ANSI/RESNET/ICC 301-2022 Addendum C-2024, Interim Updates

Note: Where this superscript, " (1) ", in blue print occurs it indicates that sections, tables and equations are added or deleted which affect existing section, table or equation numbers and references to those numbers. Renumbering will be made in the document that combines all addenda to standard 301. Footnote numbers in this Addendum do not match the respective footnote numbers in standard 301 and the other addenda. Those numbers will also be reestablished in the document that combines all addenda.

Modify sections of Standard ANSI/RESNET/ICC 301-2022 as follows.

1. Purpose.

2. Scope.

3. Definitions.

3.1. General.

3.2. Definitions.

Battery Storage Losses – Charging and discharging energy losses calculated as total annual energy based on the ~~round-trip~~rated single charge-discharge cycle efficiency for the On-Site Battery Storage system.

Carbon Dioxide Equivalent (CO2e) Emissions – The CO2 pre-combustion and combustion emissions and the emissions of CH4 and N2O at their 100-year GWP equivalent emissions in accordance with the IPCC Sixth Assessment Report.

Carbon Dioxide Equivalent Rating Index (CO2e Rating Index) – A numerical integer value that represents the relative Carbon Dioxide equivalent (CO2e) emissions of a Rated Home as compared with the CO2e emissions of the CO2e Reference Home where an Index value of 100 represents the CO2e performance of the CO2e Reference Home and an Index value of 0 (zero) represents a home that emits zero net CO2e annually.

Conditioned Space Volume (CSV)[1] – The volume within a Dwelling Unit serviced by a space heating or cooling system designed to maintain space conditions at 78°F for cooling and 68°F for heating. The following specific spaces are addressed to ensure consistent application of this definition:

- If the volume both above and below a floor assembly meets this definition and is part of the subject Dwelling Unit, then the CSV shall include the volume of the full depth

[1] (Informative Note) Informative Annex A of Standard ANSI/RESNET/ICC 380 contains a table that summarizes parts of a Dwelling Unit that are included in Conditioned Space Volume.

of the floor assembly. Otherwise, the volume of the full depth of the floor assembly shall be excluded.

Exception: The wall height used to determine the volume shall extend from the finished floor to the bottom surface of the floor decking above the Rated Dwelling Unit for all floors other than the top-floor. For Dwelling Units on the top floor, this dimension shall extend from the top surface of the finished floor to the interior surface of the enclosure air barrier.

- If the volume of at least one of the spaces horizontally adjacent to a wall assembly meets this definition, and that volume is part of the subject Dwelling Unit, CSV shall include the volume of the full width of the wall assembly. Otherwise, the volume of the full width of the wall assembly shall be excluded.

  Exception: If the subject Dwelling Unit shares a wall assembly[2] with another Dwelling Unit, then the CSV of the subject Dwelling Unit shall include half the volume of the full width of that shared wall assembly.
- The CSV shall exclude the volume of a garage even when it is conditioned.
- The CSV shall exclude the volume of a thermally isolated sunroom.
- The CSV shall include the volume of an Attic, crawlspace, or a basement only if it is contiguous with and dedicated[3] to the subject Dwelling Unit and the party conducting evaluations has either:
  - Obtained an ACCA Manual J, S, and either B or D report and verified that both the heating and cooling equipment and distribution system are designed to offset the entire design load of the volume; or
  - Verified through visual inspection that both the heating and cooling equipment and distribution system serve the volume and, in the judgment of the party conducting evaluations, are capable of maintaining space conditions at 78°F (26°C) for cooling and 68°F (20°C) for heating.
- The CSV shall include the volume of an adjacent mechanical closet, regardless of access location, only if it is contiguous with and dedicated[4] to the subject Dwelling Unit, only includes equipment serving the subject Dwelling Unit, and the party conducting evaluations has either:

  - Obtained an ACCA Manual J, S, and either B or D report and verified that both the heating and cooling equipment and distribution system are designed to offset the entire design load of the volume; or
  - Verified through visual inspection that both the heating and cooling equipment and distribution system serve the volume and, in the judgment of the party conducting evaluations, are capable of maintaining space conditions at 78°F (26°C) for cooling and 68°F (20°C) for heating.

[2] (Informative Note) For example, a common or demising wall.
[3] (Informative Note) That is, it does not span multiple Dwelling Units undivided.

Electric Auxiliary Energy (Eae) – The average annual Auxiliary Electric Consumption for a gas Furnace or Boiler in Kilowatt-Hours per year as formerly published in the AHRI Consumer's Directory of Certified Efficiency Ratings.

Heating Seasonal Performance Factor (HSPF) – A standardized measure of Heat Pump efficiency, based on the total heating output of a Heat Pump in Btu and divided by the total electric energy input in watt-hours and under test conditions specified by ~~the Air Conditioning and Refrigeration Institute~~ Standard AHRI 210/240 - 2017.

Heating Seasonal Performance Factor 2 (HSPF2) – A standardized measure of Heat Pump efficiency, based on the total heating output of a Heat Pump in Btu and divided by the total electric energy input in watt-hours and under test conditions specified by ~~the Air Conditioning and Refrigeration Institute~~ Standard AHRI 210/240 ~~2023~~.

Internal Gains – The heat gains within a home attributable to lights, people, hot water tanks, equipment, appliances, and Miscellaneous Energy Loads ~~internal to the Conditioned Space Volume~~.

On-Site Battery Storage – Electrical energy storage system on the site of the Rated Home accepting electrical energy from On-Site Power Production, storing that electric energy, and then dispatching the stored electric energy to power building loads in accordance with a defined battery energy storage system power dispatch protocol.

Seasonal Energy Efficiency Ratio (SEER) – A standardized measure of Air Conditioner efficiency based on the total cooling output of an Air Conditioner in Btu/h, divided by the total electric energy input, in Watt-hours, under test conditions specified by ~~the Air Conditioning and Refrigeration Institute~~ Standard AHRI 210/240 - 2017.

Seasonal Energy Efficiency Ratio 2 (SEER2) – A standardized measure of Air Conditioner efficiency based on the total cooling output of an Air Conditioner in Btu/h, divided by the total electric energy input, in Watt-hours, under test conditions specified by ~~the Air Conditioning and Refrigeration Institute~~ Standard AHRI 210/240 ~~2023~~.

Unconditioned Space Volume[4] – The volume within a building or Dwelling Unit that is not Conditioned Space Volume but which contains heat sources or sinks that influence the temperature of the area or room. The following specific spaces are addressed to ensure consistent application of this definition for inclusion in Unconditioned Space Volume:

- If either one or both of the volumes above and below a floor assembly is Unconditioned Space Volume, then the volume of the full depth of the floor assembly shall be included.
- If the volume of both of the spaces horizontally adjacent to a wall assembly are Unconditioned Space Volume, then the volume of the full width of the wall assembly shall be included.

[4] (Informative Note) Informative Annex A of Standard ANSI/RESNET/ICC 380 contains a table that summarizes parts of a Dwelling Unit that are included in Unconditioned Space Volume.

Exception: If the volume of one of the spaces horizontally adjacent to a wall assembly is a Dwelling Unit other than the subject Dwelling Unit, then the volume of the full width of that wall assembly shall be evenly divided between both adjacent Dwelling Units.

- The volume of an attached garage shall be included, even when it is conditioned.
- The volume of a thermally isolated sunroom shall be included.
- The volume of an Attic, a crawlspace, or a basement shall be included unless it meets the definition of Conditioned Space Volume.

3.3 Acronyms.

AHRI – Air-Conditioning, Heating, and Refrigeration Institute

CFIS *- Central Fan Integrated Supply*

CO_2e Rating Index – Carbon Dioxide Equivalent Rating Index

REC - Renewable Energy Certificate

[(1) Note to Reviewers: Where Tables and equations are added or deleted the tables and equations and the references to them will be renumbered, e.g., Table 4.2.2(4) will be renumbered to Table 4.2.2(3); Equation "Equation 4.2-X1" becomes "Equation 4.2-28"; "Equation 4.2-X2" becomes "Equation 4.2-29"; "Equation 4.2-28" becomes "Equation 4.2-30", etc. Renumbering will implemented upon finalization of the addendum.]

4. Energy Rating Calculation Procedures.

4.1. Determining the Energy Rating Index.

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

$$nMEUL = REUL * (nEC\_x / EC\_r) \qquad \textbf{(Equation 4.1-1)}$$

where:

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

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 = EC_x * (a * EEC_x – b) * ~~(EC_x * EC_r * DSE_r) /~~ (EEC_r / EEC_x ~~* REUL~~) **(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.[5,6]

~~DSE_r = REUL/EC_r * 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

[5] (Normative Note) Where indicated, MEPR values shall be determined using HSPF and SEER. When only HSPF2 and SEER2 are available, HSPF and SEER shall be calculated in accordance with Section 4.4.4.1.

[6] (Normative Note) Where indicated, MEPR values shall be calculated using EF. When only UEF is available, EF shall be calculated from the UEF using the EF calculator located at https://www.resnet.us/wp-content/uploads/RESNET-EF-Calculator-2017.xlsx or equivalent.

Table 4.1.1(1) Coefficients 'a' and 'b'

Fuel Type and End Use	a	b
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

4.1.1.1. Multiple Equipment Serving the Same End Use Load. When the Rated Home has multiple equipment serving the same end use load, the value of nMEUL for that end use shall be determined by summing the nMEULs for each individual system. For each equipment in the Rated Home, the Reference Home shall be assigned a corresponding equipment. EC_x, EEC_x, a, and b shall be determined separately for each equipment in the Rated Home. EC_r, EEC_r shall be determined for each corresponding equipment in the Reference Home. REUL for each equipment shall be determined as the Reference Home End Use Load met by the corresponding equipment in the Reference Home. Fossil fuel back-up heating for heat pump equipment shall be considered separate equipment in this calculation.

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

$$\text{Energy Rating Index} = PEfrac * [TnML / (TRL * IAF_{RH})] * 100$$

(Equation 4.1-2)

where:

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

TRL = $REUL_{HEAT} + REUL_{COOL} + REUL_{HW} + REC_{LA} + REC_{VENT} + REC_{DH}$ (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 4.2.2.5.2, 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 4.2.2.5.1, converted to MBtu/y, where MBtu/y = (kWh/y)/293 or (Therms/y)/10, as appropriate.

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:

PEfrac = (TEU – OPP + BSL) / 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 4.2.2.7 of this Standard.

BSL = Battery Storage Losses, calculated as total annual energy based on the round-trip efficiency for the On-Site Battery Storage

$$kWh_{eq} = (Btu_{fossil} * 0.40) / 3412 \quad \textbf{(Equation 4.1-3)}$$

4.2 Energy Rating Reference Home and Rated Home Configuration.

4.2.1 General Requirements. Except as specified ~~by this~~elsewhere in section 4.2, 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.

4.2.1.1 Modeling Assumptions. The assumptions specified in Normative Appendix C shall apply to all simulation models.

4.2.2 Residence Specifications.

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	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

Table 4.2.2(1) Specifications for the Energy Rating Reference and Rated Homes

Building Component	Energy Rating Reference Home	Rated Home
	Emittance = 0.90	air-mass 1.5 sun-facing global vertical solar spectral irradiance for the measurement of Solar Reflectance.[7] 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
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	Same as Rated Home Same as Rated Home

[7] (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

Building Component	Energy Rating Reference Home	Rated Home
	U-Factor: from Table 4.2.2(2)	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~~Material: 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(~~4~~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.

Table 4.2.2(1) Specifications for the Energy Rating Reference and Rated Homes

Building Component	Energy Rating Reference Home	Rated Home
	Predominant Shape:[8] Same as Rated Home	Same as Rated Home
Glazing[b]	Total area[c] =18% of CFA	Same as Rated Home
	Orientation: equally distributed to four (4) cardinal compass orientations (N, E, S, & W)	Same as Rated Home
	U-Factor: from Table 4.2.2(2)	Same as Rated Home
	SHGC: from Table 4.2.2(2)	Same as Rated Home
	Interior shade coefficient: 0.92-(0.21*SHGC ~~for~~ of the ~~standard reference design~~ Energy Rating Reference Home)~~Summer = 0.70 Winter = 0.85~~	0.92-(0.21*SHGC ~~as proposed~~of the Rated Home)~~Same as Energy Rating Reference Home[d]~~
	External shading: none	Same as Rated Home[e]
Skylights	None	Same as Rated Home

Table 4.2.2(1) Specifications for the Energy Rating Reference and Rated Homes

Building Component	Energy Rating Reference Home	Rated Home
Air exchange rate	Specific Leakage Area (SLA)[f] = 0.00036 assuming no energy recovery, supplemented as necessary with balanced mechanical ventilation to achieve the required Dwelling Unit total air exchange rate (Qtot).[g, h]	In accordance with Standard ANSI/RESNET/ICC 380, obtain airtightness test results for: • Building enclosure (for Detached Dwelling Units) • Compartmentalization Boundary (for

[8] (Informative Note) Roof shape is not a minimum rated feature. It is included here to make explicit that whatever Roof Shape is used in the Rated Home shall also be used in the Reference Home. Examples of roof shapes include Flat, Sloped/Shed, Hip and Gable.~~(Informative Note) Examples of roof shapes include Flat, Sloped/Shed, Hip and Gable.~~

Table 4.2.2(1) Specifications for the Energy Rating Reference and Rated Homes

Building Component	Energy Rating Reference Home	Rated Home
		Attached Dwelling Units). For Attached Dwelling Units with airtightness test results ≤ 0.30 cfm50 per ft^2 of Compartmentalization Boundary, the test results shall be multiplied by reduction factor A_{ext}[i] to determine the Infiltration rate. For Attached Dwelling Units with airtightness test results > 0.30 cfm50 per ft^2 of Compartmentalization Boundary, the test results shall be modeled as the Infiltration rate. For residences without Dwelling Unit Mechanical Ventilation Systems[m], or without measured airflow, or where A_{ext}[i] < 0.5 and the Mechanical Ventilation System is solely an Exhaust System, the Infiltration rate[j] shall be ~~as~~ determined by the airtightness test results described above, but not less than 0.30 ACH (at 4 Pa). Where the resulting dwelling unit total air exchange rate is less than Qtot = 0.03 x CFA + 7.5 x (Nbr+1) cfm, a supplemental balanced ventilation system shall be added to the Rated Home to meet Qtot.[zz] For residences with Dwelling Unit Mechanical Ventilation Systems, the total air exchange rate shall be the Infiltration rate[j] as determined above, in

