

CHAPTER 4

ENERGY RATING CALCULATION PROCEDURES

4.1. Determining the Energy Rating Index. The Energy Rating Index for a Rated Home shall be determined in accordance with Sections 4.1.1 and 4.1.2. This standard shall not be used to calculate the Energy Rating Index for a whole building that contains more than one Dwelling Unit or Sleeping Unit.

4.1.1. Calculating End Use Loads. The normalized Modified End Use Loads (n MEUL) for space heating and cooling and service hot water use shall each be determined in accordance with Equation 4.1-1:

$$nMEUL = REUL \times (nEC_x / EC_r) \quad \text{(Equation 4.1-1)}$$

where:

nMEUL = normalized Modified End Use Loads (for heating, cooling, or hot water) as compute using an Approved Software Rating

REUL = Reference Home End Use Loads (for heating, cooling or hot water) as computed using an Approved Software Rating Tool.

nEC_x = normalized Energy Consumption for the Rated Home's end uses (for heating, including Auxiliary Electric Consumption, cooling or hot water) as computed using an Approved Software Rating Tool.

EC_r = estimated Energy Consumption for the Reference Home's end uses (for heating, including Auxiliary Electric Consumption, cooling or hot water) as computed using an Approved Software Rating Tool.

and where:

$$nEC_x = (a \times EEC_x - b) \times (EC_x \times EC_r \times DSE_r) / (EEC_x \times REUL) \quad \text{(Equation 4.1-1a)}$$

where:

EC_x = estimated Energy Consumption for the Rated Home's end uses (for heating, including Auxiliary Electric Consumption, cooling or hot water) as computed using an Approved Software Rating Tool.

EEC_x = Equipment Efficiency Coefficient for the Rated Home's equipment such that EEC_x equals the energy consumption per unit load in like units as the load, and as derived from the Manufacturer's Equipment Performance Rating (MEPR) such that EEC_x equals 1.0 / MEPR for AFUE, COP or EF ratings, or such that EEC_x equals 3.413 / MEPR for HSPF, EER or SEER ratings.

$$DSE_r = REUL / EC_r \times EEC_r$$

For simplified system performance methods, DSE_r equals 0.80 for heating and cooling systems and 1.00 for hot water systems [see Table 4.2.2(1)]. However, for

detailed modeling of heating and cooling systems, DSE_r less than 0.80 occurs as a result of part load performance degradation, coil air flow degradation, improper system charge and auxiliary resistance heating for Heat Pumps. Except as otherwise provided by these Standards, where detailed systems modeling is employed, it must be applied equally to both the Reference and the Rated Homes.

EEC_r = Equipment Efficiency Coefficient for the Reference Home's equipment, such that EEC_r equals the energy consumption per unit load in like units as the load, and as derived from the Manufacturer's Equipment Performance Rating (MEPR) such that EEC_r equals 1.0 / MEPR for AFUE, COP or EF ratings or such that EEC_r equals 3.413 / MEPR for HSPF, EER or SEER ratings and where the coefficients 'a' and 'b' are as defined by Table 4.1.1(1) below.

**TABLE 4.1.1(1)
COEFFICIENTS 'a' AND 'b'**

FUEL TYPE AND END USE	a	b
Electric space heating	2.2561	0
Fossil fuel ^a space heating	1.0943	0.4030
Biomass space heating	0.8850	0.4047
Electric air conditioning	3.8090	0
Electric water heating	0.9200	0
Fossil fuel ^a water heating	1.1877	1.0130

a. Such as natural gas, liquid propane gas, fuel oil

4.1.2. Calculating the Energy Rating Index. The Energy Rating Index shall be determined in accordance with Equation 4.1-2.

$$\text{Energy Rating Index} = PE_{frac} \times (TnML / (TRL \times IAF_{RH})) \times 100 \quad \text{(Equation 4.1-2)}$$

where:

$$TnML = nMEUL_{HEAT} + nMEUL_{COOL} + nMEUL_{HW} + EC_{LA} + EC_{VENT} + EC_{DH} \text{ (MBtu/y)}$$

$$TRL = REUL_{HEAT} + REUL_{COOL} + REUL_{HW} + REC_{LA} + REC_{VENT} + REC_{DH} \text{ (MBtu/y)}$$

IAF_{RH} = Index Adjustment Factor of Rated Home in accordance with Equation 4.3-2.

and where:

EC_{LA} = The Rated Home energy consumption for lighting, appliances and MELs as defined by Section 4.2.2.7.2, converted to MBtu/y, where MBtu/y = (kWh/y)/293 or (Therms/y)/10, as appropriate.

