Floors (Over Unconditioned Space)

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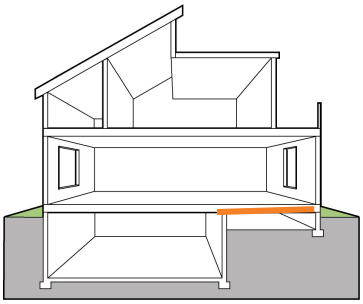
Unconditioned space includes unheated basement, vented crawlspace, or outdoor air.



Insulation must maintain permanent contact with underside of subfloor

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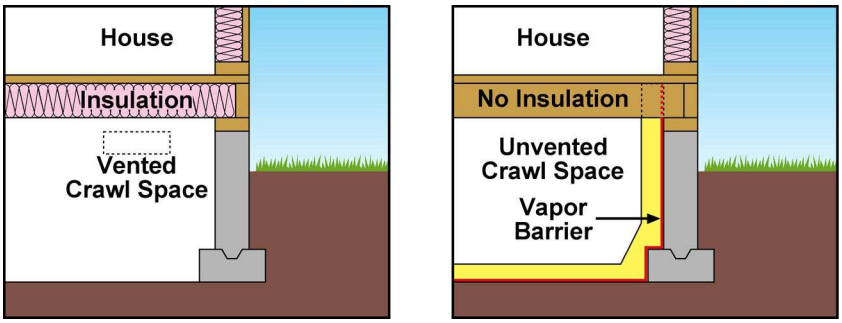
Crawlspace Wall Insulation

Section R402.2.11

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Implies an unvented crawlspace *(aka conditioned crawlspace)*

- Space must be mechanically vented or receive minimal supply air *(Refer to IRC)*
- Exposed earth must be covered with a continuous Class I vapor retarder



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Ventilation Openings

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

R408.2 Openings for under-floor ventilation.

- The minimum net area of ventilation openings shall be not less than 1 square foot (0.0929 m2 for each 150 square feet (14 m2) of under-floor area. One ventilation opening shall be within 3 feet (915 mm) of each corner of the building.
- Exception: The total area of ventilation openings shall be permitted to be reduced to 1\1,500 of the under-floor area where the ground surface is covered with an approved Class I vapor retarder material and the required openings are placed to provide cross ventilation of the space. The installation of operable louvers shall not be prohibited

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Vented and Unvented Crawlspaces

Section R402.2.11

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Vented Crawlspace Requirements:

- The raised floor over the crawlspace must be insulated.
- A vapor retarder may be required as part of the floor assembly.
- Ventilation openings must exist that are equal to at least 1 square foot for each 150 square feet of crawlspace area and be placed to provide cross-flow *(IRC 408.1, may be less if ground vapor retarder is installed).*
- Ducts in crawlspace must be sealed and have R-6 insulation.

Unvented Crawlspace Requirements:

- The crawlspace ground surface must be covered with an approved vapor retarder *(e.g., plastic sheeting).*
- Crawlspace walls must be insulated to the R-value requirements specific for crawlspace walls *(IECC Table R402.1.1).*
- Crawlspace wall insulation must extend from the top of the wall to the inside finished grade and then 24" vertically or horizontally.
- Crawlspaces must be mechanically vented *(1 cfm exhaust per 50 square feet)* or conditioned *(heated and cooled as part of the building envelope).*
- *Conditioned air supply @ 1 cubic ft. /min for each 50sqft, Including a return pathway such as duct or transfer duct to common area.*
- Ducts are inside conditioned space and therefore don't need to be insulated.

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Taking a Break

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

dcra | GOVERNMENT OF THE DISTRICT OF COLUMBIA | MURIEL BOWSER, MAYOR

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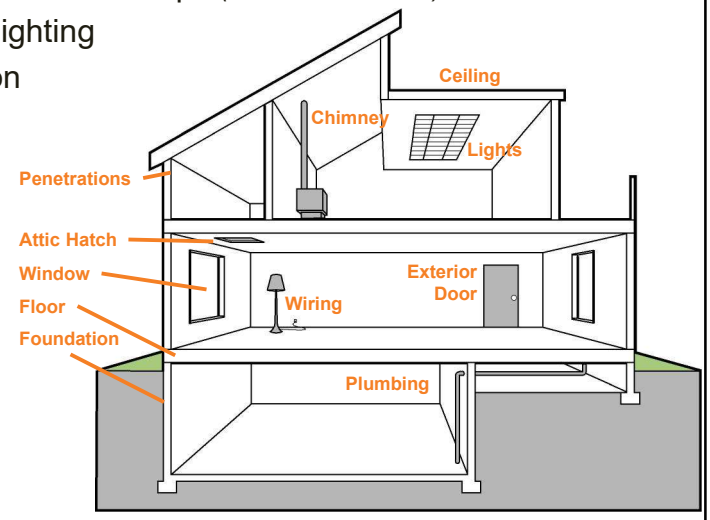
Mandatory Requirements
Section R402.4 - Air Leakage

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Building thermal envelope *(Section R402.4.1)*
- Recessed lighting
- Fenestration
- Fireplaces



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Air Leakage Control
Section R402.4.1.2

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Building thermal envelope air leakage testing must now be done in accordance with either ASTM E 779 or ASTM E 1827.

