[6450-01-P]

DEPARTMENT OF ENERGY

10 CFR Parts 429, 430, and 431

[Docket No. EERE-2015-BT-TP-0007]

RIN: 1904-AC91

Energy Conservation Program for Consumer Products and Certain Commercial and Industrial Equipment: Test Procedures for Consumer and Commercial Water Heaters

AGENCY: Office of Energy Efficiency and Renewable Energy, Department of Energy.

ACTION: Final rule.

SUMMARY: The U.S. Department of Energy (DOE), in this final rule, establishes mathematical conversion factors to translate the current energy conservation standards and the measured values determined under the energy factor, thermal efficiency, and standby loss test procedures for consumer water heaters and certain commercial water heaters to those determined under the more recently adopted uniform energy factor test procedure. As required by the Energy Policy and Conservation Act of 1975 (EPCA), as amended, DOE initially presented proposals for establishing a mathematical conversion factor in a notice of proposed rulemaking (NOPR) published on April 14, 2015 (April 2015 NOPR). Upon further analysis and review of the public comments received in response to the April 2015 NOPR, DOE published a supplemental notice of proposed rulemaking on August 30, 2016 (August 2016 SNOPR). These proposed rulemakings serve as the basis for the final rule.

DATES: The conversion factors established in this rule shall apply beginning on **[INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER]** through **[INSERT DATE ONE YEAR AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

ADDRESSES: The docket, which includes Federal Register notices, public meeting attendee lists and transcripts, comments, and other supporting documents/materials, is available for review at www.regulations.gov. All documents in the docket are listed in the www.regulations.gov index. However, not all documents listed in the index may be publicly available, such as those containing information that is exempt from public disclosure.

A link to the docket webpage can be found at https://www.regulations.gov/docket?DRegulations.gov-Docket Folder Summary=EERE-2015-BT-TP-0007. The docket webpage contains simple instructions on how to access all documents, including public comments, in the docket.

FOR FURTHER INFORMATION CONTACT: Ms. Ashley Armstrong, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Office, EE-5B, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. Telephone: (202) 586-6590. E-mail: Ashley.Armstrong@ee.doe.gov.

Mr. Eric Stas, U.S. Department of Energy, Office of the General Counsel, GC-33, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. Telephone: (202) 586-9507. E-mail: Eric.Stas@hq.doe.gov.

SUPPLEMENTARY INFORMATION:

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I. Authority and Background

Title III Part B[1] of the Energy Policy and Conservation Act of 1975 ("EPCA" or, "the Act"), Public Law 94–163 (42 U.S.C. 6291–6309, as codified) sets forth a variety of provisions designed to improve energy efficiency and established the Energy Conservation Program for Consumer Products Other Than Automobiles.[2] Consumer water heaters, one subject of this document, are a "covered product" under EPCA. (42 U.S.C. 6292(a)(4)) Title III, Part C[3] of EPCA, Public Law 94–163 (42 U.S.C. 6311–6317, as codified), added by Public Law 95–619, Title IV, Sec. 441(a), established the Energy Conservation Program for Certain Industrial Equipment, which includes commercial water heating equipment, another subject of this rulemaking, as "covered equipment." (42 U.S.C. 6311(1)(K))

Under EPCA, DOE's energy conservation program generally consists of four parts: (1) testing; (2) labeling; (3) energy conservation standards; and (4) certification and enforcement procedures. The testing requirements consist of test procedures that manufacturers of covered products and equipment must use as the basis for certifying to DOE that their products and equipment comply with the applicable energy conservation standards adopted under EPCA, and for making other representations about the efficiency of those products. (42 U.S.C. 6293(c); 42 U.S.C. 6295(s); 42 U.S.C. 6314) Similarly, DOE must use these test procedures to determine whether such products and certain equipment comply with any relevant standards promulgated under EPCA. (42 U.S.C. 6295(s); 42 U.S.C. 6314)

[1] For editorial reasons, upon codification in the U.S. Code, Part B was redesignated Part A.
[2] All references to EPCA in this document refer to the statute as amended through the Energy Efficiency Improvement Act of 2015 (EEIA 2015), Public Law 114–11 (April 30, 2015).
[3] For editorial reasons, upon codification in the U.S. Code, Part C was redesignated Part A–1.