REC_{LA} = The Reference Home energy consumption for lighting, appliances and MELs as defined by Section 4.2.2.7.1, converted to MBtu/y, where MBtu/y = (kWh/y) / 293 or (Therms/y)/10, as appropriate.

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EC_{VENT} = The Rated Home energy consumption for Dwelling Unit Mechanical Ventilation System fans, converted to MBtu/y, where $MBtu/y = (kWh/y) / 293$.

REC_{VENT} = The Reference Home energy consumption for Dwelling Unit Mechanical Ventilation System fans, converted to MBtu/y, where $MBtu/y = (kWh/y) / 293$.

EC_{DH} = The Rated Home energy consumption for dehumidification, converted to MBtu/y, where $MBtu/y = (kWh/y) / 293$.

REC_{DH} = The Reference Home energy consumption for dehumidification, converted to MBtu/y, where $MBtu/y = (kWh/y) / 293$.

and where:

$PE_{frac} = (TEU - OPP) / TEU$

TEU = Total energy use of the Rated Home including all rated and nonrated energy features where all fossil fuel site energy uses (Btu_{fossil}) are converted to equivalent electric energy use (kWh_{eq}) in accordance with Equation 4.1-3.

OPP = On-Site Power Production as defined by Section 4.2.2.8 of this Standard.

$kWh_{eq} = Btu_{fossil} \times 0.40 / 3412$

(Equation 4.1-3)

4.2. Energy Rating Reference Home and Rated Home Configuration.

4.2.1. General Requirements. Except as specified by this section, the Energy Rating Reference Home and the Rated Home shall be configured and analyzed in the Approved Software Rating Tool using identical methods and techniques.

4.2.2. Residence Specifications. The Energy Rating Reference Home and Rated Home shall be configured and analyzed in the Approved Software Rating Tool as specified by Table 4.2.2(1).

**TABLE 4.2.2(1)
SPECIFICATIONS FOR THE ENERGY RATING REFERENCE AND RATED HOMES**

BUILDING COMPONENT	ENERGY RATING REFERENCE HOME	RATED HOME
Above-grade walls separating Conditioned Space Volume from outdoor environment or Unconditioned Space Volume	Type: wood frame Gross area: same as Rated Home U-Factor: from Table 4.2.2(2) Solar Absorptance = 0.75 Emmittance = 0.90	Same as Rated Home Same as Rated Home Same as Rated Home Values from Table 4.2.2(4) shall be used to determine Solar Absorptance, except where test data are provided for wall surface in accordance with ASTM C1549 or ASTM E903 using the ASTM G197 air-mass 1.5 sun-facing global vertical solar spectral irradiance for the measurement of Solar Reflectance. ¹ The Solar Absorptance value is obtained by subtracting the measured Solar Reflectance value from the number one (Solar Absorptance = 1 – Solar Reflectance) Same as Rated Home
Above-grade walls separating Conditioned Space Volume from Unrated Heated Space, Multifamily Buffer Boundary, or Non-Freezing Space	Type: wood frame Gross Area: same as Rated Home U-Factor: 0.292 for IECC Climate Zones 1&2, 0.089 for IECC Climate Zones 3–8. Solar Absorptance = 0.75 Emittance = 0.90	Same as Rated Home Same as Rated Home Same as Rated Home Values from Table 4.2.2(4) shall be used to determine Solar Absorptance, except where test data are provided for wall surface in accordance with ANSI/CRRC S100. Same as Rated Home
Conditioned basement walls	Type: same as Rated Home Gross Area: same as Rated Home R-Value: from Table 4.2.2(2) with the insulation layer on the interior side of walls	Same as Rated Home Same as Rated Home Same as Rated Home

1.(Normative Note) Solar Reflectance is permitted to be measured in accordance with the CRRC-1 Product Rating Program Manual Appendix 8 “Standard Test Method for Determining the Directional-Hemispherical Solar Reflectance of Materials Using a Directional-Hemispherical Portable Reflectometer” with the ASTM G197 air-mass 1.5 sun-facing global vertical solar spectral irradiance