New testing procedures

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Building Thermal Envelope
Section R402.4.1.2 – Air Leakage Testing

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

TABLE R402.4.1.2
MAXIMUM ALLOWED AIR LEAKAGE RATES

	New construction	Level 3 Alteration affecting 80% or more of the aggregate work of the building (Gut Rehabilitation)
Single family detached, two family attached (duplex), townhouses, flats	3 ACH50	3 ACH50
Dwelling units in Multifamily buildings 3 stories and less	.30 CFM50/SF enclosure area of each unit or 3 ACH50	enclosure area of each unit or 3 ACH50

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Mechanical Ventilation
DC Building Code 2017 - IRC

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

R303.4 Mechanical ventilation. Where the air infiltration rate of a dwelling unit is 5 air changes per hour or less where tested with a blower door at a pressure of 0.2 inch w.c. (50 Pa) in accordance with Section N1102.4.1.2, the dwelling unit shall be provided with whole-house mechanical ventilation in accordance with Section M1507.3.

M1507.3.1 System design. The whole-house ventilation system shall consist of one or more supply or exhaust fans, or a combination of such, and associated ducts and controls. Local exhaust or supply fans are permitted to serve as such a system. Outdoor air ducts connected to the return side of an air handler shall be considered as providing supply ventilation.

M1507.3.2 System controls. The whole-house mechanical ventilation system shall be provided with controls that enable manual override.

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Slide 45

CRF(64 David can the envelope be verified for compliance by inspection or Blower door test only? And why is .30 CFM50/SF called out if its the same as 3ACH50?

Campbell, Robert F. (DCRA), 5/12/2020

Mechanical Ventilation Rate

DC Building Code 2017 - IRC

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

M1507.3.3 Mechanical ventilation rate. The whole house mechanical ventilation system shall provide outdoor air at a continuous rate of not less than that determined in accordance with Table M1507.3.3(1).

Exception: The whole-house mechanical ventilation system is permitted to operate intermittently where the system has controls that enable operation for not less than 25-percent of each 4-hour segment and the ventilation rate prescribed in Table M1507.3.3(1) is multiplied by the factor determined in accordance with Table M1507.3.3(2).

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Airflow Requirements

Table M1507.3.3(1)

DC Building Code 2017 - IRC

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

TABLE M1507.3.3(1)
CONTINUOUS WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM
AIRFLOW RATE REQUIREMENTS

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

For SI: 1 square foot = 0.0929 m^2. 1 cubic foot per minute = 0.0004719 m^3/s.

TABLE M1507.3.3(2)
INTERMITTENT WHOLE-HOUSE MECHANICAL VENTILATION RATE FACTORS a,b

RUN-TIME PERCENTAGE IN EACH 4-HOUR SEGMENT	25%	33%	50%	66%	75%	100 %
Factor"	4	3	2	1.5	1.3	1.0

a. For ventilation system run time values between those given, the factors are permitted to be determined by interpolation.
b. Extrapolation beyond the table is prohibited.

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Local Exhaust Rates
DC Building Codes 2017 - IRC

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

M1507.4 Local Exhaust rates. Local exhaust systems shall be designed to have the capacity to exhaust the minimum air flow rate determined in accordance with Table MI507.4.

TABLE M1507.4
MINIMUM REQUIRED LOCAL EXHAUST RATES FOR ONE - AND TWO - FAMILY DWELLINGS

AREA TO BE EXHAUSTED	EXHAUST RATES
Kitchens	1 00 cfm intermittent or 25 cfm continuous
Bathrooms - Toilet Rooms	Mechanical exhaust capacity of 50 cfm intermittent or 20 cfm continuous

For SI: I cubic foot per minute = 0.0004719 m^3/s.

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Rooms Containing Fuel-Burning Appliances
Section R402.4.4

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

There is a new section, R402.4.4 - "Rooms containing fuel burning appliances," that states "where open combustion air ducts provide combustion air to open combustion fuel burning appliances, the appliance and combustion air opening shall be located outside the building thermal envelope or enclosed in a room, isolated from inside the thermal envelope."

