

# Chapter Three

## RESNET Standards

### 300 NATIONAL ENERGY RATING TECHNICAL STANDARDS

**303.1.1.2** If rating a new, to-be-built home, follow the procedures set forth in Section [303.6303.7](#) and [303.7303.8](#) of these Standards to collect the data needed to calculate the rating;

**303.1.2.1** Based on the minimum rated features set forth in Section [303.7303.8](#) of these Standards.

**3.3.4** If a Projected Rating conducted under Section [303.6303.7.1](#) of these Standards, the Rating shall be prominently identified as a “Projected Rating.”

### 303.6 Standardized Existing Home Retrofit Savings

Standardized energy savings for existing home retrofits shall be determined by comparing a Baseline Home with an Improved Home in accordance with the provisions of this section.

**303.6.1 Baseline Home.** The Baseline Home model for the purposes of determining the energy savings of an existing home retrofit shall be the original configuration of the existing home, including the full complement of lighting, appliances and residual miscellaneous energy use as specified by Tables 303.4.1.7.1(1) and 303.4.1.7.1(2). The energy use of these end uses in the Baseline Home shall be based on the original home configuration following the provision of Section 303.4.1.7.2.

303.6.1.1 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 Home model.

303.6.1.2 Where a standard appliance as defined by Tables 303.4.1.7.1(1) and 303.4.1.7.1(2) does not exist in the original configuration of the existing home, the standard default energy use and internal gains as specified by Table 303.4.1(3) for that appliance shall be included in the Baseline Home model.

**303.6.2 Improved Home.** The improved home model for the purpose of determining the energy savings of an existing home retrofit shall be the existing home’s configuration including all energy improvements to the original home and including the full complement of lighting, appliances and residual miscellaneous energy use contained in the home after all energy improvements have been implemented.

303.6.2.1 Where an appliance has been upgraded but the existing appliance is not removed from the existing home property, both the new and existing appliance shall be included in the Improved Home model.<sup>1</sup>

303.6.2.2 Where a standard appliance as defined by Tables 303.4.1.7.1(1) and 303.4.1.7.1(2) does not exist in the improved configuration of the existing home, the standard default energy use and internal gains as specified by Table 303.4.1(3) for that appliance shall be included in the Improved Home model.

303.6.2.3 Improvements in lighting and appliance energy use in the Improved Home model shall be calculated in accordance with Section 303.4.1.7.2.

### **303.6.3 Standard Operating Conditions.**

303.6.3.1 Both the Baseline Home and Improved Home shall be configured and modeled in accordance with the Rated Home specifications of Table 303.4.1(1) except that the Baseline Home shall not violate the input constraints specified in Table 303.6.3(1) below.

Table 303.6.3(1) Baseline Home Input Constraints

<b><u>Equipment Constraints*</u></b>	<b><u>Minimum Value</u></b>
<u>Forced-air furnace, AFUE</u>	<u>72%</u>
<u>Hot water / steam boiler, AFUE</u>	<u>60%</u>
<u>Heat Pump, HSPF</u>	<u>6.5</u>
<u>Heat Pump, SEER</u>	<u>9.0</u>
<u>Central air conditioner, SEER</u>	<u>9.0</u>
<u>Room air conditioner, EER</u>	<u>8.0</u>
<u>Gas-fired storage water heater, EF</u>	<u>0.50</u>
<u>Oil-fired storage water heater, EF</u>	<u>0.45</u>
<u>Electric storage water heater, EF</u>	<u>0.86</u>
<b><u>Enclosure Constraints (including air film conductances)</u></b>	<b><u>Maximum U-factor</u></b>
<u>Wood-frame wall</u>	<u>0.222</u>
<u>Masonry wall</u>	<u>0.250</u>
<u>Wood-frame ceiling with attic (interior to attic space)</u>	<u>0.286</u>
<u>Unfinished roof</u>	<u>0.400</u>
<u>Wood-frame floor</u>	<u>0.222</u>
<u>Single-pane window, wood frame</u>	<u>0.714</u>
<u>Single-pane window, metal frame</u>	<u>0.833</u>

**\* Exception:** Where the labeled equipment efficiency exists for the specified piece of existing equipment, the labeled or measured steady state efficiency shall be used in lieu of these minimum input constraints. Where the labeled equipment efficiency exists for the specific piece of existing equipment, the labeled efficiency shall be used in lieu of these minimum input constraints.