TABLE 4.2.2(1)
SPECIFICATIONS FOR THE ENERGY RATING REFERENCE AND RATED HOMES—continued

BUILDING COMPONENT	ENERGY RATING REFERENCE HOME	RATED HOME
Floors over Unconditioned Space Volume, Non-Freezing Space, Unrated Heated Space, or Multifamily Buffer Boundary	Type: wood frame Gross Area: same as Rated Home U-Factor: from Table 4.2.2(2)	Same as Rated Home Same as Rated Home Same as Rated Home
Floors over outdoor environment	Type: wood frame Gross Area: same as Rated Home ceiling area U-Factor: from Table 4.2.2(2)	Same as Rated Home Same as Rated Home Same as Rated Home
Ceilings above Conditioned Space Volume and below an Attic, Unconditioned Space Volume, Non-Freezing Space, Unrated Heated Space, or Multifamily Buffer Boundary	Type: wood frame Gross Area: same as Rated Home ceiling area U-Factor: from Table 4.2.2(2)	Same as Rated Home Same as Rated Home Same as Rated Home
Roofs	Type: composition shingle on wood sheathing Gross Area: same as Rated Home Solar Absorptance = 0.75 Emittance = 0.90	Same as Rated Home Same as Rated Home Values from Table 4.2.2(5) shall be used to determine Solar Absorptance, except where test data are provided for roof surface in accordance with ANSI/CRRC S100 for the measurement of Solar Reflectance. The Solar Absorptance value is obtained by subtracting the measured Solar Reflectance value from the number one (Solar Absorptance = 1 – Solar Reflectance). Emittance values provided by the roofing manufacturer in accordance with ANSI/CRRC S100 shall be used when available. In cases where the appropriate data are not known, same as the Reference Home.
Attics	Type: vented with aperture = 1ft ² per 300 ft ² ceiling area Attic roof assemblies shall be uninsulated, while the ceiling below the Attic shall be insulated according to Table 4.2.2(2)	Same as Rated Home Same as Rated Home
Foundations	Type: same as Rated Home Gross Area: same as Rated Home U-Factor / R-Value: from Table 4.2.2(2)	Same as Rated Home Same as Rated Home Same as Rated Home

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TABLE 4.2.2(1)
SPECIFICATIONS FOR THE ENERGY RATING REFERENCE AND RATED HOMES—continued

BUILDING COMPONENT	ENERGY RATING REFERENCE HOME	RATED HOME
Crawl spaces	<p>Type: vented with net free vent aperture = 1 ft² per 150 ft² of crawl space floor area</p> <p>Crawl space walls shall be uninsulated, while the floor above the crawl space shall be insulated according to Table 4.2.2(2) as a “Floor over Unconditioned Space Volume”^a</p> <p>U-Factor: from Table 4.2.2(2) for floors over Unconditioned Space Volume or outdoor environment.</p>	<p>Same as the Rated Home, but not less net free Ventilation area than the Reference Home unless an Approved ground cover in accordance with IRC 408.3.1 is used, in which case, the same net free Ventilation area as the Rated Home down to a minimum net free vent area of 1 ft² per 1,500 ft² of crawl space floor area.</p> <p>Same as Rated Home</p>
Doors	<p>Area: 40 ft² for one- and two-family Dwellings and Townhouses; 20 ft² for all others</p> <p>Orientation: For exterior doors: North in the northern hemisphere and South in the southern hemisphere For all other doors, in adiabatic wall</p> <p>U-Factor: same as Opaque Door from Table 4.2.2(2)</p>	<p>Same as Rated Home</p> <p>Same as Rated Home</p> <p>Same as Rated Home</p>
Glazing ^b	<p>Total area^c = 18% of CFA</p> <p>Orientation: equally distributed to four (4) cardinal compass orientations (N, E, S, & W)</p> <p>U-Factor: from Table 4.2.2(2)</p> <p>SHGC: from Table 4.2.2(2)</p> <p>Interior shade coefficient: Summer = 0.70 Winter = 0.85</p> <p>External shading: none</p>	<p>Same as Rated Home</p> <p>Same as Rated Home</p> <p>Same as Rated Home</p> <p>Same as Rated Home</p> <p>Same as Energy Rating Reference Home^d</p> <p>Same as Rated Home^e</p>
Skylights	None	Same as Rated Home
Thermally isolated sunrooms	None	Same as Rated Home