Existing buildings undertaking a Level 3 *alteration* at 80% of aggregate area must comply with one of the following:

1. New equipment and appliances shall be sealed combustion; or
2. Locate open combustion appliances and equipment outside the building thermal envelope or enclosed in a room, isolated from the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Table R402.1.2, where the walls, floors and ceilings shall meet not less than the basement wall *R*-value requirement. The door into the room shall be fully gasketed and any water lines and ducts in the room insulated in accordance with Section R403. The combustion air duct shall be insulated where it passes through conditioned space to a minimum of R-8

Exceptions:

1. Power-vented equipment and appliances.
2. Fireplaces and stoves complying with Section R402.4.2 and Section R1006 of the Residential Code.

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CRF(63

Fenestration Trade-off Limits

R402.5

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Maximum fenestration U-factor and SHGC (Mandatory).

The area-weighted average maximum fenestration U-factor permitted using tradeoffs from Section R402.1.5 or R406 shall be 0.40 for vertical fenestration, and 0.75 for skylights.

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REScheck

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Generated by REScheck-Web Software

Compliance Certificate

Project 20.0390-Lot73-Sherier

Energy Code: **2015 IECC**
Location: **Washington, District of Columbia**
Construction Type: **Single-family**
Project Type: **New Construction**
Conditioned Floor Area: **7,122 ft2**
Glazing Area: **20%**
Climate Zone: **4 (4577 HDD)**
Permit Date:
Permit Number:

Construction Site: Owner/Agent: Designer/Contractor:

Compliance: Passes using UA trade-off

Compliance: **22.4% Better Than Code** Maximum UA: **794** Your UA: **616** Maximum SHGC: **0.40** Your SHGC: **0.33**

Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	U-Factor	UA
Ceiling 1: Flat Ceiling or Scissor Truss	349	38.0	0.0	0.030	10
Ceiling: Raised or Energy Truss	2,086	49.0	0.0	0.020	42
Wall: Wood Frame, 16" o.c.	5,011	13.0	17.6	0.039	157
Door-Solid: Solid Door (under 50% glazing)	53			0.350	18
Door-Glass: Glass Door (over 50% glazing) SHGC: 0.16	190			0.300	57
Double Hung: Wood Frame SHGC: 0.20	622			0.300	187
Casement: Wood Frame SHGC: 0.19	132			0.280	37
Basement: Solid Concrete or Masonry Wall height: 19.0' Depth below grade: 9.0' Insulation depth: 10.0'	2,010	0.0	15.0	0.043	83
Door: Solid Door (under 50% glazing)	19			0.350	7
Window: Wood Frame SHGC: 0.20	59			0.300	18

Project Title: 20.0390-Lot73-Sherier
Data filename:

Report date: 01/24/01
Page 1 of 19

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CRF(63 Hey David couldn't find this in IECC the hard tradeoff limits? Should this be in the presentation?
Campbell, Robert F. (DCRA), 5/12/2020

Cool Roof Requirements

R402.6

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Roof coverings for roof slopes less than or equal to two units vertical in 12 units horizontal (17 percent slope or less) for buildings and covered parking shall conform to this section.

A minimum of 75 percent of the entire roof surface not be used for roof penetrations, renewable energy power systems (e.g., photovoltaics or solar thermal collectors), harvesting systems for rainwater to be used on-site, or green roofing systems shall be covered with products that comply with one or both of the following:

- Have a minimum three-year-aged Solar Reflective Index (SRI) of 64.
- Comply with the criteria for roof products as defined in "ENERGY STAR® Program Requirements, Product Specification for Roof Products, Eligibility Criteria."

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Solar Reflective Index

R402.6.1

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Initial and aged values of the SRI shall be calculated in accordance with ASTM E1980 for medium-speed wind conditions, using a convection coefficient of [2.1 BTU/(h · ft2 · °F)] or the metric equivalent [12 W/(m2 · K)].
- The SRI shall be based upon solar reflectance as measured in accordance with ASTM E1918 or ASTM C1549, and the thermal emittance as measured in accordance with ASTM E408 or ASTM C1371.
- For roofing products, the values for solar reflectance and thermal emittance shall be determined by a laboratory accredited by a nationally recognized accreditation organization, such as the Cool Roof Rating Council CRRC-1 Product Rating Program and shall be labeled and certified by the manufacturer.

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Mandatory Requirements Systems
Section R403

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Controls
- Heat pump supplementary heat
- Ducts
  - Sealing & testing (Mandatory)
  - Insulation (Prescriptive)
- Building cavities
- HVAC piping insulation
- Circulating hot water systems
- Ventilation
  - Dampers
- Equipment sizing
- Systems serving multiple dwelling units
- Snow melt controls
- Pools and inground permanently installed spas

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Heat Pump Supplementary Heat
Section R403.1.2 - Controls

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

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.

Plans must include heat pump balance point for compliance.

The auxiliary heat temperature, that point or temperature setting that starts the auxiliary heat is crucial to system performance and energy savings.

The temperature shall be displayed on the equipment schedule for compliance.