EPCA contains what is known as an "anti-backsliding" provision, which prevents the Secretary from prescribing any amended standard that either increases the maximum allowable energy use or decreases the minimum required energy efficiency of a covered product. (42 U.S.C. 6295(o)(1); 6313(a)(6)(B)(iii)(I)) Also, the Secretary may not prescribe an amended or new standard if interested persons have established by a preponderance of the evidence that the standard is likely to result in the unavailability in the United States of any covered product type (or class) of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States. (42 U.S.C. 6295(o)(4); 6313(a)(6)(B)(iii)(II))

EPCA prescribed the energy conservation standards for consumer water heaters, shown in Table I.1 (42 U.S.C. 6295(e)(1)), and directed DOE to conduct further rulemakings to determine whether to amend these standards. (42 U.S.C. 6295(e)(4)(A)–(B)) DOE notes that under 42 U.S.C. 6295(m), the agency must periodically review its already established energy conservation standards for a covered product. Under this requirement, the next review that DOE would need to conduct must occur no later than six years from the issuance of a final rule establishing or amending a standard for a covered product. DOE also notes that the statutory energy conservation standards apply to both storage and instantaneous consumer water heaters regardless of volume capacity.

Table I.1 – EPCA Initial Energy Conservation Standards for Consumer Water Heaters

Product Class	Energy Factor
Gas Water Heater	0.62-(0.0019 x Rated Storage Volume in gallons)
Oil Water Heater	0.59-(0.0019 x Rated Storage Volume in gallons)
Electric Water Heater	0.95-(0.00132 x Rated Storage Volume in gallons)

The initial test procedures for water heaters were prescribed in a final rule published on October 4, 1977. 42 FR 54110. On October 17, 1990, DOE published a final rule which updated the test procedure from a no-draw test to a six-draw, 24-hour simulated-use test. 55 FR 42162. The effect of this change in test procedure was investigated on a sample of representative units and based on the results of testing on those units, DOE updated the energy conservation standard for electric water heaters to reflect the new test procedure. To account for the change in test procedure for electric water heaters, DOE amended the standard to 0.93-(0.00132 x Rated Storage Volume). Id. at 42177.

On April 16, 2010, DOE published a final rule (hereinafter referred to as the "April 2010 final rule") that amended the energy conservation standards for specified classes of consumer water heaters, and maintained the existing energy conservation standards for tabletop and electric instantaneous water heaters. 75 FR 20112. The standards adopted by the April 2010 final rule are shown below in Table I.2. These standards apply to all water heater product classes listed in Table I.2 and manufactured in, or imported into, the United States on or after April 16, 2015, for all classes except for tabletop and electric instantaneous. For these latter two classes, compliance with these standards has been required since April 15, 1991. 55 FR 42162 (Oct. 17, 1990). Current energy conservation standards for consumer water heaters can be found in DOE's regulations at 10 CFR 430.32(d).

Table I.2 – DOE Energy Conservation Standards for Consumer Water Heaters

Product Class	Rated Storage Volume***	Energy Factor**
Gas-fired Storage	≥20 gal and ≤55 gal	$0.675 – (0.0015 \times V_s)$
	>55 gal and ≤100 gal	$0.8012 – (0.00078 \times V_s)$
Oil-fired Storage	≤50 gal	$0.68 – (0.0019 \times V_s)$
Electric Storage	≥20 gal and ≤55 gal	$0.960 – (0.0003 \times V_s)$
	>55 gal and ≤120 gal	$2.057 – (0.00113 \times V_s)$

Tabletop*	≥20 gal and ≤120 gal	$0.93 – (0.00132 \times V_s)$
Gas-fired Instantaneous†	<2 gal	$0.82 – (0.0019 \times V_s)$
Electric Instantaneous*	<2 gal	$0.93 – (0.00132 \times V_s)$