Table 4.2.2(1) Specifications for the Energy Rating Reference and Rated Homes

Building Component	Energy Rating Reference Home	Rated Home
		combination[h] with the time-averaged Dwelling Unit Mechanical Ventilation System rate,~~[zz]~~[, k] which shall be the value measured in accordance with Standard ANSI/RESNET/ICC 380. ~~To ensure that the total air exchange rate is~~ The dwelling unit total air exchange rate shall be no less than Qtot = 0.03 x CFA + 7.5 x (Nbr+1) cfm. To ensure the total air exchange rate is sufficient, if needed, the Dwelling Unit Mechanical Ventilation System runtime operation shall first be increased, if possible, followed by increasing the airflow rate as needed. Supply and exhaust ventilation shall increase proportionally to the Rated Home's entered value(s), or if no mechanical ventilation system was specified a balanced ventilation system shall be modeled.
Dwelling Unit Mechanical Ventilation System fan power	None, except where a mechanical Ventilation system is installed in the Rated Home, in which case: Where Rated Home does not have energy recovery: 0.35 W/cfm * fanCFM_sup + 0.35 W/cfm * fanCFM_exh Where Rated Home has energy recovery: 0.50 W/cfm * fanCFM_sup + 0.50 W/cfm * fanCFM_exh And where fanCFM_sup and fanCFM_exh are the respective	Same as Rated Home[m, n, zz] except when the Dwelling Unit Mechanical Ventilation System airflow rate has been increased to meet the total air exchange rate, in which case: ~~the fan power shall be proportionally increased to maintain the fan W/cfm.~~ Where only the runtime has been increased, the fan energy shall be proportionally

Table 4.2.2(1) Specifications for the Energy Rating Reference and Rated Homes

Building Component	Energy Rating Reference Home	Rated Home
	minimum continuous supply and exhaust Dwelling Unit Mechanical Ventilation System fan flow rates~~s~~ for the Rated Home.[l, zz]	increased to maintain the Rated Home fan Wh/cfm. Where airflow rate has been increased, the fan power shall be proportionally increased to maintain the Rated Home fan W/cfm
Internal Gain	As specified ~~by Table 4.2.2(3)~~ in Section 4.2.2.7.1	Same as Energy Rating Reference Home, except as provided by Section 4.2.2.~~6~~7.2

~~d. For Fenestrations facing within 15 degrees of true south or true north, for Rated Homes in the northern and southern hemisphere respectively, that are directly coupled to thermal storage mass, the winter interior shade coefficient shall be permitted to increase to 0.95 in the Rated Home.~~ [(1)]

e. The term External Shading refers only to permanent, fixed shading devices attached to the building such as fins and overhangs. Window screens, movable awnings, roller shades, safety bars, balcony railings, and shade from adjacent buildings, trees and shrubs shall not be included in the analysis of the Rated Home energy usage. External shading shall be calculated based on the position of the sun and the dimensions and position of the shading device.

f. SLA = ~~ELA / CFA where ELA = 0.054863 * cfm50 and where CFA is in square inches.~~Specific Leakage Area as defined in Normative Appendix C2.2, Equations 3 and 19.

g. The required supplemental Dwelling Unit Mechanical Ventilation System continuous airflow rate (Qfan) for the Energy Rating Reference Home shall be determined in accordance with the following equation

$$Q_{fan} = \underline{\max}(Q_{tot} - (Q_{inf} \times A_{ext}),\underline{0})$$

where:

Q_{fan} = $Q_{fan,sup}$ = $Q_{fan,exh}$ = supplemental required mechanical Ventilation rate, cfm

$Q_{fan,sup}$ = supply fan air flow rate, cfm

$Q_{fan,exh}$ = exhaust fan air flow rate, cfm

Q_{tot} = total required ~~Ventilation~~ air exchange rate, cfm

Q_{inf} = *Infiltration*, cfm

Aext = 1 for ~~Detached *Dwelling* Units, or the ratio of exterior enclosure surface area that is not attached to garages or other *Dwelling* Units to Compartmentalization Boundary for Attached Dwelling Units~~the Energy Rating Reference Home

and where:

Qtot = 0.03 * CFA + 7.5 * (Nbr+1)

Qinf = *NL* · wsf · CFA * Hr / 60

where:

NL = *normalized* leakage ~~= 1000 * SLA * (H / Hr)$^{0.4}$~~as defined in Normative Appendix C2.2, Equation 1.

wsf = weather and shielding factor from ASHRAE Standard 62.2, Normative Appendix B

~~*H* = vertical distance between lowest and highest above-grade points within the pressure boundary (ft.)~~

Hr = reference height = 8.202 ft.

h. ~~Either h~~Hourly calculations using either the following equation or calculations yielding equivalent results shall be used to determine the combined air exchange rate resulting from Infiltration in combination with Dwelling Unit Mechanical Ventilation Systems.

$Q_i = Q_{fan,max,i} + (Qinf,i)^2 / (Qinf,~~I~~i + Qimb,i)$

where:

Q_i = *combined* air exchange rate for the time step 'i', cfm

$Q_{fan,max,i}$ = *MAX(Qfan_sup,i, Qfan_exh,i)* for the time step 'i', cfm

$Q_{fan,sup,i}$ = supply fan air flow rate for time step 'i', cfm

$Q_{fan,exh,i}$ = exhaust fan air flow rate for time step 'i', cfm

$Q_{inf,i}$ = Infiltration airflow rate for the time step 'i', cfm calculated using Shelter Class 4

Qimb,i =*ABS(Qfan_sup,i - Qfan_exh,i)* for time step 'i', cfm

((Note to readers: The equations in Table Note h. are shown here as modified by addendum ANSI/RESNET/ICC 301-2022 Addendum A-2022.)

m. Where Dwelling Unit Mechanical Ventilation Systems are specified but lack controls to either provide continuous or programmed operation, the system does not qualify as a Dwelling Unit Mechanical Ventilation System and the Rated Home shall be treated as a Dwelling Unit without a Dwelling Unit Mechanical Ventilation System. Dwelling Unit Mechanical Ventilation System fan watts shall be the value observed in the Rated Home for the highest airflow setting. Where not available, fan watts shall be based on Table 4.2.2(1a) for the given system. For systems other than Central Fan Integrated Supply systems (CFIS systems), where the airflow cannot be measured, the cfm used to determine fan watts shall be assumed to be equal to Qfan, as determined in accordance with Note g. of Table 4.2.2 (1), with a minimum of 15 cfm. For CFIS systems, the cfm used to

determine fan watts shall be the larger of 400 cfm per 12 kBtu/h cooling capacity or 240 cfm per 12 kBtu/h heating capacity. For systems that consume energy beyond what is needed to operate the ventilation fan[9], fan watts shall be the value observed either per OEM specifications or through direct measurement in the Rated Home for the highest airflow setting in ventilation-only mode.

Table 4.2.2(1a) Default Ventilation System Fan Power for Rated Home

Equipment Type	**Watts/ cfm**
Exhaust Ventilation fans	0.35
Supply Ventilation fans	0.35
Balanced Ventilation fans	0.70
HRV/ERV fans	1.00
CFIS ~~fans~~Blower Fans	0.58
Range hoods	0.70

t. For a Rated Home with a nonstorage-type water heater or where a shared water heater provides service hot water to the Rated Home, a 40-gallon storage-type water heater of the same fuel as the proposed water heater shall be assumed for the Energy Rating Reference Home. For a Rated Home with a shared storage water heater, its tank losses shall be ~~divided by the number of Dwelling Units served by the water heater, prorated based on the number of Bedrooms, (Nbr)~~prorated to a Dwelling Unit based on its number of Bedrooms relative to the total number of Bedrooms of all Dwelling Units served by the shared storage water heater. For tankless water heaters with an Energy Factor, EF shall be multiplied by 0.92 for Rated Home calculations. For tankless water heaters with a Uniform Energy Factor, UEF shall be multiplied by 0.94 for Rated Home calculations. For a Rated Home without a proposed water heater, a 40-gallon storage-type water heater of the same fuel as the predominant fuel type used for the heating system(s) shall be assumed for both the Rated and Energy Rating Reference Homes. The predominant fuel type shall be determined based on weighted space heating loads served by each fuel. Where the space heating loads served by different fuel types are equal, fossil fuel shall be used for the fuel type. In both cases, the Energy Factor of the water heater shall be as prescribed for the Energy Rating Reference Home water heater by Table 4.2.2(1). Where the Rated Home has multiple water heaters, the Energy Rating Reference Home shall have a 40-gallon storage-type water heater of the same fuel as the predominant fuel type used for the water heaters in the Rated Home. The predominant fuel type shall be determined based on weighted water heating loads served by each fuel. Where the water heating loads served by different fuel types are equal, fossil fuel shall be used for the fuel type.

[9] (Informative Note) Such as dehumidifying ventilation systems.

x. Any untested forced air distribution system is permitted to be modeled with a DSE of 0.70.

When both of the following conditions are met and documented, an untested forced air distribution system is permitted to be modeled with a DSE of 0.80.~~duct leakage testing is also not required.~~

1. At a pre-drywall stage of construction, 100 percent of the ductwork and air handler shall be visible and visually verified to be contained inside the Conditioned Space Volume.
2. At a final stage of construction, ductwork that is visible and the air handler shall be verified again to be contained in the Conditioned Space Volume.

~~To calculate the energy impacts on the Rated Home, a DSE of 0.808, shall be applied to both the heating and cooling system efficiencies.~~

~~If at a pre-drywall stage of construction, the ductwork is visually verified to be 100 percent fully ducted with no building cavities used as supply or return ducts, a DSE of 0.88 shall be applied to both the heating and cooling system efficiencies. As an alternative to the DSE = 0.88, a value of 4 cfm per 100 square feet of Conditioned Floor Area may be modeled for duct leakage to outside if the above conditions are met and no ductwork is contained within envelope assemblies adjacent to the exterior or Unconditioned Space Volumes.~~

Or

If the two preceding conditions are met and it is visually verified and documented at a pre-drywall stage of construction that all ductwork is fully ducted with no building cavities used as supply or return ducts then either:

- An untested forced air distribution system is permitted to be modeled with a DSE of 0.88

  Or

- If no ductwork is contained within envelope assemblies adjacent to the exterior or Unconditioned Space Volumes a value of 4 cfm per 100 square feet of Conditioned Floor Area is permitted to be modeled for duct leakage to outside.

yy. When the air distribution system leakage split between the supply and return side is not measured, the air distribution system leakage to outdoors at 25 Pascal pressure difference shall be split equally between the supply and return side of the air distribution system with the leakage distributed evenly across the duct system. Where air distribution leakage to outside the CSV is imbalanced and occurring in spaces other than CSV, and the software does not model a pressure-based airflow mass balance, the imbalanced airflow shall induce an equivalent infiltration flow in the Conditioned

Space Volume or the space where the ducts are located. The induced infiltration shall be determined by the leakage imbalance fractions defined in Table 4.2.2(1c); the fraction from outside into CSV shall be included in *Qfan,exh,i* and the fraction from CSV to outside shall be included in *Qfan,sup,i* of Note h. of Table 4.2.2 (1).

Table 4.2.2(1c) Duct Leakage Imbalance Induced Infiltration

Leakage Imbalance	Duct Space Venting	Fraction from outside into CSV	Fraction from CSV to outside	Fraction from outside into duct space	Fraction from duct space to outside	Fraction from duct space into CSV	Fraction from CSV into duct space
Supply > Return (CSV depressurized)	Vented	1.0	0.0	0.0	1.0	0.0	0.0
Supply > Return (CSV depressurized)	Unvented	0.5	0.0	0.0	0.5	0.5	0.0
Supply < Return (CSV pressurized)	Vented	0.0	1.0	1.0	0.0	0.0	0.0
Supply < Return (CSV pressurized)	Unvented	0.0	0.5	0.5	0.0	0.0	0.5

zz. Minimum continuous mechanical ventilation system requirements for the Rated Home shall be equal to Qfan_max, which shall be calculated as follows:

IF FracImbal = 0
Qfan_max = Qtot – Qinf_eff

ELSE
Qfan_max = (SQRT(FracImbal^2*Qtot^2 – 4*FracImbal*Qinf_eff^2 + 2*FracImbal*Qinf_eff*Qtot + Qinf_eff^2) + FracImbal*Qtot - Qinf_eff) / (2*FracImbal)

where:

Qfan_max = larger of Rated Home supply fan and exhaust fan air flows, cfm

FracImbal = ABS(Qfan_sup – Qfan_exh) / MAX (Qfan_sup, Qfan_exh)

Exception:

FracImbal = 1 where:

Multiple, intermittent, unbalanced Dwelling Unit Mechanical Ventilation Systems are present.

Qfan_sup = Rated Home supply fan continuous-equivalent air flow, cfm

Qfan_exh = Rated Home exhaust fan continuous-equivalent air flow, cfm

Qtot = 0.03*CFA + 7.5*(Nbr+1)

Qinf_eff = Qinf × A_{ext}

A_{ext} = 1 for Detached *Dwelling* Units, or for Attached Dwelling Units with airtightness test results > 0.30 cfm50 per ft^2 of Compartmentalization Boundary. For Attached Dwelling Units with airtightness test results <= 0.30 cfm50 per ft^2 of Compartmentalization Boundary, the ratio of exterior enclosure surface area that is not attached to garages or other *Dwelling* Units to the Compartmentalization Boundary for Attached Dwelling Units

Qinf = NL * wsf * CFA * Hr / 60

where:

NL = normalized leakage, as defined in Normative Appendix C2.2, Equation 1 ~~= 1000 * (ELA / CFA) * [H / Hr]^0.4 (where both ELA and CFA are in square inches)~~ except where the Rated Home air exchange rate is specified as ACH (at 4 Pa) in which case NL shall be determined using Equation 21.

wsf = weather and shielding factor from ASHRAE Standard 62.2, Normative Appendix B

~~ELA = cfm50 * 0.054863 (in2)~~

~~H = vertical distance between lowest and highest above-grade points within the pressure boundary (ft.)~~

Hr = reference height = 8.202 ft.

Where Qfan_max as calculated above is greater than both Qfan_sup and Qfan_exh, the Rated Home Qfan_sup and Qfan_exh shall be increased using the Rated Home FracImbal such that the larger of Qfan_sup and Qfan_exh equals Qfan_max.

Where this requires the Rated Home mechanical Ventilation rate to be adjusted in the simulation, and where the Ventilation air is pre-conditioned as part of a shared Ventilation system shared by multiple Dwelling Units, the software shall make corresponding adjustments to the shared preconditioning equipment energy consumption assigned to the Rated Home.

Table 4.2.2(2) Component Heat Transfer Characteristics for Energy Rating Reference Home[a]

Climate Zone[b]	Glazing and Opaque Door U-Factor	Glazed Fene-stration Assembly SHGC	Ceiling U-Factor	Frame Wall U-Factor	Floor Over Uncond-itioned Space U-Factor	Basement Wall Interior Insulation R-Value[c]	Slab-on-Grade R-Value & Depth[d,e]
1	1.20	0.40	0.035	0.082	0.064	0	0
2	0.75	0.40	0.035	0.082	0.064	0	0
3	0.65	0.40	0.035	0.082	0.047	0	0
4 except Marine	0.40	0.40	0.030	0.082	0.047	10	10, 2 ft.
5 and Marine 4	0.35	0.40	0.030	0.060	0.033	10	10, 2 ft.
6	0.35	0.40	0.026	0.060	0.033	10	10, 4 ft.
7 and 8	0.35	0.40	0.026	0.057	0.033	10	10, 4 ft.