<sup>1</sup> For example, if a refrigerator is upgraded to a more efficient model and the original refrigerator is kept on property for potential use as a second refrigerator; both refrigerators shall be included in the Improved Home energy model.

### 303.6.3.2 Air Distribution Systems

303.6.3.2.1 In cases where the air distribution system leakage is not measured in the original Baseline Home, the ducts shall be modeled in the spaces in which they are located and the air distribution system leakage to outdoors at 25 Pascal pressure difference shall be modeled in both the Baseline Home and the Improved Home as 0.10 times the conditioned floor area of the home split equally between the supply and return side of the air distribution system with the leakage distributed evenly across the duct system.

**Exception:** If the air handler unit and a minimum of 75% of its duct system are entirely inside the conditioned space boundary, the air distribution system leakage to outdoors at 25 Pascal pressure difference shall be modeled in both the Baseline Home and the Improved Home as 0.05 times the conditioned floor area of the home split equally between the supply and return side of the air distribution system with the leakage distributed evenly across the duct system.

303.6.3.2.2 In cases where the air distribution system leakage is measured:

303.6.3.2.2.1 For the Baseline Home, the ducts shall be modeled in the spaces in which they are located and the air distribution system leakage to outdoors at 25 Pascal pressure difference shall be modeled as the lesser of the measured air distribution system leakage to outdoors at 25 Pascal pressure difference in the original Baseline Home or 0.24 times the conditioned floor area of the home, either split evenly between the supply and return side of the air distribution system or as measured separately with the leakage distributed evenly across the duct system.

303.6.3.2.2.2 For the Improved Home, the ducts shall be modeled in the spaces in which they are located and the air distribution system leakage to outdoors at 25 Pascal pressure difference shall be set equal to the measured air distribution system leakage to outdoors at 25 Pascal pressure difference in the Improved Home, either split evenly between the supply or return side of the air distribution system or as measured separately with the leakage distributed evenly across the duct system.

~~303.6.1.1~~303.6.3.3 Both the Baseline Home and the Improved Home shall be subjected to the operating conditions specified by Section 303.5.1.4.2.

### ~~303.6.2~~303.6.4 Total Energy Savings Calculation.

303.6.4.1 Energy units used in the calculation of energy savings shall be units of Equivalent Electric Power. Energy using the Reference Electricity Production Efficiency for fossil fuels. Equivalent electric energy use shall be calculated using Equation 303.6.4-1.

$$kWh_{eq} = kWh_{elec} + \frac{Btu_{fossil} \times 0.40}{3412} \quad \text{(Eqn. 303.6.4-1)}$$

303.6.4.2 Energy savings shall be calculated as the difference between the whole-house projected equivalent electric energy use of the Baseline Home and the whole-house projected equivalent electric energy use of the Improved Home.

303.6.4.3 The energy savings percentage of the retrofit shall be calculated as the whole-house equivalent electric energy savings as determined by Section 303.6.4.2 above divided by the whole-house equivalent electric energy use of the Baseline Home.

### **303.6303.7 Projected and Confirmed Ratings**

**303.6303.7.1** A HERS provider may calculate the Projected Rating of a to-be-built or to-be-improved home based on architectural drawings with material, mechanical and electrical specifications for a to-be-built home, or based on a site audit for a to-be-improved home; and by:

**303.6303.7.1.1** Using either the envelope leakage rate specified as the required performance by the construction documents, the site-measured envelope leakage rate, or a default value as specified for the Reference home in Table 303.4.1(1).

**303.6303.7.1.2** Using either the distribution system efficiency specified as the required performance by the construction documents, the site-measured distribution system efficiency, or a default distribution system efficiency value from Table 303.4.1(1); and

**303.6303.7.1.3** Using the planned location and orientation of the proposed home, or if the proposed orientation is unknown, calculating ratings for the home facing each of the four cardinal directions, north, south, east and west, and using the largest HERS Index as the "worst case" Projected Rating.