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Insulation (Mandatory)

R403.3.1

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Supply and return ducts outside of the building thermal envelope shall be insulated to a minimum of R-8.

Exception: Where ducts are less than 3 inches (76mm) in diameter, a minimum of R6 is allowed

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Duct Sealing

***Section R403.3.2* - Mandatory**

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Sealing (Mandatory)

- Joints and seams to comply with IMC or IRC
- All ducts, air handlers, and filter boxes to be sealed *(Section R403.2.2)*

Exceptions

1. Air impermeable spray foam products shall be permitted to be applied without additional joint seals.
2. For ducts having a static pressure classification of less than 2 inches of water column (500 Pa), additional closure systems shall not be required for continuously welded joints and seams and locking type joints and seams of other than the snap lock and button lock type.

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Duct Tightness Tests
Section R403.3.3

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Duct tightness shall be verified by either of the following:

Post construction test

- Total leakage:
  - tested at a pressure differential of 0.1 in w.g. (25Pa) across entire system, including manufacturer's air handler enclosure
- All register boots taped or otherwise sealed during test

Rough-in test

- Total leakage:
  - tested at a pressure differential of 0.1 in w.g. (25Pa) across roughed-in system, including manufacturer's air handler enclosure
  - all register boots taped or otherwise sealed during test.

Exceptions:

1. Duct tightness test is not required if the air handler and all ducts are located within building thermal envelope
2. Where ducts from an existing heating and cooling system are extended to an addition, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces.

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Duct-Tightness Tests
Section R403.3.3

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

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Mechanical Ventilation System

R403.6

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

R403.6 Mechanical ventilation (Mandatory). The building shall be provided with ventilation that meets the requirements of the Residential Code or the Mechanical Code, as applicable. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating

R403.6.1 Mechanical ventilation system fan efficacy. Mechanical ventilation system fans shall meet the efficacy requirements of Table R403.6.1 or be certified to the most current version of ENERGY STAR.

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Mechanical Ventilation System

R403.6

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

TABLE R403.6.1
MECHANICAL VENTILATION SYSTEM FAN EFFICACY

FAN LOCATION	AIR FLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)	AIR FLOW RATE MAXIMUM (CFM)
Range hoods	Any	2.8 cfm/watt	Any
In-line fan	Any	2.8 cfm/watt	Any
Bathroom or, utility room	10	1.4 cfm/watt	< 90
Bathroom or, utility room	90	2.8 cfm/watt	Any

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Systems
Section R403.8

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Systems serving multiple dwelling units shall comply with Sections 6 and 7 of the Commercial Energy Conservation Code-in lieu of Section R403.

Exception: Accessory Dwelling Unit (ADU) and *flats* are exempt.

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Covers
R403.10.3

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Outdoor heated pools and outdoor permanent spas shall be provided with permanent, operable vapor-retardant cover or other approved vapor-retardant means.

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Lighting Equipment
R404.1

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Not less than 85 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps or not less than 85 percent of the permanently installed lighting fixtures shall contain only high-efficacy lamps.

High efficacy lamps are either LED, compact fluorescent lamps (CFL's), T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy of:

1. 60 lumens per watt for lamps over 40 watts;
2. 50 lumens per watt for lamps over 15 watts to 40 watts; and
3. 40 lumens per watt for lamps 15 watts or less.

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Additional Efficiency Package
R405

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

R405.1 Requirements New buildings shall comply with at least one of the following:

1. Enhanced HVAC performance in accordance with Section R405.2.
2. Enhanced Building Envelope in accordance with Section R405.3.
3. Enhanced Air Leakage and Heat Recovery Ventilation in accordance with Section R405.4.
4. Enhanced Water Heating System in accordance with Section R405.5.

Exception: Alterations are exempt from Section R405.

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Efficient Heating and Cooling Systems

R405.2

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

All heating and cooling equipment shall meet the minimum efficiency requirements of Table R405.2.

Equipment Type	Efficiency
Split and Packaged Air Conditioners	≥ 15 SEER [a]
Split and Packaged Air Source Heat Pumps	≥ 15 SEER [a], ≥ 9.0 HSPF [b]
Gas-fired Furnace	≥ 90% AFUE [c] and Furnace Fan Efficiency ≤ 2.0%
Gas-fired Boiler	≥ 90% AFUE [c]
Ground Source Heat Pump	≥ 17.1 EER [d] and ≥ 3.6 COP [e]

a. SEER - Seasonal Energy Efficiency Ratio
b. HSPF – Heating Seasonal Performance Factor
c. AFUE – Annual Fuel Utilization Efficiency
d. EER – Energy Efficiency Ratio
e. COP – Coefficient of Performance

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Enhanced Building Thermal Envelope

R405.3

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Building Thermal Envelope shall comply with Table R405.3 in addition to Table R402.1.2.