Notes:

a. U-Factor values are from 2006 IECC, Table 402.1.3 and R-Values are from 2006 IECC, Table 402.1.1.
b. Climates zones shall be as specified by the 2006 IECC.
c. For basements that are within the Conditioned Space Volume, basement wall insulation shall be continuous across the entire area of the wall.
d. R-5 shall be added to the required R-Value for slabs with embedded heating.
e. Insulation shall extend downward from the top of the slab vertically to the depth indicated.

Delete Table 4.2.2(3) and renumber the following tables accordingly:

~~Table 4.2.2(3) Internal Gains for Energy Rating Reference Homes~~ ~~(a)~~ (1)

~~End Use Component~~	~~Sensible Gains (Btu/day)~~			~~Latent Gains (Btu/day)~~		
	~~a~~	~~b~~	~~c~~	~~a~~	~~b~~	~~c~~
~~Residual MELs~~		~~7.27~~			~~0.38~~	
~~Interior lighting~~	~~4,253~~	~~7.48~~				
~~Refrigerator~~ ~~(d)~~	~~5,955~~		~~168~~			
~~TVs~~	~~3,861~~		~~645~~			
~~Range/Oven (elec)~~ ~~(b) (d)~~	~~2,228~~		~~262~~	~~248~~		~~29~~
~~Range/Oven (gas)~~ ~~(b) (d)~~	~~4,086~~		~~488~~	~~1,037~~		~~124~~
~~Clothes Dryer (elec)~~ ~~(b) (d)~~	~~502~~		~~143~~	~~56~~		~~16~~
~~Clothes Dryer (gas)~~ ~~(b) (d)~~	~~562~~		~~159~~	~~69~~		~~19~~
~~Dishwasher~~ ~~(d)~~	~~168~~		~~67~~	~~168~~		~~67~~
~~Clothes Washer~~ ~~(d)~~	~~135~~		~~38~~	~~15~~		~~4~~
~~General water use~~ ~~(e)~~	~~-1227~~		~~-409~~	~~1,245~~		~~415~~
~~Occupants~~ ~~(c)~~			~~3716~~			~~2,884~~

~~**Notes:**~~

~~(a) Table values are coefficients for the following general equation:~~
~~Gains = a + b*CFA + c*Nbr~~
~~where: CFA = Conditioned Floor Area and Nbr = Number of Bedrooms.~~

~~(b) For Rated Homes with electric appliance, use (elec) values. For Rated homes with natural gas-fired appliance, use (gas) values~~

~~(c) Software tools shall use either the occupant gains provided above or similar temperature dependent values generated by the software where the number of occupants equals the number of Bedrooms and occupants are present in the home 16.5 hours per day.~~

~~(d) When any of these appliances associated with a Rated Home is located in Unrated Heated Space, Unrated Conditioned Space or otherwise outside of and away from the Dwelling Unit, the Internal Gains associated with that appliance shall be excluded from both the Reference and Rated Homes.~~

~~(e) (Informative Note) Accounts for evaporation of roughly 2 gal of water per week from mopping, shower/tub/sink surfaces, plant watering, etc.~~

Table 4.2.2(4) (1) **Default Solar Absorptance for Various Wall Colors**

Rated Home Wall Color	Absorptance
White	0.65
Yellow, Light Grey, or Silver	0.75
All others	0.85
Black	0.92

4.2.2.6. For non-electric Boilers, the values in Table 4.2.2.4(1) (1) shall be used for Electric Auxiliary Energy (Eae) in the Rated Home and Reference Home.

Table 4.2.2.4(1) Electric Auxiliary Energy for Fossil Fuel Heating Systems

System Type	Eae
Oil Boiler	330
Gas Boiler	170

4.2.2.7. Lighting, Appliances, Miscellaneous Energy Loads (MELs), Ventilation and Service Hot Water Systems.

Unless otherwise specified, hourly energy use for Lighting, Appliances, and Miscellaneous Energy Loads shall be determined according to Equation 4.2-X1. (1)

((Annual Energy)/365)*(Hourly Profile Value)*(Monthly Multiplier)

Equation 4.2-X1 (1)

where "Hourly Profile Value" and "Monthly Multiplier" are defined in Normative Appendix ~~C.4~~C3. If no corresponding "Hourly Profile Value" or "Monthly Multiplier" is provided in Normative Appendix ~~C.4~~C3, values of 0.042 and 1.00, respectively, shall be used.

Hourly energy for refrigerators is determined according to Equation 4.2-X2[10]:(1)

((Annual Energy)/8760)*(a + b*T_{space}) **Equation 4.2-X2** (1)

Where:

a = Constant Coefficient from Normative Appendix ~~C.4~~C3. Table C.3(2)

b = Temperature Coefficient from Normative Appendix ~~C.4~~C3. Table C.3(2)

T_{space} = Temperature of the space where the refrigerator is located, (in °F)

Hourly Internal Gains associated with Lighting, Appliances, and Miscellaneous Energy Loads shall be determined by applying the values of $f_{internal}$, $f_{sensible}$ associated with the end use. The total Internal Gain associated with an end use energy is determined by $f_{internal}$. The Internal Gain is then split into sensible ($f_{sensible}$) and latent (1 – $f_{sensible}$) portions.

4.2.2.7.1. Energy Rating Reference Home. Annual Energy and Internal Gains for Lighting, Appliance and Miscellaneous Energy Loads in the Energy Rating Reference Home shall be determined in accordance with the values provided in Table 4.2.2.~~5~~7(1) and Table 4.2.2.~~5~~7(2) and Table 4.2.2.7(3), as appropriate, and Equation 4.2-28: (1)

~~kWh (or therms) per year =~~ Energy or Internal Gains = a + b*CFA + c*Nbr

(Equation 4.2-28) (1)

[10] (Informative Note) Calculated refrigerator annual energy will deviate from the annual energy input into the equation.

where:

a, *b*, and *c* are values provided in Table 4.2.2.5~~7~~(1) and Table 4.2.2.5~~7~~(2) and Table 4.2.2.7(3) [(1)]

CFA = Conditioned Floor Area

Nbr = number of Bedrooms

With the exception of Exterior lighting, all relevant End Use Components in Tables 4.2.2.7(1), 4.2.2.7(2), and 4.2.2.7(3) are located within the CSV of the Energy Rating Reference Home. [(1)]

4.2.2.7.1.1 Electric Lighting and ~~Reference Homes~~Appliances. Where the Rated Home has electric appliances, the Energy Rating Reference Home lighting, appliance and Miscellaneous Energy Loads Annual Energy and Internal Gains shall be determined in accordance with the values given in Table 4.2.2.5~~7~~(1). [(1)]

Table 4.2.2.5~~7~~(1) Lighting, Appliance and Miscellaneous Energy Loads in electric Energy Rating Reference Homes[(1)]

End Use Component	Units	Equation Coefficients			$f_{internal}$	$f_{sensible}$
		a	b	c		
Residual MELs	kWh/y		0.91		~~1.00~~0.9	~~1.00~~0.95
Interior lighting	kWh/y	455	0.80		1.0	1.0
Exterior lighting	kWh/y	100	0.05		0.0	0.0
Refrigerator	kWh/y	637		18	1.0	1.0
Televisions	kWh/y	413		69	1.0	1.0
Range/Oven	kWh/y	331		39	0.8	0.9
Clothes Dryer (Vented)	kWh/y	398		113	0.15	0.9
Dishwasher	kWh/y	60		24	0.6	0.5
Clothes Washer	kWh/y	53.53		15.18	0.3	0.9

4.2.2.7.1.2 ~~Reference Homes with~~ Natural Gas Appliances. Where the Rated Home has gas appliances, those appliances in the Energy Rating Reference Home shall be determined in accordance with the natural gas and electric appliance loads provided below in Table 4.2.2.5~~7~~(2), as applicable for each appliance. [1]

Table 4.2.2.5~~7~~(2) Natural Gas Appliance Loads for Energy Rating Reference Homes with Gas Appliances[(1)]

End Use Component[a]	Units	Equation Coefficients			$f_{internal}$	$f_{sensible}$
		a	b	c		
Range/Oven ~~Range/Oven~~	Therms/y	22.6		2.7	0.8	0.8
	kWh/y	22.6		2.7		
Clothes Dryer (Vented) ~~Clothes Dryer~~	Therms/y	14.3		4.05	0.15	0.9
	kWh/y	31.5		8.93		

Note:
a. Both the natural gas and the electric components shall be included in determining the Energy Rating Reference Home appliances.

4.2.2.7.1.3. Garage Lighting. Where the Rated Home includes an enclosed garage for the sole use of the occupants of the Rated Home, 100 kWh/y shall be added to the energy use of the Reference Home to account for garage lighting. Lighting for shared parking garages or parking lots shall not be included in the Reference Home.

4.2.2.7.1.4. Service Hot Water Use. Service hot water system use in gallons per ~~day~~ hour for the Energy Rating Reference Home shall be determined in accordance with Equation 4.2-29: [(1)]

$$HWgp\text{~~d~~}h = (refDWgp\text{~~d~~}h + refCWgp\text{~~d~~}h + F_{mix}*(refFgp\text{~~d~~}h + refWgp\text{~~d~~}h))$$

(Equation 4.2-29) [(1)]

where:

~~HWgpd~~HWgph = gallons per ~~day~~ hour of hot water use

~~refDWgpd~~refDWgph = reference dishwasher gallons per ~~day~~ hour
= (0.7801*Nbr+1.976)*h_{DW}

~~refCWgpd~~refCWgph = reference clothes washer gallons per ~~day~~ hour
= (0.6762*Nbr + 2.3847)*h_{CW}

F_{mix} = 1 - ((T_{set} – T_{use})/ (T_{set} – T_{mains}))

where:

T_{set} = Water heater set point temperature = 125 F

T_{use} = Temperature of mixed water at fixtures = 105 F

T_{mains} = ($T_{amb,avg}$ + *offset*) + ratio * ($\Delta T_{amb,max}$ / 2) * sin (0.986 * (day# - 15 - *lag*) – *hemisphere* * 90)
(with a minimum value of 32ºF)

where:

T_{mains} = temperature of potable water supply entering residence (ºF)

$T_{amb,avg}$ = annual average ambient air temperature (ºF)

$\Delta T_{amb,max}$ = maximum difference between monthly average ambient temperatures[11] (ºF)

0.986 = degrees/day (360/365)

day# = Julian day of the year (1-365)

offset = 6°F

ratio = 0.4 + 0.01 ($T_{amb,avg}$ – 44)

lag = 35 – 1.0 ($T_{amb,avg}$ – 44)

hemisphere = 1 for northern hemisphere, -1 for southern hemisphere

~~refFgpd~~ refFgph = (14.6 + 10.0*Nbr)*h_F

= reference climate-normalized ~~daily~~ hourly fixture water use in Energy Rating Reference Home (in gallons per ~~day~~hour)

~~refWgpd~~ refWgph = (9.8*Nbr $^{0.43}$)*h_F

= reference climate-normalized ~~daily~~ hourly hot water waste due to distribution system losses in Energy Rating Reference Home (in gallons per ~~day~~hour)

where:

Nbr = number of Bedrooms in the Rated Home, not to be less than 1.

h_{DW} = hourly profile schedule value for dishwashers in Normative Appendix C3. Table C.3(1).

h_{CW} = hourly profile schedule value for clothes washers in Normative Appendix C3. Table C.3(1).

h_F = hourly profile schedule value for fixtures in Normative Appendix C3. Table C.3(5).

4.2.2.7.1.5. Ceiling Fans. Where ceiling fans are included in the Rated Home, they shall also be included in the Reference Home in accordance with the provisions of Section 4.2.2.7.2.12. (1)

4.2.2.7.1.6. Other Internal Gains. Hourly Internal Gains not associated with Lighting, Appliances, or Miscellaneous Energy Loads shall be calculated by multiplying the daily values derived using Equation 4.2-28 and the coefficients in Table 4.2.2.7(3) by the corresponding profile schedule values in Normative Appendix ~~C.4~~C3. Table ~~C4~~C.3(5). (1)

[11] (Informative Reference) For example: $T_{amb,avg,july} - T_{amb,avg,january}$

Table 4.2.2.7(3) Other Internal Gains for Energy Rating Reference Homes[1]

End Use Component	Sensible Gains (Btu/day)			Latent Gains (Btu/day)		
	a	b	c	a	b	c
General water use [(a)]	-1227		-409	1,245		415
Occupants [(b)]			3716			2,884
(a) (Informative Note) Accounts for evaporation of roughly 2 gal of water per week from mopping, shower/tub/sink surfaces, plant watering, etc.						

4.2.2.7.2. Energy Rating Rated Homes. [(1)] The lighting, appliance, hot water heating, ventilation systems and Miscellaneous Energy Loads in the Energy Rating Rated Home shall be determined in accordance with Sections 4.2.2.7.2.1 through ~~4.2.2.7.2.12~~4.2.2.7.2.~~14~~13. For a Rated Home without a refrigerator, dishwasher, range/oven, clothes washer or clothes dryer, the values from Table 4.2.2.~~5~~7(1) shall be assumed for both the Energy Rating Reference Home and Rated Home. Unless specified, the values of $f_{internal}$ and $f_{sensible}$ for end uses in the Rated Home shall be the same as those listed in Tables 4.2.2.7(1) and Tables 4.2.2.7(2) according to the fuel type of the appliance in the Rated Home.

Internal Gains shall be included in the simulation of the appropriate space within the Rated Home ~~and~~ where a heat balance of the space is explicitly modeled by the software.

4.2.2.7.2.1. Residual MELs. Residual miscellaneous annual electric energy use in the Rated Home shall be the same as in the Energy Rating Reference Home and shall be calculated as 0.91*CFA.

4.2.2.7.2.2. Interior Lighting. Interior lighting annual energy use in the Rated Home shall be determined in accordance with Equation 4.2-30: [(1)]

$$kWh/y = 0.9/0.925*(455 + 0.8*CFA)*[(1 - FFII_{IL} - FFI_{IL}) + FFI_{IL}*15/60 + FFII_{IL}*15/90] + 0.1*(455 + 0.8*CFA)$$

(Equation 4.2-30) [(1)]

where:

CFA = Conditioned Floor Area

FFI_{IL} = The ratio of the interior Tier I Qualifying Light Fixtures to all interior light fixtures in Qualifying Light Fixture Locations.

$FFII_{IL}$ = The ratio of the interior Tier II Qualifying Light Fixtures to all interior light fixtures in Qualifying Light Fixture Locations.