**303.6303.7.2** Upon completion of construction and verification of the proposed specifications, all rated features of the home shall be confirmed using site inspections and envelope air leakage rates and distribution system efficiencies derived from on-site diagnostic tests conducted in accordance with Section 303.7303.8.1 of this Standard, and the actual orientation of the home.

**303.6303.7.3** Rating tools accredited under Section 303.8 of this Standard must be retested and re-certified if a new version of the tool is released that includes changes to the engineering algorithms.

### **303.7303.8 Minimum Rated Features**

**303.7303.8.1** All HERS providers shall calculate the estimated annual purchased energy consumption for heating, cooling, water heating and lighting and appliances set forth in Section 303.1 of this Standard using the energy loss and gain associated with the minimum rated features as set forth in Table 303.7303.8.1(1),

**303.7303.8.1.1** For existing homes, the envelope thermal characteristics of building elements 1 through 7 set forth in Table 303.7303.8.1(1) are determined by site observation.

**303.7303.8.1.2** If data for the minimum rated features set forth in Section [303.7303.8.1.1](#) of this Standard cannot be obtained by observation or without destructive disassembly of the home, default values shall be used. The default values are determined from the following sources listed in the preferential order of use:

- (a) For manufactured homes, available manufacturer's data;
- (b) Current and historical local building practices; or
- (c) Current and historical local building codes.

**303.7303.8.1.3** For existing homes, the determination of air leakage and duct leakage values set forth as building elements 10 and 11 in Table [303.7303.8.1\(1\)](#) are determined by data collected on site using the following procedures listed in preferential order of use:

**303.7303.8.1.3.1** Current on-site diagnostic tests conducted in accordance with the requirements set forth in Table [303.4.1\(1\)](#); or

**303.7303.8.1.3.2** Observations of the condition of the building and duct system made by a Certified Rater. Based on these observations, values from Tables [303.4.1\(3\)](#) shall be used.

**303.7303.8.1.3.3** The energy efficiency of the mechanical equipment set forth as building elements 12 through 14 in Table [303.7303.8.1\(1\)](#) is determined by data collected on site using the following sources listed in preferential order of use:

- (a) Current on-site diagnostic test data as corrected using the following equation:

$$\text{Eff}_{\text{rated}} = \text{Eff}_{\text{listed}} * \text{Es}_{\text{measured}} / \text{Es}_{\text{listed}}$$

where:

Eff<sub>rated</sub> = annual efficiency to use as input to the rating

Eff<sub>listed</sub> = listed annual efficiency by manufacturer or directory

Es<sub>measured</sub> = measured steady state efficiency of system

Es<sub>listed</sub> = manufacturer's listed steady state efficiency, under the same operating conditions found during measurement

- (b) Name plate data;
- (c) Manufacturer's data sheet; or
- (d) Equipment directories.

**303.7303.8.1.4** When information on the energy efficiency of mechanical equipment cannot be determined from the sources listed in paragraph [303.7303.8.1.3.3](#) of this Standard, the values set forth in Tables [303.7303.8.1\(2\)](#); [303.7303.8.1\(3\)](#); [303.7303.8.1\(4\)](#) and [303.7303.8.1\(5\)](#) shall be used.

**303.7303.8.1.5** Any HERS provider may base annual purchased energy consumption estimates for the Rated Home on additional features if the HERS provider's energy analysis tool is capable of doing so.