FENESTRATION	Windows = 0.24 U-Factor ENERGY STAR Compliant Doors
SKYLIGHT U-FACTOR	0.45 U-Factor
GLAZED FENESTRATION SHGC	0.40 Solar Heat Gain Coefficient (SHGC)
CEILING	R60
MASS WALL	U-factor less than or equal to .035 or R-19 cavity + R-10 continuous, or R-13 in cavity + R-15 continuous, or R-25 continuous
WOOD FRAME	U-factor less than or equal to .035 or R-19 cavity + R-10 continuous, or R-13 in cavity + R-15 continuous, or R-25 continuous
METAL FRAME WALL	U-factor less than or equal to .035
CONTINUOUS SLAB INSULATION	R10 continuous

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Enhanced Air Leakage and Heat Recovery Ventilation *Section 405.4*

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Buildings shall meet the minimum air leakage requirements of Table R405.4 and install a heat or energy recovery ventilation system.

	New construction
Single family detached, two family attached (duplex), townhouses, flats	2 ACH50
Dwelling units in Multifamily buildings 3 stories and less	.25 CFM50/SF enclosure area of each unit or 2 ACH50

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Efficient Appliances and Water Heating *Section R405.5*

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

All refrigerators, freezers, dishwashers, clothes washers, and ceiling fans must be ENERGY STAR Qualified, and water heater(s) shall meet the minimum efficiency requirements of Table R405.5.

Equipment Type	**Efficiency**
Gas Storage Water Heaters	≥ 0.90 Energy Factor (EF)
Tankless Water Heaters	≥ 0.95 Energy Factor (EF) with electronic ignition
Electric Water Heaters	≥ 2.2 Energy Factor (EF)

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Energy Rating Index
Section R406

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Performance Path - Energy Rating Index (ERI)

- R406.2 Compliance with measure requires that the mandatory provisions identified in sections R401.2 and R403.5.3 be met. - The building thermal envelope shall be greater than or equal to the level of efficiency and SHGC in table 402.1.2 or 402.1.4 of the 2009 IECC.
- R406.6.2 Compliance report – compliance software tools shall generate a report that documents that the ERI of the rated design complies with sections R406.3 and R406.4.

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Energy Rating Index Compliance Alternative *Section R406*

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Compliance with this section requires that the provisions identified in Sections R401 through R404 labeled as “mandatory” be met. The building thermal envelope shall be greater than or equal to Table R406.2.

FENESTRATION U-FACTOR[b]	0.35 U-Factor
SKYLIGHT[b] U-FACTOR	0.60 U-Factor
GLAZED FENESTRATION SHGC[b]	No Requirement
CEILING	R-38
WOOD FRAME WALL	R-13
MASS WALL	R-5 exterior continuous or R-10 interior continuous
FRAME FLOOR	R-19
MASS FLOOR	R-15
BASEMENT WALL	R-10 continuous or R-13 in cavity
SLAB c R-VALUE & DEPTH	R-10 for the first 2 feet
CONDITIONED CRAWLSPACE WALL	R-10 continuous or R-13 in cavity

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be less than the *R*-value specified in the table.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

c. R-5 shall be added to the required slab edge R-values for heated slabs.

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Energy Rating Index
Section R406

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- R406.3 Energy Rating Index shall be a numerical integer value that is based on a linear scale constructed such that the ERI reference design has an index value of 100 and a residential building that uses no net purchased energy has an index value of 0.
- Each integer value on the scale shall represent a 1% change in the total energy use of the rated design relative to the total energy use of the ERI reference design. The ERI shall consider all energy used in a building.
- R406.3.1. ERI reference design – The ERI reference design shall be configured such that it meets the minimum requirements of the 2006 IECC prescriptive code requirements.

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ERI-Based Compliance
Section R406.4

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Compliance based on an ERI analysis requires that the rated design be shown to have an ERI less than or equal to **54** when compared to the ERI reference design.

R406.4.1 Renewable energy. The use of renewable energy is not allowed to meet the minimum requirement of **54** as listed in R406.4.

The engagement of a HERS rater is required at this time prior to agency approval.

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Existing Buildings
Chapter 5 (RE)

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

R501.1.1 Additions, alterations or repairs: General. Additions, alterations or repairs to an existing building, building system or portion thereof shall comply with section R502, R503 or R504. Unaltered portions of the existing building or building system shall not be required to comply with this code.

R502.1.2 Existing plus addition compliance (Energy Rating Index Compliance Alternative). The addition shall be deemed to comply where the annual site energy use of the addition and the existing building, and any alterations that are part of the project, is less than or equal to the annual site energy use of the existing building when modeled in accordance with Section R406. The addition and any alterations that are part of the project shall comply with Section R406 in its entirety.