~~For the purpose of adjusting the annual interior lighting energy consumption for calculating the Rating, EC_{LA} shall be adjusted by~~

~~ΔEC_{IL}, which shall be calculated as the annual interior lighting energy use derived by the procedures in this section minus the annual interior lighting energy use derived for the Energy Rating Reference Home in Section 4.2.2.6.1 converted to MBtu/y, where MBtu/y = (kWh/y)/293.~~

~~For interior lighting, Internal Gains in the Rated Home shall be modified by 100 percent of the interior lighting ΔEC_{IL} converted to Btu/day as follows: $\Delta EC_{IL} * 10^6 / 365$.~~

4.2.2.7.2.3. Exterior Lighting. Exterior lighting annual energy use in the Rated Home shall be determined in accordance with Equation 4.2-31: (1)

$$kWh/y = (100 + 0.05*CFA)*[(1 - FFI_{EL} - FFII_{EL}) + 15/60*FFI_{EL} + 15/90*FFII_{EL}]$$ **(Equation 4.2-31)** (1)

where:

CFA = Conditioned Floor Area

FFI_{EL} = Fraction of exterior fixtures that are Tier I Qualifying Light Fixtures

$FFII_{EL}$ = Fraction of exterior fixtures that are Tier II Qualifying Light Fixtures

~~For the purpose of adjusting the annual exterior lighting energy consumption for calculating the Rating, EC_{LA} shall be adjusted by ΔEC_{EL}, which shall be calculated as the annual exterior lighting energy use derived by the procedures in this section minus the annual exterior lighting energy use derived for the Energy Rating Reference Home in Section 4.2.2.7.1, converted to MBtu/y, where MBtu/y = (kWh/y)/293.~~

~~Internal Gains in the Rated Home shall not be modified as a result of reductions in exterior lighting energy use.~~

4.2.2.7.2.4. Garage Lighting. For Rated Homes with garages for the sole use of the occupants of the Rated Home, garage annual lighting energy use in the Rated Home shall be determined in accordance with Equation 4.2-32: (1)

$$kWh = 100*[(1 - FFI_{GL} - FFII_{GL}) + 15/60*FFI_{GL} + 15/90*FFII_{GL}]$$ **(Equation 4.2-32)** (1)

where:

FFI_{GL} = Fraction of garage fixtures that are Tier I Qualifying Light Fixtures

$FFII_{GL}$ = Fraction of garage fixtures that are Tier II Qualifying Light Fixtures

Lighting for shared parking garages or parking lots shall not be included in the Rated Home.

~~For the purpose of adjusting the annual garage lighting energy consumption for calculating the Rating, EC_{LA} shall be adjusted by AEC_{GL}, which shall be calculated as the annual garage lighting energy use derived by the procedures in this section minus the annual garage lighting energy use derived for the Energy Rating Reference Home in Section 4.2.2.7.1, converted to MBtu/y, where MBtu/y = (kWh/y)/293.~~

~~Internal Gains in the Rated Home shall not be modified as a result of reductions in garage lighting energy use.~~

4.2.2.7.2.5. Refrigerators. Refrigerator annual energy use for the Rated Home shall be determined from either refrigerator Energy Guide labels or from age-based defaults in accordance with Table 4.2.2.5.2.5(1). (1)

Table 4.2.2.5~~7~~.2.5(1) Age-based Refrigerator Defaults(1)

Refrigerator/Freezer Type	Annual kWh Equation
Single-door refrigerator only	(13.5*AV + 299)*VR
Single-door refrigerator/freezer	(13.5*AV + 299)*VR
Refrigerator with top freezer	(16.0*AV + 355)*VR
with TDI	(17.6*AV + 391)*VR
Refrigerator with side-by-side freezer	(11.8*AV + 501)*VR
with TDI	(16.3*AV + 527)*VR
Refrigerator with bottom freezer	(16.6*AV + 367)*VR
Upright freezer only manual defrost	(10.3*AV + 264)*VR
Upright freezer only auto defrost	(14.0*AV + 391)*VR
Chest freezer only	(11.0*AV + 160)*VR
where: AV = Adjusted Volume = (refrigerator compartment volume) + 1.63*(freezer compartment volume) TDI = Through the door ice VR = Vintage Ratio from Table 4.2.2.5.2.5(2)	

Table 4.2.2.5~~7~~.2.5(2) Age-based Vintage Ratios(1)

Refrigerator Vintage	Vintage Ratio
1980 or before	2.50
1981-1984	1.82
1985-1988	1.64
1989-1990	1.39
1991-1993	1.30
1994-2000	1.00
2001-Present	0.77

Default values for adjusted volume (AV) shall be determined in accordance with Table 4.2.2.5.2.5(3) (1)

Table 4.2.2.~~5~~7.2.5(3) Default Adjusted Volume Equations(1)

Model Type	Default Equation
Single-door refrigerator only	AV = 1.00 * nominal volume
Single-door refrigerator/freezer	AV = 1.01 * nominal volume
Bottom Freezer	AV = 1.19 * nominal volume
Top Freezer	AV = 1.16 * nominal volume
Side by Side	AV = 1.24 * nominal volume
Freezer only	AV = 1.73 * nominal volume

~~For the purpose of adjusting the annual refrigerator energy consumption for calculating the Rating, EC_{LA} shall be adjusted by ΔEC_{FRIC}, which shall be calculated as the annual refrigerator energy use derived by the procedures in this section minus the annual refrigerator energy use derived for the Energy Rating Reference Home in Section 4.2.2.7.1, converted to MBtu/y, where MBtu/y = (kWh/y)/293.~~ (1)

~~For refrigerator energy use, Internal Gains in the Rated Home shall be modified by 100 percent of the refrigerator ΔEC_{FRIC} converted to Btu/day as follows: $\Delta EC_{FRIC} * 10^6 / 365$. Internal Gains shall not be modified for refrigerators located in Unconditioned Space Volume, Unrated Heated Space, Unrated Conditioned Space or outdoor environment.~~[12]

4.2.2.7.2.6. Televisions. Television annual energy use in the Rated Home shall be the same as television energy use in the Energy Rating Reference Home and shall be calculated as TVkWh/y = 413 + 69*Nbr, where Nbr is the number of Bedrooms in the Rated Home.

4.2.2.7.2.7. Range/Oven. Range/Oven (cooking) annual energy use for the Rated Home shall be determined in accordance with Equations 4.2-33a through 4.2-30c, as appropriate. (1)

1) For electric cooking:
kWh/y = BEF * OEF * (331 + 39*Nbr) **(Equation 4.2-33a)** (1)

2) For natural gas cooking:

[12] ~~(Informative Note) Example: an unconditioned garage.~~

Therms/y = OEF*(22.6 + 2.7*Nbr) **(Equation 4.2-33b)** [(1)]

plus:

kWh/y = 22.6 + 2.7*Nbr **(Equation 4.2-33c)** [(1)]

where:

BEF = Burner Energy Factor = 0.91 for induction ranges and 1.0 otherwise.

OEF = Oven Energy Factor = 0.95 for convection types and 1.0 otherwise.

Nbr = Number of Bedrooms.

~~For the purpose of adjusting the annual range/oven energy consumption for calculating the Rating, EC_{LA} shall be adjusted by ΔEUL_{RO}, which shall be calculated as the annual range/oven energy use derived by the procedures in this section minus the annual range/oven energy use derived for the Energy Rating Reference Home in Section 4.2.2.7.1, converted to MBtu/y, where MBtu/y = (kWh/y) / 293 or (Therms/y) / 10, whichever is applicable.~~

~~For range/oven energy use, Internal Gains in the Rated Home shall be modified by 80 percent of the range/oven ΔEC_{RO} converted to Btu/day as follows: $\Delta EC_{RO} * 10^6 / 365$. Of this total amount, Internal Gains shall be apportioned as follows, depending on fuel type:~~

~~a) For electric range/ovens, 90-percent sensible Internal Gains and 10-percent latent Internal Gains~~

~~b) For gas range/ovens, 80-percent sensible Internal Gains and 20-percent latent Internal Gains.~~

~~Internal Gains shall not be modified for range/oven equipment located outside the Rated Home.~~

4.2.2.7.2.8. Clothes Dryers. Clothes Dryer annual energy use for the Rated Home shall be determined in accordance with Equation 4.2-34 and shall be based on the clothes dryer located within the Rated Home. If no clothes dryer is located within the Rated Home, a clothes dryer in the nearest shared laundry room on the project site shall be used if available for daily use by the occupants of the Rated Home. If the shared laundry room has multiple clothes dryers, the clothes dryer with the lowest EF or CEF shall be used. [(1)]

CDkWh/y = (((RMC-0.04)*100)/55.5)*(8.45/CEF)*ACY **(Equation 4.2-34)** [(1)]

where:

RMC = Remaining Moisture Content = (0.97 * (CAPw / IMEF) – LER/312) / ((2.0104 * CAPw + 1.4242) * 0.455) + 0.04

ACY = Annual Cycles per Year = (164+46.5*Nbr) * ((3*2.08+1.59) / (CAPw*2.08+1.59))

Nbr = Number of Bedrooms in home.

CEF = Combined Energy Factor is the clothes dryer efficiency[13] (lbs dry clothes/kWh) based on current U.S. DOE clothes dryer testing procedures. (default = 3.73 for electric dryers or 3.30 for gas dryers)

CAPw = Capacity of clothes washer (ft^3) from the manufacturer's data

IMEF = Integrated Modified Energy Factor, which has replaced MEF as the U.S. DOE Energy Factor test metric for clothes washers. (default = 1.57 for top load clothes washers or 1.84 for front load clothes washers)

LER = Labeled Energy Rating of clothes washer (kWh/y) from the Energy Guide label.

For natural gas clothes dryers, annual energy use shall be determined in accordance with Equations 4.2-35a and 4.2-35b. (1)

Therms/y = (result of Equation 4.2-31)*3412*(1-0.07) *(3.73/3.30)/100000 **(Equation 4.2-35a)** (1)

kWh/y = (result of Equation 4.2-31)*0.07*(3.73/3.30) **(Equation 4.2-35b)** (1)

~~For the purpose of adjusting the annual clothes dryer energy consumption for calculating the Rating, EC_{LA} shall be adjusted by AEC_{CD}, which shall be calculated as the annual clothes dryer energy use derived by the procedures in this section minus the annual clothes dryer energy use derived for the Energy Rating Reference Home in Section 4.2.2.7.1, converted to MBtu/y, where MBtu/y = (kWh/y) / 293 or (Therms/y) / 10, whichever is applicable.~~

When a Dwelling Unit has no in-unit clothes dryer, and no shared clothes dryers are available in the building or on the project site for daily use by the Rated Home occupants or they exist, but the ratio of Dwelling Units to shared clothes dryers is greater than 14, the clothes dryer values from Table 4.2.2.~~5~~7(1) shall be assumed for both the Energy Rating Reference Home and Rated Home. (1)

[13] (Informative Reference) See the CEC Appliance Efficiency Database http://www.energy.ca.gov/appliances/ or the ENERGY STAR Appliance database https://www.energystar.gov/products/appliances/clothes_dryers.

Internal Gains for ventless clothes dryers shall use $f_{internal}$ = 1.0 and $f_{sensible}$ = 0.9.

~~For clothes dryer energy use, total Internal Gains in the Rated Home shall be modified by 15 percent of the clothes dryer ΔEC_{CD} converted to Btu/day as follows: $\Delta EC_{CD} * 10^6 / 365$. Of this total amount, 90 percent shall be apportioned to sensible Internal Gains and 10 percent to latent Internal Gains. Internal Gains shall not be modified for clothes dryers located in Unconditioned Space Volume, Unrated Heated Space, Unrated Conditioned Space or outdoor environment.[14]~~

4.2.2.7.2.9. Dishwashers. Dishwasher annual energy use for the Rated Home shall be determined in accordance with Equation 4.2-36a and shall be based on the dishwasher located within the Rated Home, with the highest kWh/y. If no dishwasher is located within the Rated Home, a dishwasher in the nearest shared kitchen in the building shall be used only if available for daily use by the occupants of the Rated Home. (1)

dWkWh/y = dWkWh/cyc * dWcpy **(Equation 4.2-36a)** (1)

where:

dWkWh/y = dishwasher annual electric use excluding water heater energy use

dWkWh/cyc = [(GHWC * 0.5497/ Gas$ - LER * Elec$ * 0.02504 / Elec$) / (Elec$ * 0.5497 / Gas$ - 0.02504)] / 208

GHWC = Labeled annual cost when used with a gas water heater

Gas$ = Labeled price of gas in $/therm

LER = Labeled dishwasher Energy Rating using electric water heater in kWh/y

Elec$ = Labeled price of electricity in $/kWh

dWcpy = dishwasher cycles per year = (88.4 + 34.9*Nbr)*12/dWcap

Nbr = Number of bedrooms in Rated Home

dWcap = Dishwasher capacity where Standard = 12 and Compact = 8

~~And the change (Δ) in daily hot water use (GPD – gallons per day) for dishwashers shall be calculated in accordance with Equation 4.2-36b.~~ (1)

~~$\Delta GPD_{DW} = refDWgpd - rateDWgpd$ **(Equation 4.2-36b)**~~ (1)

~~where:~~

[14] ~~(Informative Note) Example: an unconditioned garage.~~

~~refDWgpd = [(88.4+34.9*Nbr)*8.16] / 365~~
~~rateDWgpd = (LER - kWh/cyc*208) * 0.02504 * dWcpy / 365~~

For dishwashers where an Energy Guide label is not available, dishwasher inputs from Table 4.2.2.6.2.9 shall be used.

Table 4.2.2.6.2.9 Default Dishwasher Inputs

Default Dishwasher Energy Guide Label Data				
Energy Guide Label Information	ENERGY STAR Defaults		NAECA minimum	ERI Reference
Dishwasher Size	compact	standard	standard	standard
Annual Energy kWh/y (LER)	203	270	307	467
Annual Gas Hot Water Cost ($/y)	$14.20	$22.23	$22.32	$33.12
Electricity Price ($/kWh)	$0.12	$0.12	$0.12	$0.12
Gas Price ($/therm)	$1.09	$1.09	$1.09	$1.09
Label Cycles per Year (LCY)	208	208	208	208

~~For the purpose of adjusting the annual dishwasher energy consumption for calculating the Rating, EC_{LA} shall be adjusted by ΔEC_{DW}, which shall be calculated as the annual dishwasher energy use derived by the procedures in this section minus the annual dishwasher energy use derived for the Energy Rating Reference Home in Section 4.2.2.7.1, converted to MBtu/y, where MBtu/y = (kWh/y) / 293 or (Therms/y) / 10, whichever is applicable.~~

~~For the purpose of adjusting the daily hot water use for calculating the Rating, the daily hot water use change shall be 'ΔGPD_{DW}' as calculated above.~~

When a Dwelling Unit has no in-unit dishwasher and no shared dishwashers are available in the building for daily use of the Rated Home occupants, the energy and hot water use of the Rated Home dishwasher shall be the same as the Energy Rating Reference Home in accordance with Section 4.2.2.7.1.