**Table 303.7303.8.1(1) Minimum Rated Features**

<b>Building element</b>	<b>Minimum Rated Feature</b>
1. Floor/Foundation Assembly.	Construction type (slab-on-grade, crawl space; basement), insulation value (edge, under slab, cavity, sheathing), framing material and on-center spacing, insulation installation (Grade I, II, or III), vented or unvented (crawl space), capacitance (if slab or basement receives appreciable solar gain).
2. Walls	Construction type, insulation value (cavity, sheathing), framing material and on-center spacing insulation installation (Grade I, II, or III) capacitance, color (light, medium, or dark).
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 (light, medium, or dark).
4. Rim Joist	Insulation value (cavity, sheathing).
5. Doors	Construction type, insulation value.
6. Windows	Construction type, orientation, U-value (of complete assembly), solar heat gain coefficient, shading.
7. Skylights	Construction type, orientation, tilt, U-value (of complete assembly), heat gain coefficient, shading.
8. Passive Solar System (Direct Gain system)	Solar type, collector type and area, orientation, tilt efficiency, storage tank size, pipe insulation value.
9. Solar Domestic Hot Water Equipment	System type, collector type and area, orientation, tilt, efficiency, storage tank size, pipe insulation value.
10. Air Leakage	Air leakage measurement type (default estimate, blower door test, tracer gas test), volume of conditioned space.
11. Distribution System	System type, location, insulation value (duct and pipe), air leakage measurement type (default estimate, duct pressurization).
12. Heating Equipment	Equipment type, location, efficiency (AFUE, HSPF), auxiliary electric (Eae); power consumption of ground fluid circulating pump(s) for ground-loop and ground-water heat pumps.
13. Cooling Equipment	Equipment type, location, efficiency (SEER, COP).
14. Domestic Hot Water Equipment	Equipment type, location, energy factor or seasonal efficiency, extra tank insulation value, pipe insulation value.
15. Control Systems	Thermostat type.

**Table 303.7303.8.1(1) Minimum Rated Features**

<b>Building element</b>	<b>Minimum Rated Feature</b>
16. Light fixtures	Number of qualifying and non-qualifying light fixtures in qualifying locations (i.e. kitchens, dining rooms, living rooms, family rooms/dens, bathrooms, hallways, stairways, entrances, bedrooms, garage, utility rooms, home offices, and all outdoor fixtures mounted on a building or pole (excluding landscape lighting)).
17. Refrigerator(s)	Total annual energy consumption (kWh) for all units from:  California Energy Commission: Appliance Database at <a href="http://www.energy.ca.gov/appliances/appliance/index.html">http://www.energy.ca.gov/appliances/appliance/index.html</a>  or  Association of Home Appliance Manufacturers (AHAM) directories
18. Dishwasher(s)	Energy factor (cycles/kWh) for all units from: the Federal Trade Commission's "Dishwasher Energy Data" posted at <a href="http://www.ftc.gov/bcp/online/edcams/eande/appliances/data/2004/dwasher/brand.htm">http://www.ftc.gov/bcp/online/edcams/eande/appliances/data/2004/dwasher/brand.htm</a>
19. Ceiling Fans	Labeled cfm, Watts and cfm/Watt at medium fan speed from EPA ENERGY STAR ceiling fan label.
20. Mechanical Ventilation System(s)	Equipment type, daily run hours, and wattage (may be listed in the Certified Home Ventilating Products Directory available from the Heating and Ventilation Institute (HVI).
21. On-site Power Generation	Total annual kWh generation and total site fuel used in the production of on-site power generation as derived from manufacturer's performance ratings.

**Table 303.7303.8.1(2) Default Solid Fuel Combustion Seasonal Efficiencies for Space Heating**

<b>Type</b>	<b>Location</b>	<b>Seasonal Efficiency</b>	<b>Notes</b>
EPA-Listed Stove, Furnace, or Boiler	Conditioned space	Contained in the EPA publication "Certified Wood Heaters" and posted at <a href="http://www.epa.gov/compliance/resources/publications/monitoring/programs/woodstoves/certifiedwood.pdf">http://www.epa.gov/compliance/resources/publications/monitoring/programs/woodstoves/certifiedwood.pdf</a>	
EPA-Listed Stove, Furnace or Boiler	Unconditioned space	0.85 of EPA listing	
EPA Stove – Not Listed	Conditioned space	60%	For stoves with documented EPA