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Alterations
Section R503

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

R503.1.1 Building envelope. Building envelope assemblies that are part of the alteration shall comply with Section R402.1.2 or R402.1.4, Sections R402.2.1 through R402.2.12, R402.3.1, R402.3.2, R402.4.1.1, R402.4.3 and R402.4.4.

Exception: The following alterations need not comply with the requirements for new construction provided the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.

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Additional Insulation Requirements for Level 3 Alterations *Section R503.1.1.2*

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Alterations affecting 80 percent or more of the aggregate area of the building. Existing exterior wall, ceiling, and floor assemblies that are not part of the scope of work of the alteration but are in an existing building undertaking a Level 3 alteration affecting 80 percent or more of the aggregate area of the building are required to comply with the following minimum insulation requirements:

1. Existing exterior walls shall be insulated to a minimum of R-7.5 continuous insulation or R-13 cavity insulation. Air permeable cavity insulation shall also be sufficient to fill the cavity.
2. Existing ceilings must be insulated to R-49 or have the cavity filled with insulation to the maximum extent possible.
3. Existing floors must be insulated to R-25 or have the cavity filled with insulation to the maximum extent possible.

Exception: Existing exterior walls where space constraints would make it impractical to meet this section without substantial reconfiguration of interior spaces or features.

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Air Leakage Testing *Section R503.1.1.3*

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Level 3 alterations affecting 80 percent or more of the aggregate area of the building must comply with air leakage requirements and procedures per Section R402.4.1.2.

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Heating and Cooling Systems

Section R503.1.2

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- New heating, cooling and duct systems that are part of the alteration shall comply with Sections R403.1, R403.2, R403.3 R403.4, R403.6, and R403.7.
- Exception: Where ducts from an existing heating and cooling system are extended, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3.
- R503.1.3 Service hot water systems. New service hot water systems that are part of the alteration shall comply with Section R403.5.

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Alterations
Section R503

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R503.1.4 Lighting. New lighting fixtures that are part of the alteration shall comply with Section R404.

R503.2 Change in space conditioning. Any nonconditioned or low-energy space, as defined in R402.1 that is altered to become conditioned space shall be required to be brought into full compliance with this code.

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Appendix RA
Combustion Appliance Zone

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- Appendix RA – has a test procedure for what's called worst case testing of atmospheric venting systems RA301.1. Tables RA301.1 (1)CAZ depressurization limits, Table RA301.1(2) Acceptable Draft Test Correction and Table RA301.1(3) Acceptable draft test correction form the basis for testing of the combustion appliance zones (CAZ).

- Exception: Buildings or dwellings containing only category III or IV direct-vent or integral vent appliances that do not draw combustion air from the inside of the building or dwelling unit.

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Combustion Appliance Zone (CAZ)

RA201

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- Combustion Appliance Zone (CAZ) is an area within the home that usually has the furnace & water heater and or other combustion equipment within however, it could be the main body of the home. These areas let's say mechanical rooms have atmospherically vented appliances of different categories drawing combustion air from inside the building.
- RA301.1 calls for the testing of such areas (CAZ) for spillage, acceptable draft and carbon monoxide (CO).

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Testing Required

RA301.1

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- The CAZ shall be tested for draft, spillage and Carbon Monoxide (CO).
- If the furnace, boiler, or water heater to be installed is atmospheric or mechanically vented and draws its combustion air from the combustion appliance zone, A test shall be performed on the equipment using the procedures outlined in this section.
- Draft – pressure difference existing between the appliance or any component part and the atmosphere that causes a flow of air.
- Spillage – combustion gases emerging from an appliance or venting system into the CAZ.
- CO – Carbon Monoxide concentration in the ambient air and in the flue. Ambient CO concentration should be < 25 ppm (< 8 ppm is preferred).

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CAZ Depressurization Limits

TABLE RA301

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TABLE RA301.1(1)
CAZ DEPRESSURIZATION LIMITS

VENTING CONDITION	LIMIT (Pa)
Category I - atmospherically vented water heater	-2.0
Category I or II - atmospherically vented boiler or furnace common vented with a Category I - atmospherically vented water heater	-3.0
Category I or II - atmospherically vented boiler or furnace, equipped with a flue damper, and common vented with a Category I atmospherically vent water heater	-5.0
Category I or II - atmospherically vented boiler or furnace alone	
Category I or II - atmospherically vented, fan assisted boiler or furnace common vented with a Category I atmospherically vented water heater	
Decorative vented, gas appliance	
Category III - Power vented or induced draft boiler or furnace alone or fan assisted water heater alone	-15.0
Category IV - direct vented appliances and sealed combustion appliances	-50.0

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UL 1738 Requirements for Gas Combustion Venting

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- Mechanical Code, Fuel & Gas code has references along with the national fire code.
- UL 1738 is a standard for Venting Systems for Gas-Burning Appliances, Categories II, III, and IV.
- IFGC Chapter 5, Section 3: - Chimneys and Vents, Venting of Appliances:

  503.4.1 Plastic Piping
- Where plastic piping is used to vent an appliance, the appliance shall be listed for use with such venting materials and the appliance manufacturer's installation instructions shall identify the specific plastic piping material. The plastic pipe venting materials shall be labeled in accordance with the product standards specified by the appliance manufacturer or shall be listed and labeled in accordance with ANSI/UL 1738.