~~For dishwasher energy use, total Internal Gains in the Rated Home shall be modified by 60 percent of the dishwasher ΔEC_{DW} converted to Btu/day as follows: $\Delta EC_{DW} * 10^6 / 365$. Of this total amount, 50 percent shall be apportioned to sensible Internal Gains and 50 percent to latent Internal Gains.~~

~~Internal Gains shall not be modified for dishwashers located outside the Rated Home.~~

4.2.2.7.2.10. Clothes Washers. Clothes Washer annual energy use and daily hot water use for the Rated Home shall be determined as follows and shall be based on the clothes washer located within the Rated Home. If no clothes washer is located within the Rated Home, a clothes washer in the nearest shared laundry room on the project site shall be used if available for daily use by the occupants of the Rated Home. If the shared laundry room has multiple clothes washers, the clothes washer with the highest LER shall be used.

Annual energy use shall be calculated in accordance with Equation 4.2-37a. [(1)]

CWkWh/y = Cwappl / LCY * ACY **(Equation 4.2-37a)** [(1)]

where:

Cwappl = (GHWC * gasH2O / gas$ - (LER*elec$) * elecH2O / elec$) / (elec$ * gasH2O / gas$ - elecH2O)

GHWC = Gas Hot Water Costs from Energy Guide Label

gasH2O = 0.3914 (gal/cyc) per (therm/y)

elecH2O = 0.0178 (gal/cyc) per (kWh/y)

LER = Label Energy Rating (kWh/y) from the Energy Guide Label.

elec$ = Electric Rate from Energy Guide Label. (default = $0.12 per kWh)

gas$ = Gas Rate from Energy Guide Label. (default = $1.09 per therm)

LCY = Label Cycles per Year from Energy Guide Label (default = 6 loads per week = 312)

ACY = Annual Cycles per Year.

and where:

ACY = SCY * [(3.0*2.08+1.59)/(CAPw*2.08+1.59)]

where:

SCY = (164 + Nbr*46.5).

CAPw = washer capacity in cubic feet from the Energy Guide Label

Daily hot water use shall be calculated in accordance with Equation 4.2-37b.

CWgpd = (LER – Cwappl) * elecH2O * ACY / 365 **(Equation 4.2-37b)** [(1)]

For clothes washers where an Energy Guide label is not available, clothes washer inputs from Table 4.2.2.6.2.10 shall be used. [(1)]

Table 4.2.2.6.2.10 Default Inputs for Clothes Washer Based on Year (1)

Standard Clothes Washer Models						
	ERI Ref 2006[a]	Std 2008-2017[b]	ENERGY STAR 2006-2017[c]	Std 2018-present	ENERGY STAR 2018-present	CEE Tier II 2018[d]
Clothes Washer Inputs:						
LER [Label Energy Rating in kWh/y]=	400	380	260	284	152	125
GHWC [Cost with gas hot water in $/y]=	$27	$27	$18	$18	$12	$9
elec_price [$/kWh]=	$0.12	$0.12	$0.12	$0.12	$0.12	$0.12
gas_price [$/therm]=	$1.09	$1.09	$1.09	$1.09	$1.09	$1.09
IMEF [ft3/(kWh/cyc)]=	1	1.21	1.63	1.57	2.06	2.92
CAPw [ft3]=	3	3.2	3.5	4.2	4.2	5.2
IWF [(gal/cyc)/ft3]=	11.4	9.5	5.2	6.5	4.3	3.2
LCY [Label Cycles per Year] =	312	312	312	312	312	312

Footnotes
a: Used for standard clothes washers between 2006 – 2007
b: Used for standard clothes washers between 2008 – 2017
c: Used for ENERGY STAR clothes washers between 2006 and 2017
d: Consortium for Energy Efficiency Tier II efficiency minimum requirements

~~For the purpose of adjusting the annual clothes washer energy consumption for calculating the Rating, EC_{LA} shall be adjusted by AEC_{CW}, which shall be calculated as the annual clothes washer energy use derived by the procedures in this section minus the annual clothes washer energy use derived for the Energy Rating Reference Home in Section 4.2.2.7.1, converted to MBtu/y, where MBtu/y = (kWh/y) / 293 or (Therms/y) / 10, whichever is applicable.~~

~~For the purpose of adjusting the daily hot water use for calculating the Rating, the daily hot water use change shall be calculated as the daily hot water use derived by the procedures in this Section minus the gallons per day derived for the Energy Rating Reference Home clothes washer in Section 4.2.2.7.1.4.~~

When a Dwelling Unit has no in-unit clothes washer, and no shared clothes washers are available in the building or on the project site for daily use by the Rated Home occupants or they exist, but the ratio of Dwelling Units to shared clothes washers is greater than 14, the energy and hot water use of the Rated Home clothes washer shall be

the same as the Energy Rating Reference Home, in accordance with Section 4.2.2.7.1.

~~For clothes washer energy use, total Internal Gains in the Rated Home shall be modified by 30 percent of the clothes washer ΔEC_{CW} converted to Btu/day as follows: $\Delta EC_{CW} * 10^6 / 365$. Of this total amount, 90 percent shall be apportioned to sensible Internal Gains and 10 percent to latent Internal Gains. Internal Gains shall not be modified for clothes washers located in Unconditioned Space Volume, Unrated Heated Space, Unrated Conditioned Space, or outdoor environment.~~[15]

4.2.2.7.2.11. Service Hot Water Use. Service hot water system use in gallons per ~~day~~ hour for the Rated Home shall be determined in accordance with Equation 4.2-38. (1)

$$~~HWgpd~~ HWgph = (~~DWgpd~~ DWgph + ~~CWgpd~~ CWgph + F_{eff} * adjF_{mix} * (~~refFgpd~~ refFgph + ~~oWgpd~~ oWgph + ~~sWgpd~~ sWgph * WD_{eff})) \quad \textbf{(Equation 4.2-38)}$$ (1)

where:

~~HWgpd~~HWgph = gallons per ~~day~~ hour of hot water use in Rated Home.

~~DWgpd~~DWgph = dishwasher gallons per ~~day~~hour.
= (((88.4+34.9*Nbr)*12/dWcap*(4.6415*(1/EF)-1.9295))/365)*h_{DW}

~~CWgpd~~CWgph = clothes washer gallons per ~~day~~ hour =
(60*((LER*($/kWh) -AGC)/(21.9825*($/kWh) - ($/therm))/392)*ACY/365)*$h_{CW}$~~.~~

h_{DW} = hourly profile schedule value for dishwashers in Normative Appendix ~~C.4~~C3 Table ~~C4~~C.3 (1).

h_{CW} = hourly profile schedule value for clothes washers in Normative Appendix ~~C.4~~C3. Table ~~C4~~C.3(1).

Where more than one water heater exists in a Rated Home or building, and it is evident which water heater provides an appliance with hot water, the ~~DWgpd~~ DWgph load and ~~CWgpd~~ CWgph load must be attributed to the water heater providing that appliance with hot water.

F_{eff} = fixture effectiveness in accordance with Table 4.2.2.5.2.11(1). (1)

~~[15] (Informative Note) Example: an unconditioned garage.~~

Table 4.2.2.5.2.11(1) Hot water fixture effectiveness (1)

Plumbing Fixture Description		F_{eff}
Standard-flow: showers ≤2.5 gpm and ~~b~~Bathroom sink faucets ≤2.2 gpm		1.00
Low-flow: all showers[16] and ~~b~~Bathroom sink faucets ≤2.0 gpm		0.95

$adjF_{mix} = 1 - ((T_{set} - T_{use})/ (T_{set} - WH_{in}T))$ **(Equation 4.2-3)**(1)

where:

T_{set} = 125 °F = water heater set point temperature.

T_{use} = 105 °F = temperature of mixed water at fixtures.

$WH_{in}T$ = water heater inlet temperature.

where:

$WH_{in}T$ = T_{mains} + $WH_{in}T_{adj}$ for DWHR systems and where $WH_{in}T_{adj}$ is calculated in accordance with Equation 4.2-42.

$WH_{in}T$ = T_{mains} for all other hot water systems.

T_{mains} = temperature of potable water supply entering the residence calculated in accordance with Section 4.2.2.7.1.4.

~~refFgpd~~refFgph = reference climate-normalized ~~daily~~ hourly fixture water use calculated in accordance with Section 4.2.2.7.1.4.

~~oWgpd~~ oWgph = ~~refWgpd~~ refWgph * oFrac * (1-oCD_{eff}) **(Equation 4.2-40)**(1)

where:

~~oWgpd~~oWgph = ~~daily~~ hourly standard operating condition waste hot water quantity.

oFrac = 0.25

= fraction of hot water waste from standard operating conditions.

oCDeff = Approved Hot Water Operational Control Device effectiveness (default = 0.0)

~~sWgpd~~ sWgph = (~~refWgpd~~ refWgph – ~~refWgpd~~ refWgph * oFrac) * pRatio * sysFactor **(Equation 4.2-41)** (1)

where:

~~sWgpd~~sWgph = ~~daily~~ hourly structural waste hot water quantity.

~~refWgpd~~refWgph = reference climate-normalized distribution system waste water use calculated in accordance with Section 4.2.2.7.1.4.

[16] (Normative Note) A shower with multiple showerheads that operate simultaneously meets the low-flow criteria if the sum of the flow rates of all showerheads is less than or equal to 2.0 gpm.

oFrac = 0.25
= fraction of hot water waste from standard operating conditions.
pRatio = hot water piping ratio.

where:

for standard systems:

pRatio = PipeL / refPipeL

where:

PipeL = measured length of hot water piping from the hot water heater (or from a shared recirculation loop serving multiple[17] Dwelling Units) to the farthest hot water fixture, measured longitudinally from plans, assuming the hot water piping does not run diagonally, plus 10 feet of piping for each conditioned floor level[18] including conditioned basements (if any), plus 5 feet of piping for unconditioned basements (if any).[19]

refPipeL = $2*(CFA/Nfl)^{0.5} + 10*Nfl + 5*Bsmt$
= hot water piping length for Reference Home.

where:

CFA = Conditioned Floor Area.

Nfl = number of conditioned floor levels in the Dwelling Unit, including conditioned basements.

Bsmt = presence = 1.0 or
= absence = 0.0 of an unconditioned basement in the Dwelling Unit.

for recirculation systems (entirely within the Rated Home):[20]

pRatio = BranchL /10

where:

BranchL = measured length of the branch hot water piping from the recirculation loop to the farthest hot water fixture from the recirculation loop, measured longitudinally from plans, assuming the branch hot water piping does not run diagonally.

sysFactor = hot water distribution system factor from Table 4.2.2.5.2.11(2).

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[17] (Informative Note) Pump energy associated with the shared central recirculation loops are modeled separately from this section in section 4.2.2.6.2.11.2.

[18] (Normative Note) Ten feet of pipe length applies to every conditioned floor level not just the level on which the farthest hot water fixture is located.

[19] (Normative Note) Where both an unconditioned basement and a conditioned basement exist on the same floor level of the Rated Home, only ten feet shall be assumed for the vertical pipe length.

[20] (Normative Note) Attached Dwelling Units shall be modeled with a Standard (nonrecirculating) system, except for recirculating systems that are entirely within the Rated Home (i.e., an individual Townhouse).

Table 4.2.2.5.2.11(2) Hot Water Distribution System Insulation Factors

Distribution System Description	sysFactor	
	No pipe insulation	≥R-3 pipe insulation[21]
Standard systems	1.00	0.90
Recirculation systems	1.11	1.00

WD_{eff} = distribution system water use effectiveness from Table 4.2.2.5.2.11(3)[43]

Table 4.2.2.5.2.11(3) Distribution system water use effectiveness

Distribution System Description	**WD_{eff}**
Standard systems	1.00
Recirculation systems	0.10

4.2.2.7.2.11.1. Drain Water Heat Recovery (DWHR) Units

4.2.2.7.2.11.2. Hot Water System Annual Energy Consumption

Service hot water energy consumption shall be calculated using Approved Software Tools. The provisions of Section 4.2.2.7.1.4, Section 4.2.2.7.2.11 and Section 4.2.2.7.2.11 shall be followed to determine appropriate inputs to the calculations.

If the Rated Home includes a hot water recirculation system either within the Dwelling Unit or in the form of a shared recirculation system serving multiple Dwelling Units, then the annual electric consumption of the recirculation pump shall be added to the total hot water energy consumption. The hourly recirculation pump ~~kWh/y~~energy shall be calculated using Equation 4.2-43a for recirculation systems located completely within the Dwelling Unit. The shared recirculation pump ~~kWh/y~~energy shall be calculated using Equation 4.2-43b for shared recirculation systems serving multiple Dwelling Units. The recirculation pump ~~kWh/y~~energy shall be pro-rated to a Dwelling Unit based on its number of Bedrooms relative to the total number of Bedrooms of all Dwelling Units served by the hot water recirculation system. (1)

[21] (Normative Note) One hundred percent (100%) of the hot water distribution system piping, elbows and tees must be insulated to a minimum of R-3 to utilize the factors in this column.

pumpkWh~~/y~~ = ((pumpW * Efact)/365)*h_{RP} **(Equation 4.2-43a)**

where:

pumpW = pump power in Watts (default pumpW = 50 Watts).

Efact = factor selected from Table 4.2.2.5.2.11(5). (1)

h_{RP} = 0.042 for recirculation without control, or the corresponding hourly profile schedule value for recirculation pumps in Normative Appendix ~~C.4~~C3. Table ~~C.4~~C.3(5)

Table 4.2.2.5.2.11(5) Annual electricity consumption factor for hot water recirculation system pumps (1)

Recirculation System Description	Efact
Recirculation without control or with timer control	8.76
Recirculation with temperature control	1.46
Recirculation with demand control (presence sensor)	0.15
Recirculation with demand control (manual)	0.10

SharedHWpumpkWh~~/y~~ = ((SHWP$_{kW}$*OpHrs*(N_{br}/$N_{brtotdwu}$)/365)* h_{RP} **(Equation 4.2-43b)** (1)

where:

$SHWP_{kW}$ = Shared HW pump power in kW. Convert HP to kW with the formula:

kW = HP x 0.746 / motor efficiency. If pump motor efficiency is unknown, use 0.85. If HP is unknown, use 0.25.

OpHrs = annual pump operating hours.
= 730 [for demand control].
= 8760 [without control or with timer or temperature control].

N_{br} = number of Bedrooms in the Rated Home (rated Dwelling Unit), not less than 1.

$N_{brtotdwu}$ = total number of Bedrooms for all Dwelling Units served by the shared hot water recirculation system, not less than 1 per unit.

Results from standard hot water energy consumption data (stdECHW)[22] shall be adjusted to account for the energy delivery effectiveness of the hot water distribution system in accordance with Equation 4.2-44.