**Table 303.7303.8.1(2) Default Solid Fuel Combustion Seasonal Efficiencies for Space Heating**

Type	Location	Seasonal Efficiency	Notes
			compliance, but not found on EPA's Web site list of certified stoves
EPA Stove – Not Listed	Unconditioned space	50%	For stoves with documented EPA compliance, but not found on EPA's Web site list of certified stoves
EPA-Listed Stove Insert	Enclosed, such as in fireplace	Subtract 10% from listed seasonal efficiency	
Non-EPA Stove	Conditioned space	50%	Not tested or listed by EPA
Non-EPA Stove	Unconditioned space	40%	Not tested or listed by EPA
Biomass Fuel Furnace or Boiler with Distribution System	Conditioned space	50%	Not tested or listed by EPA Distribution system efficiency shall also be considered
Biomass Fuel Furnace or Boiler with Distribution System	Unconditioned space	40%	Not tested or listed by EPA Distribution system efficiency shall also be considered
Biomass Fuel Furnace or Boiler with Distribution System	Outside	30%	Not tested or listed by EPA Distribution system efficiency shall also be considered
Solid Fuel Furnace or Boiler – Independently Tested	Central with ducted or hydronic distribution	0.85 of tested listing	Only permitted with documentation of independent testing lab documentation Distribution system efficiency shall also be considered



**Table 303.7303.8.1(3) Default Values for Mechanical System Efficiency (Age-based)\***

Mechanical Systems	Units	Pre-1960	1960-1969	1970-1974	1975-1983	1984-1987	1988-1991	1992 to present
<b>Heating:</b>								
Gas Furnace	AFUE	0.6072	0.6072	0.6572	0.6872	0.6872	0.76	0.78
Gas Boiler	AFUE	0.60	0.60	0.65	0.65	0.70	0.77	0.80
Oil Furnace or Boiler	AFUE	0.60	0.65	0.72	0.75	0.80	0.80	0.80
Air-Source Heat Pump	HSPF	4.506.5	4.506.5	4.706.5	5.506.5	6.306.5	6.80	6.80
Ground-Water Geothermal Heat pump	COP	2.70	2.70	2.70	3.00	3.10	3.20	3.50
Ground-Coupled Geothermal Heat Pump	COP	2.30	2.30	2.30	2.50	2.60	2.70	3.00
<b>Cooling:</b>								
Air-Source Heat Pump	SEER	5.009.0	6.109.0	6.509.0	7.409.0	8.709.0	9.40	10.00
Ground-Water Geothermal Heat Pump	EER	10.00	10.00	10.00	13.00	13.00	14.00	16.00
Ground-Coupled Geothermal Heat Pump	EER	8.00	8.00	8.00	11.00	11.00	12.00	14.00
Central Air Conditioner	SEER	5.009.0	6.109.0	6.509.0	7.409.0	8.709.0	9.40	10.00
Room Air Conditioner	EER	5.008.0	6.108.0	6.108.0	6.708.0	7.708.0	8.10	8.50
<b>Water Heating:</b>								
Storage Gas	EF	0.4750	0.4750	0.4750	0.4950	0.55	0.56	0.56
Storage Oil	EF	0.47	0.47	0.47	0.48	0.49	0.54	0.56
Storage Electric	EF	0.7986	0.8086	0.8086	0.8186	0.8386	0.87	0.88

\* **Exception:** Where the labeled equipment efficiency exists for the specific piece of existing equipment, the labeled efficiency shall be used in lieu of these minimum input constraints.

**TABLE 303.7303.8.1(4) Default Values for Mechanical System Efficiency (not Age-based)\***

	Units	Rating
<b>Heating:</b>		
Gas Wall Heater (Gravity)	AFUE	0.6572
Gas Floor Furnace	AFUE	0.6072
Gas Water Heater (Space Heating).	AFUE	0.75

**TABLE 303.7303.8.1(4) Default Values for Mechanical System Efficiency (not Age-based)\***

	Units	Rating
Electric Furnace	HSPF	3.413
Electric Radiant	HSPF	3.413
Heat Pump Water Heater (Space)	HSPF	5.11
Electric Water Heater (Space)	HSPF	2.73
Cooling:		
Electric Evaporative Cooling	EER	30
Gas Absorption Cooler	COP	0.40
Water Heating:		
Heat Pump	COP	2.00
Instantaneous Electric	EF	0.87
Instantaneous Gas	EF	0.75
Solar (Use SRCC Adjustment Procedures)	EF	2.00

**\* Exception:** Where the labeled equipment efficiency exists for the specific piece of existing equipment, the labeled efficiency shall be used in lieu of these minimum input constraints.