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UL 1738 Requirements for Gas Combustion Venting

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- Fuel Gas Codes Cover Reference UL 1738 and ULC-S636
- Vent products used with efficient appliances and equipment are designed with these unique operating conditions in mind. Section 12.5 of NFPA 54/ANSI Z223.1, National Fuel Gas Code (NFGC) covers venting system types, including a table that directs users to appropriate vent types, based on applications and a variety of fuel types. Where nonmetallic pipe venting is appropriate, the Code acknowledges two possible choices. One option is for an appliance to be evaluated and listed for use with a specific vent material, with the manufacturer's installation instructions identifying the specific pipe material to be used, as well as instructions for joining vent pipe sections together. The nonmetallic venting material must be labeled in accordance with the product standard specified by the appliance manufacturer (e.g., labeling as required by an ASTM standard). Alternatively, the venting system shall be listed and labeled in accordance with UL 1738, Venting Systems for Gas-Burning Appliances, Categories II, III, and IV. Per UL 1738, the materials and means for joining sections is evaluated by review and by test.
- Vent materials for Category II, III, and IV appliances may also be manufactured of corrosion resistant metal, such as stainless steel, or possibly a metal overlaid with durable coating or plating. In the NFGC the term "special(-type) gas vents" is used to cover venting for Category II-IV appliances, whether manufactured of metallic or nonmetallic materials.

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UL 1738 Requirements for Gas Combustion Venting

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- 503.4.1.1 Plastic Vent Joints
- Plastic pipe and fittings used to vent appliances shall be installed in accordance with the appliance manufacturer's instructions. Plastic pipe venting materials listed and labeled in accordance with UL 1738 shall be installed in accordance with the vent manufacturer's installation
- System 1738 – Pipe
- Pipe is Black with 2 Orange print lines 180° apart
  - Line A: System 1738 ® Gas Vent Categories II, IV 149°F / 65°C PVC UL 1738 Min. Clearance to combustible construction 0mm – manufacture's installation instruction must be followed / <Date Code> Made in USA by IPEX USA LLC
  - Line B: System 1738 ® Gas Vent Categories II, IV 149°F / 65°C System 1738 Gas Vent Categories II, IV 149°F / 65°C

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UL 1738 Requirements for Gas Combustion Venting

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Venting History – Conflicting Standards?

- Conversely, manufacturers of the plumbing pipe and fittings do not endorse, promote or warranty their products for flue gas venting applications.
- The Reason:

Products manufactured to ASTM Standards are manufactured for fluid handling applications and are not designed or tested for flue gas venting applications.

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UL 1738 Requirements for Gas Combustion Venting

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CO Statistics

- In 2014, the Consumer Product Protection Association reported 165 unintentional non-fire CO poisoning deaths; an increase of 11% from the average number of reported incidents between 2012–2013. · Of these reported incidents, heating system fatalities represented the largest percentage at 39% or 65 deaths.
- Some examples of vent failures that exhibit either embrittlement, material degradation or vent separation were reported and documented in Aspen Colorado, Nashua New Hampshire, South Bend Indiana, and Port Mouth Virginia
- Venting. Reinvented, UL 1738 Fuel Gas Venting Systems webinar available from ICC

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Industry Concerns

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Solar Ready Provisions
Appendix RB

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RB101.1 General. These provisions shall be applicable for **new construction and Level 3 *alteration* affecting 80% or more of the aggregate area of the building**.

RB103.1 General.

A residential building with a roof area of 600 square feet (55.74 m2) or more oriented between 110 degrees and 270 degrees of true north shall comply with Sections RB103.2 through RB103.8.

Exceptions:

1. Residential buildings with a permanently installed on-site renewable energy system with a minimum size of 2 kilowatts (KW) per dwelling unit.
2. A building with a solar-ready zone that is shaded for more than 70 percent of daylight hours annually.

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Solar-Ready Zone
Section RB103

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

RB103.3 Solar-ready zone. The total solar-ready zone area shall be not less than 300 square feet (27.87 m2) exclusive of mandatory access or set back areas as required by the Fire Code.

Residential buildings with a total floor area less than or equal to 2,000 square feet (185.8 m2) per dwelling shall have a solar-ready zone area of not less than 150 square feet (13.94 m2). The solar-ready zone shall be composed of areas not less than 5 feet (1524 mm) in width and not less than 80 square feet (7.44 m2) exclusive of access or set back areas as required by the International Fire Code.