$EC_{HW} = stdEC_{HW} * (E_{waste} + 128) / 160$

(Equation 4.2-44) (1)

where E_{waste} is calculated in accordance with Equation 4.2-45.

$E_{waste} = oEW_{fact} * (1\text{-}oCD_{eff}) + sEW_{fact} * pEratio$

(Equation 4.2-45) (1)

where:

oEW_{fact} = EW_{fact} * oFrac
= standard operating condition portion of hot water energy waste.

where:

EW_{fact} = energy waste factor in accordance with Table 4.2.2.5.2.11(6).

oCD_{eff} is in accordance with Section 4.2.2.7.2.11

sEW_{fact} = EW_{fact} – oEW_{fact} = structural portion of hot water energy waste

pEratio = piping length energy ratio

where:

for standard system:

pEratio = PipeL / refpipeL

for recirculation systems (entirely within the Rated Home):[23]

pEratio = LoopL / refLoopL

and where:

LoopL = hot water recirculation loop piping length including both supply and return sides of the loop, measured longitudinally from plans, assuming the hot water piping does not run diagonally, plus 20 feet of piping for each floor level greater than one plus 10 feet of piping for unconditioned basements.

refLoopL = 2.0*refPipeL – 20

[22] (Normative Note) The value for the water heater inlet temperature, $WH_{in}T$, used to determine $adjF_{mix}$ shall be the value for the water heater inlet temperature used to calculate $stdEC_{HW}$.

[23] (Normative Note) Attached Dwelling Units shall be modeled with a Standard (nonrecirculating) system, except for recirculating systems that are entirely within the Rated Home (i.e., an individual Townhouse).

Table 4.2.2.5.2.11(6) Hot water distribution system relative annual energy waste factors(1)

Distribution System Description	EW_{fact}	
	No pipe insulation	≥R-3 pipe insulation[24]
Standard systems	32.0	28.8
Recirculation without control or with timer control	500	250
Recirculation with temperature control	375	187.5
Recirculation with demand control (presence sensor)	64.8	43.2
Recirculation with demand control (manual)	43.2	28.8

4.2.2.7.2.12. Ceiling Fans. Where the number of ceiling fans included in the Rated Home is equal to or greater than the number of Bedrooms plus one, they shall also be included in the Reference Home. The number of Bedrooms plus one (Nbr+1) ceiling fans shall be assumed in both the Reference Home and the Rated Home. A daily ceiling fan operating schedule ~~equal to 10.5 full-load hours~~ according to Normative Appendix ~~C.4~~C3. Table ~~C4~~C.3(5). shall be assumed in both the Reference Home and the Rated Home during months with an average outdoor temperature greater than 63 ºF. The cooling thermostat (but not the heating thermostat) shall be set up by 0.5 ºF in both the Reference and Rated Home during these months.

The Reference Home shall use number of Bedrooms plus one (Nbr+1) standard ceiling fans of 42.6 Watts each. The Rated Home shall use the ~~Labeled Ceiling Fan Standardized Watts (LCFSW)~~ceiling fan EnergyGuide label to obtain the standardized "Energy Use" Watts ~~and also~~ multiplied by number of Bedrooms plus one (Nbr+1) fans to obtain total ceiling fan wattage for the Rated Home. ~~The Rated Home LCFSW shall be calculated in accordance with Equation 4.2-46.~~

~~LCFSW = (3000cfm) / (cfm/Watt as labeled at medium speed) (Equation 4.2-46)~~

Where installed ceiling fans in the Rated Home have different EnergyGuide labels~~values of LCFSW~~, the average ~~LCFSW~~"Energy Use" Watts shall be used for calculating ceiling fan energy use in the Rated Home.

[24] (Normative Note) One hundred percent (100%) of the hot water distribution system piping, elbows and tees must be insulated to a minimum of R-3 to utilize the factors in this column.

During periods of fan operation, the fan wattage at 100-percent Internal Gain fraction shall be added to Internal Gains for both the Reference and Rated Homes ($f_{internal}$ = 1.0 and $f_{sensible}$ = 1.0). In addition, annual ceiling fan energy use, in MBtu/y [(kWh/y)/293], for both the Rated and Reference Homes shall be added to the lighting and appliance energy consumption (EC_{LA} and REC_{LA}, as appropriate) as specified by Equation 4.1-2 in Section 4.1.2. **(1)**

4.2.2.7.2.13. Internal Gains of Occupants and General Water Use. These hourly Internal Gains shall be calculated the same as they are in the Reference Home as specified in Section 4.2.2.7.1.6.

4.2.2.9. On-Site Battery Storage. The Energy Rating Reference Home shall not include On-Site Battery Storage. Where the project site includes On-Site Battery Storage and it is used in the calculations of the Energy Rating Index and CO_2e Rating Index of the Rated Home, the stored battery energy shall be dispatched to the Rated Home loads in accordance with Section 4.2.2.9.1 and 4.2.2.9.2.

4.2.2.9.1 For Dwelling Units that share On-Site Battery Storage, the battery charge/discharge rates and capacity shall be pro-rated to individual Dwelling Units based on the number of Bedrooms such that the per-Bedroom On-Site Battery Storage charge/discharge rates and capacity is used in the determination of the Energy Rating Index and the CO_2e Rating Index of the individual Dwelling Units that share the On-Site Battery Storage.

4.2.2.9.2 On-Site Battery Storage shall charge any time On-Site Power Production is greater than the total on-site electrical load until the stored battery energy has reached its maximum capacity. The charge rate shall be the lesser of the excess power production or the maximum charging rate of the battery. On-Site Battery Storage shall discharge any time when On-Site Power Production is less than the total on-site electrical load until the stored battery energy has reached its manufacturer's recommended minimum capacity. The discharge rate shall be the lesser of the excess electrical load or the maximum discharging rate of the battery.

4.3 Index Adjustment Factor (IAF).

4.3.1 Index Adjustment Design (IAD).

Table 4.3.1(1) Configuration of Index Adjustment Design

Building Component	Index Adjustment Design (IAD)
Air exchange rate[a]	Combined Infiltration flow rate plus mechanical Ventilation flow rate of 0.03 * CFA + 7.5 * (Nbr+1) cfm

Building Component	Index Adjustment Design (IAD)
	Infiltration flow rate shall be determined using the following envelope leakage rates: 5 ACH_{50} in IECC[25] Climate Zones 1-2 3 ACH_{50} in IECC[6~~9~~5] (2) Climate Zones 3-8
Dwelling Unit Mechanical Ventilation System fan energy	Balanced Ventilation System without energy recovery and with fan power = 0.70 * fanCFM * 8.76 kWh/y
Internal Gains	As specified in Section 4.2.2.7.1~~by Table 4.2.2(3)~~, except that lighting shall be 75% Tier 1

4.4. Operating Condition Assumptions.

4.4.3. HVAC Sizing.

4.4.3.1. Energy Rating Reference Home.

4.4.3.1.4. All windows shall have blinds/draperies that are positioned in a manner that gives an Internal Shade Coefficient (ISC) ~~of 0.70 in the summer and an ISC of 0.85~~of 0.92-(0.21*SHGC of the Energy Rating Reference Home)~~ in the winter~~. ~~These values are~~This value is ~~represented in ACCA Manual J, 8th Edition as "dark closed blinds" in the summer and "dark, fully drawn roller shades" in the winter~~.

4.4.3.2. Rated Home.

4.4.3.2.5. Windows shall include observed blinds/draperies. For new homes, all windows shall assume blinds/draperies that are positioned in a manner that gives an Internal Shade Coefficient (ISC)~~ of 0.70 in the summer and an ISC of 0.85~~ of 0.92-(0.21*SHGC of the Rated Home)~~in the winter~~. ~~These values are~~This value is ~~represented in ACCA Manual J, 8th Edition as "dark closed blinds" in the summer and "dark fully drawn roller shades" in the winter~~.

4.4.4. Air Source Heat Pumps and Air Conditioners.

4.4.4.1. For Heat Pumps and Air Conditioners where a detailed, hourly HVAC simulation is used to separately model the compressor and evaporator energy (including part-load performance), the back-up heating energy, the distribution fan or blower energy and crank case heating energy, the Manufacturer's Equipment Performance Rating (HSPF and SEER[26]) shall be modified to represent the performance of the compressor and evaporator

[25] (Normative Note) Climates zones shall be as specified by the 2006 IECC.

(2) *Note: This footnote is numbered "69" in ANSI/RESNET/ICC 301-2022 but numbered 23 in sequence with other footnotes in this draft. The same footnote is used for "3 ACH_{50} in IECC" in the standard but is misnumbered "65". The change shown above in the draft corrects the reference to footnote "69".)*

[26] (Normative Note) For Commercial Variable Refrigerant Flow (VRF) Multi-Split Air Conditioning and Heat Pump Equipment, use IEER in place of SEER.

components alone.[27] The energy uses of all components, including compressor and distribution fan/blower and crank case heater, shall then be added together to obtain the total energy uses for heating and cooling.

For Heat Pumps and Air Conditioners with the more recent Manufacturer's Equipment Performance Ratings (HSPF2 or SEER2) available, and HSPF or SEER are not available, these ratings shall be converted to HSPF or SEER values by dividing HSPF2 or SEER2 by the conversion factors in Table 4.4.4.1(1). If the type of equipment is not determined, the conversion shall default to the "Ducted Split System" factors. All calculations, including Equation 4.1-1a, shall use HSPF or SEER values as made available by the Manufacturer or converted as specified in this section.

Table 4.4.4.1(1) SEER2 and HSPF2 Conversion Factors[28]

Equipment Type	**SEER2/SEER**	**EER2/EER**[29]	**HSPF2/HSPF**
Ductless Systems	1.00	1.00	0.90
Ducted Split System	0.95	0.95	0.85
Ducted Packaged System	0.95	0.95	0.84
Small Duct High Velocity System	1.00	Not Applicable	0.85
Ducted Space-Constrained Air Conditioner[30]	0.97	Not Applicable	Not Applicable
Ducted Space-Constrained Heat Pump[30]	0.99	Not Applicable	0.85

4.5 Minimum Rated Features. The estimated annual Purchased Energy consumption for heating, cooling, water heating and lighting and appliances set forth in Section 4.2 shall be determined using the energy loss and gain associated with the Minimum Rated Features as set forth in Table 4.5.2(1).

[27] (Informative Note) Such approaches are described in Cutler et al. 2011 and Fairey et al. 2004.
[28] (Informative Note) Conversion factors developed by AHRI, and adopted by RESNET.
[29] (Informative Note) EER and EER2 are not required in this Standard for equipment relevant to this table, but the values are shared here for informative purposes.
[30] (Normative Note) ***Space Constrained AC or Heat Pump*** – A space constrained unit is a product that has two overall exterior dimensions or an overall displacement that is substantially smaller than those of other units that are of similar heating and/or cooling capacity, and has rated cooling capacities no greater than 30,000 BTU/hr., and that if increased, would result in considerable increase in cost of installation or utility, and was available for purchase in the United States as of December 1, 2000. (Aligns with Title 20 and AHRI Standard 210/240 definitions.)

4.5.1 Data Sources. If data for the Minimum Rated Features set forth in Section 4.5.2 cannot be obtained by observation or without destructive disassembly of the home, default values Approved by the entity adopting the use of this Standard shall be used based on current and historical local building practice and building codes, and for modular or manufactured housing, using available data from the manufacturer.

4.5.2 Standard Features. The Minimum Rated Features associated with the home shall be determined and documented by a Certified Rater or Approved Inspector in accordance with Sections 4.5.2.1 through 4.5.2.4 and the on-site inspection procedures in Appendix A and Appendix B and shall reflect the home at the time of inspection[31].

4.5.2.4 The Air Conditioner, Furnace, and Heat Pump Installation Quality Grade set forth as building element 13 in Table 4.5.2(1) shall be determined by using Standard ANSI/RESNET/ACCA/ICC 310. When information on the Installation Quality Grade cannot be determined, the values set forth in Table 4.5.2(5) shall be used. **(1)**

[31] (Informative Note) For example, for a model home in which a garage has been converted into a sales office, the Minimum Rated Features shall reflect the home with the sales office because that is the state of the home at the time of the inspection, even if the builder intends to convert the sales office back to a garage prior to closing. Alternatively, if the inspection is completed after the sales office has been converted back to a garage, then the Minimum Rated Features shall reflect the home with the garage."

Table 4.5.2(1) Minimum Rated Features	
Building Element	**Minimum Rated Feature**
General Project Info	Total number of buildings, Dwelling Units, and total number of Bedrooms in the project.
1. Floor/Foundation Assembly	Construction type (slab-on-grade, crawlspace, basement), boundary condition (adiabatic, above unconditioned space, above Non-Freezing Space), dimensions, insulation type, value, and location (edge, under slab, cavity, sheathing), framing material and on-center spacing, insulation installation (Grade I, II, or III), vented or unvented (crawlspace), capacitance (if slab or basement receives appreciable solar gain).
2. Walls Assembly	Construction type, <u>orientation (for exterior walls),</u> boundary condition (adiabatic, ambient, Multifamily Buffer Boundary), insulation value (cavity, sheathing), framing material and on-center spacing, insulation installation (Grade I, II, or III), capacitance, exterior color (according to Table 4.2.2(4)).
3. Roof/Ceiling Assembly	Construction type, insulation value (cavity, sheathing), framing material and on-center spacing, insulation installation (Grade I, II, or III), framing covered by insulation or exposed, roof color (according to Table 4.2.2(5)). To determine the attic eave geometry determine the roof slope, eave height, ceiling framing height, and eave length.
22. Clothes Dryer	Location, clothes washer Modified Energy Factor (MEF) or Integrated Modified Energy Factor (IMEF) and clothes washer Labeled Energy Rating (kWh/y) from Energy Guide label; clothes washer capacity from manufacturer's data or CEC Appliance Efficiency Database or EPA ENERGY STAR website; <u>clothes dryer venting type (vented or ventless);</u> and clothes dryer Efficiency Factor (EF) or Combined Efficiency Factor (CEF) from CEC Appliance Efficiency Database or EPA ENERGY STAR website, for all clothes dryers located in the Rated Home or any clothes dryers in the building intended for use by the Rated Home occupants, as defined in Section 4.2.2.6.2.8.
23. Ceiling Fans	Total number of ceiling fans in the Dwelling Unit, ~~Labeled cfm, Watts, and cfm/Watt at medium fan speed from~~<u>EnergyGuide Labeled "Energy Use" Watts for</u> each ceiling fan~~ label~~.
26. On-site Power Production	System type, ~~total annual kWh generation,~~ and total site fuel used in the On-Site Power Production as derived from manufacturer's performance ratings.
<u>27. On-Site Battery Storage</u> [1]	<u>Storage type, maximum kW charging/discharging rates, usable kWh capacity, round-trip efficiency.</u>

5. Existing Home Retrofit Savings.

5.1. Baseline Existing Home.

5.1.1. Where multiple appliances of the same type exist in the original configuration of the existing home, the same number of those appliance types shall be included in the Baseline Existing Home Model.