**Table 303.7303.8.1(5) Default EAE Values**

System Type	EAE
Oil boiler	330
Gas boiler	170
Oil furnace	$439 + 5.5 * \text{Capacity (kBtu/h)}$
Gas furnace	$149 + 10.3 * \text{Capacity (kBtu/h)}$

### **303.8303.9 Software Rating Tools**

**303.8303.9.1** Minimum capabilities. Calculation procedures used to comply with this Standard shall be computer-based rating software tools capable of calculating the annual energy consumption and HERS Index of all building elements that differ between the HERS Reference Home and the Rated Homes and shall include the following capabilities:

**303.8303.9.1.1** Compliance with the rating provisions of Section 303.1 of this Standard

**303.8303.9.1.2** Computer generation of HERS Index and star ratings in accordance with the provisions of Section 303.2 of this Standard

**303.8303.9.1.3** Automated computer generation of the HERS Reference Home using only the input for the Rated Home

**303.8303.9.1.4** The software tool shall not allow the user to directly modify the building component characteristics of the HERS Reference Home

**303.8303.9.1.5** Calculation of whole-building, single-zone sizing for the heating and cooling equipment in the HERS Reference Home residence in accordance with Section 303.5.1.4 of this Standard.

**303.8303.9.1.6** Calculations that account for the indoor and outdoor temperature dependencies and the part-load performance of heating, ventilating, and air conditioning equipment based on climate and equipment sizing

**303.8303.9.1.7** Printed rating report in accordance with Section 303.3 of this Standard

**303.8303.9.2** Approved tools. Rating software tools shall be accredited by RESNET through compliance with the “RESNET Rating Software Testing and Verification Procedures” posted on the RESNET web site at [www.natresnet.org](http://www.natresnet.org) (see also Chapter 1, Section 102.2.1).

### **303.9303.10 Innovative Design Request**

**303.9303.10.1** HERS providers can petition RESNET for adjustment to the HERS Index for a Rated Home with features or technologies not addressed by approved software tools and/or this Standard. Innovative Design Requests (IDRs) to RESNET shall include, at a minimum, the following:

**303.9303.10.1.1** A Rating generated from approved rating software tool for Rated Home without feature(s) that cannot be modeled in the software tool.

**303.9303.10.1.2** Written description of feature(s) not included in Rating generated from software.

**303.9303.10.1.3** Manufacturer’s technical and/or performance specifications for feature(s) not included in the Rating generated from the approved software tool.

**303.9303.10.1.4** Estimated energy impact. Calculations or simulation results estimating the energy impact of feature(s) not included in the Rating generated from an approved software tool and documentation to support the calculation methodology and/or describe the modeling approach used.

**303.9303.10.1.5** Estimated adjustment to HERS Index. Calculations shall follow procedures of Sections 303.1 and 303.2.

**303.9303.10.2** Upon review of an IDR, RESNET Standing Technical Committee shall request additional supporting documentation for further consideration or provide a recommendation with justification to the Board as follows: a) is approved, b) is denied, or c) is approved with modifications. The RESNET Board of Directors shall accept or reject the recommendation of Technical Committee or request further information from the Technical Committee.

| **303.9303.10.3** IDRs shall be approved on a case by case basis. RESNET shall assign a unique identifier to each IDR and maintain a database of IDRs. If RESNET approves the IDR, the HERS provider may issue a supplemental report that adjusts the HERS Index as approved.

| *Modify the following definition in Appendix B*

| *Equivalent Electric ~~Power~~ Energy* – The amount of electricity that would be produced from site fossil fuel uses when converted to electrical power using the Reference Electricity Production Efficiency.

**Justification for Proposed Amendment:**

For quite some time, it has been the contention of many that the RESNET standards apply only to new homes and that they do not address existing home. While this has never been the actual case, it has also been true that the RESNET standards did not contain a specific methodology for the calculation of standardized energy savings (asset savings) resulting from existing home retrofits. This proposed new section of the RESNET Standards is drafted to provide a specific methodology that will fill this gap. Such a standard methodology is sorely needed by the Rating industry and by others, including Congress, in the development of policies and programs aimed at reducing energy use in existing housing stock.

**Proposed Effective Date for Amendment:** Thirty days after the adoption by the RESNET Board of Directors .