RB103.8 Construction documentation certificate. A permanent certificate, indicating the solar-ready zone and other requirements of this section, shall be posted near the electrical distribution panel, water heater or other conspicuous location by the builder or registered design professional.

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DCSEU Solar for All Grant

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WHAT IS SOLAR FOR ALL?

A program of the District of Columbia's Department of Energy and Environment, which seeks to provide the benefits of solar electricity to 100,000 low-income households and reduce their energy bills by 50% by 2032.

For more information about Solar for All visit: doee.dc.gov/solarforall

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Equipment Sizing
Section R403.7

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Heating and cooling equipment shall be sized in accordance with the Air Conditioning Contractors of America (ACCA) Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies.

- ACCA Manual J, Residential Load Calculations, 8th edition.
- ACCA Manual S, Residential Equipment Selection

Exceptions:

1. Where the new cooling equipment utilizes multistage technology or variable refrigerant flow technology.
2. Where the new heating and/or cooling equipment is 1.5 tons or less.
3. Where ductwork is being extended from an existing equipment into an addition.
4. Where there is a replacement in kind of an existing system, as long as the BTU's of the new system are equivalent or smaller to the new equipment and the building thermal envelope is not being altered.

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Interior Design Conditions

Section R302.1

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The interior design temperatures used for heating and cooling load calculations shall be a maximum of 72°F (22°C) for heating and minimum of 75°F (24°C) for cooling.

Outside air shall be a maximum of 92°F (33°C) for cooling & 21°F (-6.1°C) for heating.

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ACCA Approved Software

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Wrightsoft Right-J8 – Load short form (entire house & per system) Building Analysis, Project summary (entire house & per system), Component construction (entire house & per system) and the Right-J worksheet.

Elite RHVAC – Project, Miscellaneous, Load preview, Total Building summary (entire house & per system), Building envelope and the detailed room loads report.

Cool Calc Manual J full version - Cooling & Heating loads (entire house & per system), Component loads (entire house & per system) and the Building envelope report.

(we do not accept the one-page web-based version).

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ACCA Approved Software

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We have not developed a report requirement, for these products since they are rarely encountered, but be sure to include reports that display input and output data as mentioned with the other software:

- Adtek AccuLoads
- Florida Solar Energy Center's EnergyGauge
- CarmelSoft HVAC ResLoad-J
- Avenir MJ8 Editions of HeatCAD® and LoopCAD®

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Types of Software and Reports

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WHERE TO FIND THE INFORMATION

Load Variable	Elite Load Reports	Wrightsoft Load Reports
Design Temps	Project Report Miscellaneous Report	Short Form Building Analysis Component Constructions Project Summary AED Assessment
Envelope Details	Total Building Summary Loads System Summary Loads	Component Constructions Right-J Worksheet
Orientation	Project Report – Frond Door Orientation Building Rotation General Overview Detailed Room Loads – Window Orientation	Multiple Orientations Report Component Constructions (Use window directions)

Load Variable	Elite Load Reports	Wrightsoft Load Reports
Ductwork Details Note that all duct characteristics do not show up on reports.	Loads & duct location show in: Miscellaneous Report	Loads show in: Building Analysis Project Summary Right-J Worksheet
Infiltration `	Miscellaneous Report Total Building Summary Loads System Summary Loads	Building Analysis Component Constructions Project Summary
Ventilation Note that type & efficiency does not show up on reports.	Miscellaneous Report Total Building Summary Loads System Summary Loads	Loads show in: Load Short Form ("Other Equip. Loads") Building Analysis Project Summary
Appliance Loads	Total Building Summary Loads System Summary Loads	Right-J Worksheet

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Directions for locating load sizing policy letter

- Once you logon the website shown above look to the left information bar and go to compliance.
- Once there look to what's displayed on the main screen and click on Interpretations and Guidance.
- Scroll all the way down to almost to the bottom of the page.
- There is a note: A Manual S report must accompany the manual J report.
- Look for the Guidelines link and click on it.
- The load sizing policy letter will open.

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Inspection Data Plates

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The data plate for AC compressors have the tonnage or capacity identified for all different sizes that a particular manufacturer has.

While examining the model number look for a number that has these numerical identifiers, they usually are in multiples of ½ a ton for instance: A 1 ton system displays:

1 ton - 12
1.5 ton -18
2 ton - 24
2.5 ton - 30
3 ton - 36
3.5 ton – 42 and so on and so forth, get it!

You will see these numbers somewhere on the model number data plate and that's how tonnage is determined out in the field. Tonnage defines AC condensers or compressors; BTU's define furnaces or water heaters.

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Contact Us

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