5.1.2. Where a standard appliance as defined by Tables 4.2.2.~~5~~7(1) and 4.2.2.~~5~~7(2) does not exist in the original configuration of the existing home, the standard default energy use and Internal Gains as specified in Section 4.2.2.7.1~~by Table 4.2.2(3)~~ for that appliance shall be included in the Baseline Existing Home Model.

5.2. Improved Home.

.5.2.1. Where an existing appliance[32] is replaced with a new appliance as part of the improvement but the existing appliance is not removed from the property, both the new and existing appliance shall be included in the Improved Home Model.

5.2.2. Where a standard appliance as defined by Tables 4.2.2.~~5~~7(1) and 4.2.2.~~5~~7(2) does not exist in the improved configuration of the existing home, the standard default energy use and Internal Gains as specified in Section 4.2.2.7.1~~by Table 4.2.2(3)~~ for that appliance shall be included in the Improved Home Model.

7.1.3. Reports. All reports generated by an Approved Software Rating Tool shall, at a minimum, contain the information specified by Sections 0 through ~~0~~7.1.3.7.

7.1.3.1. The property location, including city, state, zip code and either the street address or the Community Name and Plan Name for the Rating.

7.1.3.2. The name of the Certified Rater conducting the Rating.

7.1.3.3. The name of the Approved Rating Provider under whose auspices the Certified Rater is certified.

7.1.3.4. The date the Rating was conducted.

7.1.2.5. The name and version number of the Approved Software Rating Tool used to determine the Rating.

7.1.3.6. The following statement in no less than 10-point font, "The Energy Rating Disclosure for this home is available from the Approved Rating Provider." At a minimum, this statement shall also include the Approved Rating Provider's mailing address and phone number.

[32] (Informative Note) Example: a refrigerator.

7.1.3.7 The edition of the Standard used to determine the Rating, including any Addenda.[33]

7.3. Labeling. Energy Rating labels shall, at a minimum, contain the information specified by Sections 0 through 08.

7.3.1. Real property physical address of the home, including city and state or territory.

7.3.2. Energy Rating Index of the home.

7.3.3 CO_2e Rating Index for the home, calculated in accordance with Section 6.[34]

7.3.4 Projected CO_2e emissions for the home, calculated in accordance with Sections 5.1.2.2.1.1 and 5.1.2.2.1.1.

7.3.5. Projected annual site energy use of the home by fuel type.

7.3.6. Projected annual energy cost of the home,[35] calculated in accordance with energy price rate provisions of Section **Error! Reference source not found.**.

7.3.7. Name and address of the Approved Rating Provider.

7.3.8. Date of the Energy Rating.

9. Normative References.

AHRI 210/240-2023 (2020) "Performance Rating of Unitary Airconditioning & Air-source Heat Pump Equipment." Air Conditioning and Refrigeration Institute, Arlington, VA.

[33] (Informative note) For example, "Calculated in accordance with ANSI / RESNET / ICC 301-2019, including Addenda A & B".

[34] (Normative note) Where Cambium data are not available for the Rated Home location, the CO_2e Index and projected CO_2e emissions shall not be required.

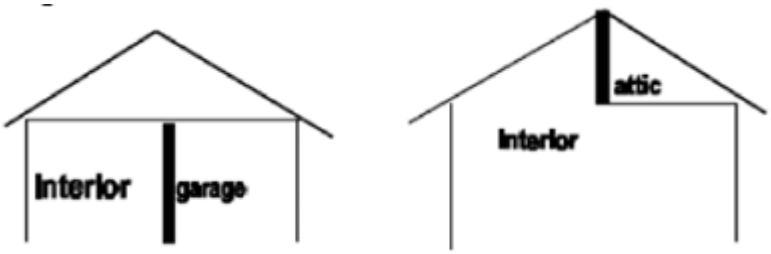
[35] (Informative Note) The projected energy cost shown on the label might not reflect the projected energy costs to be paid by the occupant as metering configurations can result in certain energy costs and end-uses being paid by the building owner.

Normative Appendix B

Inspection Procedures for Minimum Rated Features

Building Element: Wall Assembly		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Gross Area	Determine and record surface area of all walls.	Measure linear perimeter of the walls and round to the nearest foot. Measure the interior wall height of the walls and round to the nearest foot. Use these measurements to calculate surface area and round to the nearest square foot. Each unique wall exposure, construction type and R-Value combination shall be calculated separately. Where the portion of the wall assembly is occupied by through-wall AC sleeves, PTAC, or PTHP penetrations, that portion of the wall shall be modeled separately, using an R-value of 2 or less.
Wall exposure	Determine and record whether walls border Exterior, Unconditioned Space Volume, Multifamily Buffer Boundary, Unrated Conditioned Space, Unrated Heated Space, Non-Freezing Space or Adjacent Building.	1. *Wall to Exterior* – Walls border exterior space. 

2. *Wall to Unconditioned Space Volume* – Walls border Unconditioned Space Volume as defined in Section 3.



3. *Wall to Multifamily Buffer Boundary* – The space adjacent to the Dwelling Unit wall has no heating or cooling system or the space is not designed to maintain space conditions at 78 °F (26 °C) ± 5°F for cooling and 68 °F (20 °C) ± 5°F for heating.

4. *Wall to Unrated Conditioned Space Volume* – The space adjacent to the Dwelling Unit wall is serviced by a heating or cooling system designed to maintain space conditions at 78 °F (26 °C) ± 5°F for cooling and 68 °F (20 °C) ± 5°F for heating.

5. *Wall to Unrated Heated Space* – The space adjacent to the Dwelling Unit wall is outside of the Conditioned Space Volume and only interacts with the Rated Home via the shared services located within. This space is not cooled.

6. *Wall to Non-Freezing Space* – The temperature of the space directly adjacent to the Dwelling Unit wall varies with outside temperature but is heated as necessary to stay at or above 40°F.

		7. *Wall to Adjacent Building* – When a Dwelling Unit is directly adjacent to another building, the walls adjacent to that other building shall be considered exterior walls. However, if there is no air space present between the two buildings and the building that is adjacent is inspected and determined to meet the definition of Conditioned Space Volume, then the wall shall be considered adiabatic.
Construction type	Determine and record the structural system of walls.	*Framed walls* – Wood studs are typically located at 16" or 24" on center along the wall. Measure and record the predominant on-center spacing of the studs. *Masonry walls* – Masonry walls are load-bearing walls constructed of concrete brick or block. A wood framed wall with brick veneer is not a masonry wall. Also record the siding or finish material on the exterior of the wall. If interior framing is present, record whether it is wood or metal. *Foam core walls (SIP)* – Foam core walls are a sandwich panel consisting of a foam center with outer layers of structural sheathing, gypsum board or outer finish materials. Foam core panels may be structural or nonstructural. Structural panels are also known as structural insulated panels (SIPs). Nonstructural panels are frequently used in post and beam construction.
		Log walls – Log walls are solid wood walls, using either milled or rough logs or solid timbers. Some homes have the appearance of solid log walls yet are actually wood frame walls with siding that looks like solid logs inside and out. Some log walls are manufactured with insulated cores. Assume no added insulation exists in a log wall unless manufacturer's data sheet and/or a visual inspection confirms insulation type and thickness.
Orientation	Determine and record orientation of exterior walls.	Determine orientation of at least one exterior wall and record orientations of all exterior walls to the nearest cardinal/ordinal points.

		When using a compass, ~~First~~ first make sure the compass is not noticeably affected by steel members or electric current in the place you are standing. Then ~~While~~ while standing in front of an exterior wall inside the Dwelling Unit, record orientation while facing the exterior. When using a compass while standing outside the Dwelling Unit, record orientation while standing with back to the exterior wall.
Framing members	Determine and record the framing size spacing and type of all framed wall segments that separate one space type from another or from the exterior	Determine the framing member size, spacing (either 16” or 24” on-center), and framing type of each applicable framed wall segment through visual observation. To determine framing member size: • Where framing is visible: If insulation is in place, carefully probe depth using tape measure, wire probe, or foam insulation depth gauge while disturbing as little of the assembly as possible. • Where framing is not visible: Measure the width of the window or door jambs; Subtract the widths of the wall coverings and sheathing materials;[117] Compare the remaining width to 3.5" for a 2x4 wall or 5.5" for a 2x6 wall; Where exposed garage walls exist, examine them for reference although they will not always be the same as other walls; Where a wall does not come close to the framing width of a 2x4 or 2x6, inspect for continuous insulation on the inside or outside of the walls or look for “double stud” or “strapped” walls or other factors that account for a thickness greater than 5.5". For brick veneer walls,

		assume 4.5" - 5" for brick, airspace and sheathing material. To determine framing member spacing: Use visual observation.[118] To determine framing member type: Designate the type as Advanced if, through visual observation, the segment meets all of the requirements for the Advanced framing type defined in Section 4.2.2.1.1. Designate the type as Structural Insulated Panel if it meets the definition contained within this standard. If not, or if the framing cannot be observed, then designate the type as Standard. Use the framing spacing and framing type to determine the default framing fraction per Table 4.2.2(5). As an alternative to determining the framing spacing and framing member type, if a framing plan with the design framing fraction and a professional engineer's stamp has been obtained, then verify through visual observation that the actual assembly in field matches the framing plan. If it does match, then the design framing fraction may be used, per Section 4.2.2.1.2.

Building Element: Windows		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Orientation	Determine and record orientation of all windows.	Determine and record orientation of all windows and record orientation to the nearest cardinal/ordinal points. When using a compass while standing in front of a window inside the Dwelling Unit, record orientation while facing the exterior. When using a compass while standing outside the Dwelling Unit, record orientation while standing with back to the window.

Building Element: Dwelling Unit Mechanical Ventilation System(s)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Centralized system equipment type	Data collection for centralized Dwelling Unit Mechanical Ventilation systems that serve more than one Dwelling Unit	*Centralized exhaust fans* – Record the model number from the nameplate data of each fan being utilized to provide Dwelling Unit Mechanical Ventilation. Use the fan model number to determine and record the fan cfm and wattage or horsepower from the manufacturer's data sheet. *Centralized supply or balanced system fans* – Record the model number from the nameplate data of each fan being utilized to provide ventilation air, directly or indirectly, to the Dwelling Unit. Record the percent of outdoor air in the supply air and whether the supply air is heated or cooled. If conditioned, record capacity and efficiency ratings of heating and cooling systems. Use the fan model number to determine and record the fan cfm and wattage or horsepower from the manufacturer's data sheet. For balanced systems, also record the sensible recovery efficiency and total recovery efficiency.
Individual system equipment type	Data collection for individual Dwelling Unit Mechanical Ventilation systems that serve a single Dwelling Unit	*Individual exhaust fans* – Determine and record the fan wattage and model number from the nameplate data of the exhaust fan being utilized to provide Dwelling Unit Mechanical Ventilation. Use the fan model number to determine and record the fan wattage from the manufacturer's data sheet or HVI Directory. Where the fan is operated using a programmed schedule, document the daily run time for the fan, using the ventilation controller run time setting as observed on-site. If the fan is set to run continuously, then document the daily run time as 24 hours. In Attached Dwelling Units, determined and recorded whether there is supply air provided to the Dwelling Unit, directly or indirectly from adjacent corridor. See Corridor Ventilation section for guidance. *Individual supply fans* - Record the fan wattage and model number from the nameplate data of the supply fan being utilized

		to provide Dwelling Unit Mechanical Ventilation. Use the fan model number to determine and record the fan wattage from the manufacturer's data sheet or HVI Directory. Where the fan is operated using a programmed schedule, document the daily run time for the fan, using the ventilation controller run time setting as observed on-site. If the fan is set to run continuously then document the daily run time as 24 hours. Record whether the supply fan is separate or integrated with the space conditioning system. *Individual Balanced Ventilation Fans* – These are commonly known as energy recovery ventilators (ERV) or heat recovery ventilators (HRV). Record model number from the nameplate data of the ERV/HRV. Use the model number to determine and record the fan wattage, sensible recovery efficiency and total recovery efficiency from the manufacturer's data sheet or HVI Directory. Where the fan is operated using a programmed schedule, document the daily run time for the fan, using the ventilation controller run time setting as observed on-site. If the fan is set to run continuously, then document the daily run time as 24 hours. *Central Fan Integrated Supply (CFIS) Ventilation System* – A central fan integrated Supply Ventilation System is a specific type of supply-only ventilation that includes a duct running from the outside into the return plenum of the heating/cooling system, a mechanical damper, and controls that ensure the system provides ventilation air even when there is no demand for heating or cooling. For these systems, record the central fan model number from the nameplate data of the air handler fan and whether it is equipped with an ECM motor. Use the fan model number to determine and record the fan cfm and either horsepower or wattage from the manufacturer's data sheet. Where fan wattage is not provided, use (HP x 746)/0.90 to calculate fan wattage. Where the fan has multiple speeds, use values associated with the

		high-speed setting to select or calculate the fan wattage. *Unit ventilator* – Similar to the CFIS system, a fan coil unit can be designed to provide both space conditioning and mechanical ventilation to the space that it is serving. Classify as a ventilation system only if the unit operates continuously with the outside air damper open or if the damper is controlled to allow the supply of ventilation air when there is no call for heating or cooling.
Dwelling Unit Mechanical Ventilation rate	Measure exhaust and supply airflow	Ventilation airflows in the Dwelling Unit shall be measured following the procedures in ANSI/RESNET/ICC 380.

Building Element: Heating and Cooling Distribution System		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Location of air ducts	Determine and record the location of ducts	Locate and differentiate between supply and return ducts. The location of air ducts shall be recorded as in attic space, crawlspace, basement or other conditioned or unconditioned space. Use the definitions in Section 3 to classify the locations as Infiltration Volume, Conditioned Space Volume, Unconditioned Space Volume or Unrated Conditioned Space. Approximate the percentage and square foot surface area of both the supply and return ductwork in each area when supply/return ducts are located in more than one area.
Insulation	Determine and record the R-Value of distribution system insulation	Inspect the ducts or pipes to confirm they are insulated and look for labeling printed on the insulation by the manufacturer. Record R-Value. Where insulation is not marked with the R-Value, identify type and measure the thickness of the insulation to determine and record R-Value.
Leakage of air ducts	Determine and record air leakage from ducts	Use default estimates as applicable in Table 4.2.2(1) or follow Procedure for Measuring Airtightness of Duct Systems in ANSI/RESNET/ICC 380. <u>The air handler shall be installed prior to testing.</u>

Building Element: Heating and Cooling Equipment		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Equipment class	Identify Class of equipment for heating and/or cooling	*Individual* - standalone equipment serving a single Dwelling Unit, often located within the Dwelling Unit. These units heat or cool the space and, other than electric connections to power the fans, controls or compressors, are not connected to circulating fluids from a central Boiler or Chiller. *Terminal* - In-Dwelling Unit equipment that heats and cools the space and is connected to Boilers, Chillers, Variable Refrigerant Flow Multi-Split Air Conditioning and Heat Pump Equipment or Cooling Towers. Fan coils and Water Loop Heat Pumps often indicate the use of a remote central Boiler or *Chiller*. However, some terminal equipment appears similar to individual equipment and yet relies on a remote energy source to function. Look for insulated water pipes, refrigerant tubing, or control valves. Confirm that there is no in-unit heating or cooling equipment or equipment in adjacent spaces that solely serves the terminal equipment of the Dwelling Unit that may be outside of the Dwelling Unit. *Central* - larger heating or cooling equipment that serves more than one Dwelling Unit and possibly common spaces using a conveyance to deliver and receive a circulating energy transfer medium to heat or cool the Dwelling Units through their terminal equipment. The circulation conveyance may be water piping or refrigerant tubing and likely will be insulated. Water loops will have circulating pumps. See Central Equipment below for details.

Building Element: Heating and Cooling Equipment		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Location	Determine and record the location of heating and cooling equipment	Record whether individual, terminal and central systems are in Conditioned Space Volume, Unrated Conditioned Space, Unrated Heated Space or Unconditioned Space Volume.
Control system	Identify the control system for the heating and cooling system(s)	Determine and record the type of control systems and look for separate controls for the heating and cooling systems. Determine and record whether the Dwelling Unit thermostat controls are programmable, understanding that not all digital thermostats are programmable.
Efficiency	Determine and record the heating and cooling equipment efficiency and capacity[36]	Look for the equipment nameplates and product literature. Record the manufacturer and model number, capacity and, if listed directly on the nameplate, the efficiency rating. If not listed, use the model number to identify the efficiency rating in the AHRI directory. Where the nameplate information is not available or not accessible, use manufacturer's data sheet, equipment directories or age-based defaults from Section 4.5.2 to determine and record an appropriate efficiency. SEER is used to measure the cooling efficiency of central air conditioning and Air Source Heat Pump systems. EER is used to determine and record the cooling efficiency of room Air Conditioners, VRF, Water Loop Heat Pumps and Ground Source Heat Pumps. EER can be calculated from the nameplate information by dividing Btu output by Watt input. Chillers are rated in kW/ton.

[36] (Normative Note) OEM-provided documentation with the air conditioner or heat pump rated efficiency for a specific combination of different OEM indoor and outdoor components is acceptable.

Building Element: Heating and Cooling Equipment		
Rated Feature	**Task**	**On-Site Inspection Protocol**
		HSPF or COP is used to measure the heating efficiency of Air Source Heat Pumps, VRF, Water Loop Heat Pumps, and Ground Source Heat Pumps. AFUE or Thermal Efficiency is used to measure the efficiency of Furnaces and Boilers.
Heating and cooling energy source	Determine and record fuels used for heating and cooling	Heating systems use natural gas, propane, oil, electricity, or some other fuel. Most cooling systems are driven by electricity; however, some cooling equipment use natural gas or propane.

Building Element: On-Site Power Production		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Annual electricity generation for On-Site Power Production (OPP) systems	Data collection for On-Site Power Production systems	*On-Site Power Production systems* – Collect documentation that shows the annual kWh/y generated. For combined heat and power systems, the documentation shall include the annual gas use in addition to kWh/y generated. *Photovoltaic Systems* – In situations where the Approved Software Rating Tool calculates electricity generation from photovoltaic systems, determine and record the following: • the orientation of the photovoltaic array to the nearest cardinal/ordinal point, in the direction the array faces; • the tilt of the array. Use an angle finder instrument or geometric calculation; • the area of the array and the peak power using the information on the SRCC label or manufacturer's data sheet; and • the efficiency of the inverter using the manufacturer's data sheet.

Building Element: On-Site Battery Storage		
Rated Feature	**Task**	**On-Site Inspection Protocol**
On- Site Battery Storage Systems	Data collection for On-Site Battery Storage systems	*On-Site Battery Storage systems* – Collect documentation that shows the battery storage system type, its maximum kW charge and discharge rates, its usable kWh capacity, and its round-trip efficiency.

Normative Appendix C: Modeling Assumptions

C1.Material Thermal Properties.

The following thermal properties shall be applied where the respective materials are used in a model:

Table C.1(1) Material Thermal Properties

Material	Conductivity (Btu/hr-F-ft)
Soil (adjacent to the home's foundation)	1.000
Wood	0.067
Drywall	0.092

C2.Conversions between Infiltration Metrics.

There are a large number of descriptors and variables used in the determination and representation of envelope leakage and infiltration in residential buildings. Conversions between infiltration metrics within the software shall use the following conventions and procedures.

C2.1 General Nomenclature

ELA = effective leakage area (in^2) *[US: ASTM E 779-92]* [37]
CFA = conditioned floor area (ft^2)
SLA = specific leakage area (in^2/in^2) = ELA / (CFA*144)
C = leakage coefficient (result of least squares regression of test data) [38]
n = flow exponent (result of least squares regression of test data) [39]
ΔP = pressure differential (Pa)
EqLA = equivalent leakage area (in^2) *[Canadian: CAN/SGSB-149.10-M86]* [40]
ach_4 = annual average air change rate (conditioned space volume changes per hour)
ach_{50} = air changes per hour at 50 Pa pressure differential
cfm_{50} = airflow through leakage area at 50 Pa pressure differential
cfm_{25} = airflow through leakage area at 25 Pa pressure differential
wsf = weather and shielding factor *[from ASHRAE Standard 62.2]*
H = vertical distance between the lowest and highest above grade points within the pressure envelope (ft)
Hr = reference height = 8.202 feet (2.5 m)
Hf = average floor to ceiling height (ft)
NL = normalized leakage *[ASHRAE Standard 62.2]*

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[37] The standard reference pressure differential for the calculation of ELA is 4 Pa (U.S. Standard).
[38] The units of measured data used in the least squares regression determine the units and value of 'C'. For SI units, 'C' will be derived from airflows measured in m^3/s and for IP units; 'C' will be derived from airflows measured in ft^3/min (cfm). As a result, the value and units of 'C' will differ substantially based on whether the regression is performed using IP units or SI units. The units of pressure in both systems are Pa.
[39] Where 'n' is not determined by multi-point test data regression, 0.65 is used.
[40] The standard reference pressure differential for the calculation of EqLA is 10 Pa (Canadian Standard).

C2.2 Conversion Equations

$NL = 1000 * SLA * (H/Hr)^{0.4}$ [*ASHRAE Standard 62.2*] (Eq. 1)

$SLA = NL / (1000 * (H/Hr)^{0.4})$ (Eq. 2)

$SLA = ELA / (CFA*144)$ (Eq. 3)

$ELA = (CFA*144) * SLA$ (Eq. 4)

$SLA = ach_4 * (Hf/Hr) / (1000 * wsf * (H/Hr)^{0.4})$ (Eq. 5)

$ach_4 = SLA * 1000 * wsf * (H/Hr)^{0.4} * Hr/Hf$ (Eq. 6)

$ELA = 0.283316 * C * 4^n$ *['C' input in IP units]* (Eq. 7)

$EqLA = 0.2937 * C * 10^n$ *['C' input in IP units]* (Eq. 8)

$C = ELA / (0.283316 * 4^n)$ *['C' returned in IP units]* (Eq. 9)

$C = EqLA / (0.2932 * 10^n)$ *['C' returned in IP units]* (Eq. 10)

$cfm_{50} = C * 50^n$ *['C' input in IP units]* (Eq. 11)

$cfm_{25} = C * 25^n$ *['C' input in IP units]* (Eq. 12)

$ach_{50} = (cfm_{50} * 60) / (CFA * Hf)$ (Eq. 13)

$cfm_{50} = CFA * Hf * ach_{50} / 60$ (Eq. 14)

$ach_{50} = SLA / (0.283316 * 4^n) * (50^n * 60 * 144 / Hf)$ (Eq. 15)

$SLA = ach_{50} * (0.283316 * 4^n) / (50^n * 60 * 144 / Hf)$ (Eq. 16)

$ach_{50} = SLA * 19200$ *[for Hf =Hr and n = 0.65]* (Eq. 17)

$SLA = ach_{50} / 19200$ *[for Hf =Hr and n = 0.65]* (Eq. 18)

$ELA = 0.054863 * cfm_{50}$ *[for n = 0.65]* (Eq. 19)

$ach_{50} = 19.2 * ach_4 / (wsf * (H/Hr)^{0.4})$ *[for n = 0.65]* (Eq. 20)

$NL = ach_4 * (Hf/Hr) / wsf$ *[for n = 0.65]* (Eq. 21)

C3.Load Profile Schedules.

Schedules for Internal Gains, appliances, lighting, and other equipment (as specified by this standard) shall vary according to the profiles specified in Tables C.3(1) – C.3(5).

Table C.3(1) Fraction of Daily End Use Profile Schedules for Appliances (except Refrigerators)

Hour of Day	Clothes Washer	Clothes Dryer	Dishwasher	Range/ Oven	Televisions	Misc. Electric Loads
0-1	0.009	0.010	0.015	0.008	0.014	0.036
1-2	0.007	0.006	0.007	0.008	0.007	0.036
2-3	0.004	0.004	0.005	0.008	0.004	0.036
3-4	0.004	0.002	0.003	0.008	0.003	0.036
4-5	0.007	0.004	0.003	0.008	0.004	0.036
5-6	0.011	0.006	0.010	0.015	0.006	0.036
6-7	0.022	0.016	0.020	0.023	0.010	0.038
7-8	0.049	0.032	0.031	0.039	0.015	0.041
8-9	0.073	0.048	0.058	0.046	0.020	0.042
9-10	0.086	0.068	0.065	0.046	0.025	0.042
10-11	0.084	0.078	0.056	0.046	0.028	0.042
11-12	0.075	0.081	0.048	0.054	0.031	0.042
12-13	0.067	0.074	0.042	0.062	0.033	0.042
13-14	0.060	0.067	0.046	0.046	0.038	0.042
14-15	0.049	0.058	0.036	0.039	0.042	0.042
15-16	0.051	0.061	0.038	0.054	0.046	0.044
16-17	0.050	0.055	0.038	0.076	0.054	0.047
17-18	0.049	0.054	0.049	0.134	0.062	0.050
18-19	0.049	0.051	0.087	0.114	0.080	0.051
19-20	0.049	0.051	0.111	0.058	0.110	0.050
20-21	0.049	0.052	0.090	0.039	0.132	0.048
21-22	0.047	0.054	0.067	0.031	0.125	0.044
22-23	0.032	0.044	0.044	0.023	0.077	0.040
23-24	0.017	0.024	0.031	0.015	0.034	0.037

Table C.3(2) Daily Refrigerator Coefficient Schedules

Hour of Day	Constant Coefficient (a)	Temperature Coefficient (b)
0-1	-0.487	0.019
1-2	-0.340	0.016
2-3	-0.370	0.017
3-4	-0.361	0.016
4-5	-0.515	0.018
5-6	-0.684	0.021
6-7	-0.471	0.019
7-8	-0.159	0.015
8-9	-0.079	0.015
9-10	-0.417	0.019
10-11	-0.411	0.018
11-12	-0.386	0.018
12-13	-0.240	0.016
13-14	-0.314	0.017
14-15	-0.160	0.015
15-16	-0.121	0.015
16-17	-0.469	0.020
17-18	-0.412	0.020
18-19	-0.091	0.017
19-20	0.077	0.014
20-21	-0.118	0.016
21-22	-0.247	0.017
22-23	-0.445	0.019
23-24	-0.544	0.020

Table C.3(3) Daily End Use Profile Schedules for Lighting

Hour of Day	Interior	Exterior	Garage
0-1	0.012	0.040	0.023
1-2	0.010	0.037	0.019
2-3	0.010	0.037	0.015
3-4	0.010	0.035	0.017
4-5	0.011	0.035	0.021
5-6	0.018	0.039	0.031
6-7	0.030	0.044	0.042
7-8	0.038	0.041	0.041
8-9	0.041	0.031	0.034
9-10	0.041	0.025	0.029
10-11	0.039	0.024	0.027
11-12	0.037	0.024	0.025
12-13	0.036	0.025	0.021
13-14	0.035	0.028	0.021
14-15	0.037	0.030	0.021
15-16	0.041	0.035	0.026
16-17	0.050	0.044	0.031
17-18	0.065	0.056	0.044
18-19	0.086	0.064	0.084
19-20	0.106	0.068	0.117
20-21	0.110	0.070	0.113
21-22	0.079	0.065	0.096
22-23	0.040	0.056	0.063
23-24	0.018	0.047	0.039

Table C.3(4) Monthly Lighting Multipliers

Month	Multiplier
Jan	1.19
Feb	1.11
Mar	1.02
Apr	0.93
May	0.84
Jun	0.80
Jul	0.82
Aug	0.88
Sep	0.98
Oct	1.07
Nov	1.16
Dec	1.20

Table C.3(5)

Hour of Day	Hot Water Fixtures	Occupancy Gains	General Water Use	Ceiling Fan	Demand Controlled Recirculation Pump	Temperature Controlled Recirculation Pump
0-1	0.012	0.035	0.023	0.057	0.012	0.067
1-2	0.006	0.035	0.021	0.057	0.006	0.072
2-3	0.004	0.035	0.021	0.057	0.004	0.074
3-4	0.005	0.035	0.025	0.057	0.005	0.073
4-5	0.010	0.035	0.027	0.057	0.010	0.069
5-6	0.034	0.059	0.038	0.057	0.034	0.048
6-7	0.078	0.082	0.044	0.057	0.078	0.011
7-8	0.086	0.055	0.039	0.024	0.086	0.003
8-9	0.080	0.027	0.037	0.024	0.080	0.009
9-10	0.067	0.014	0.037	0.024	0.067	0.020
10-11	0.056	0.014	0.034	0.024	0.056	0.030
11-12	0.047	0.014	0.035	0.024	0.047	0.037
12-13	0.040	0.014	0.035	0.024	0.040	0.043
13-14	0.035	0.014	0.035	0.024	0.035	0.047
14-15	0.033	0.019	0.039	0.024	0.033	0.050
15-16	0.031	0.027	0.043	0.024	0.031	0.051
16-17	0.038	0.041	0.051	0.024	0.038	0.044
17-18	0.051	0.055	0.064	0.024	0.051	0.034
18-19	0.060	0.068	0.065	0.052	0.060	0.026
19-20	0.060	0.082	0.072	0.057	0.060	0.026
20-21	0.055	0.082	0.073	0.057	0.055	0.030
21-22	0.048	0.070	0.063	0.057	0.048	0.036
22-23	0.038	0.053	0.045	0.057	0.038	0.045
23-24	0.026	0.035	0.034	0.057	0.026	0.055