*Tabletop and electric instantaneous water heater standards were not updated by the April 2010 final rule.
**V_s is the "Rated Storage Volume" (in gallons), as determined by 10 CFR 429.17.
*** Rated Storage Volume limitations result from either a lack of test procedure coverage or from divisions created by DOE when adopting standards. The division at 55 gallons for gas-fired and electric storage water heaters was established in the April 16, 2010 final rule amending energy conservation standards. 75 FR 20112. The other storage volume limitations shown in this table are a result of test procedure applicability and are discussed in the July 2014 final rule. 79 FR 40542 (July 11, 2014).
† The standard for gas-fired instantaneous water heaters applies only to gas-fired instantaneous water heaters with a rated input of greater than 50,000 Btu/h.

The initial Federal energy conservation standards and test procedures for commercial water heating equipment were added to EPCA as an amendment made by the Energy Policy Act of 1992 (EPACT). (42 U.S.C. 6313(a)(5)) These initial energy conservation standards corresponded to the efficiency levels contained in the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1 (ASHRAE Standard 90.1) in effect on October 24, 1992. The statute provided that if the efficiency levels in ASHRAE Standard 90.1 were amended after October 24, 1992, the Secretary must establish an amended uniform national standard at new minimum levels for each equipment type specified in ASHRAE Standard 90.1, unless DOE determines, through a rulemaking supported by clear and convincing evidence, that national standards more stringent than the new minimum levels would result in significant additional energy savings and be technologically feasible and economically justified. (42 U.S.C. 6313(a)(6)(A)(ii)(I)–(II)) The statute was subsequently amended to require DOE to review its standards for commercial water heaters (and other "ASHRAE equipment") every six years. (42 U.S.C. 6313(a)(6)(C)) On January 12, 2001, DOE published a final rule for commercial water heating equipment that amended energy conservation standards by adopting the levels in ASHRAE Standard 90.1-1999 for all types of commercial water heating equipment, except for electric storage water heaters. 66 FR 3336. For electric storage water heaters, the

standard in ASHRAE Standard 90.1-1999 was less stringent than the standard prescribed in EPCA and, consequently, would have increased energy consumption, so DOE maintained the standards for electric storage water heaters at the statutorily prescribed level. DOE published the most recent final rule for commercial water heating equipment standards on July 17, 2015, in which DOE adopted the thermal efficiency level for oil-fired storage water heaters that was included in ASHRAE 90.1-2013. 80 FR 42614. The current standards for commercial water heating equipment are presented in Table I.3.

Table I.3 - Energy Conservation Standards for Commercial Water Heating Equipment

Equipment Category	Size	Energy conservation standards*	
		Minimum thermal efficiency (equipment manufactured on and after October 9, 2015) **, †	Maximum standby loss (equipment manufactured on and after October 29, 2003)**,††
Electric storage water heaters	All	N/A	$0.30 + 27/V_m$ (%/h)
Gas-fired storage water heaters	≤155,000 Btu/h	80%	$Q/800 + 110(V_r)^{1/2}$ (Btu/h)
	>155,000 Btu/h	80%	$Q/800 + 110(V_r)^{1/2}$ (Btu/h)
Oil-fired storage water heaters	≤155,000 Btu/h	80%†	$Q/800 + 110(V_r)^{1/2}$ (Btu/h)
	>155,000 Btu/h	80%†	$Q/800 + 110(V_r)^{1/2}$ (Btu/h)
Electric instantaneous water heaters†††	<10 gal	80%	N/A
	≥10 gal	77%	$2.30 + 67/V_m$ (%/h)
Gas-fired instantaneous water heaters and hot water supply boilers	<10 gal	80%	N/A
	≥10 gal	80%	$Q/800 + 110(V_r)^{1/2}$ (Btu/h)
Oil-fired instantaneous water heater and hot water supply boilers	<10 gal	80%	N/A
	≥10 gal	78%	$Q/800 + 110(V_r)^{1/2}$ (Btu/h)
Equipment Category	**Size**	**Minimum thermal insulation**	
Unfired hot water storage tank	All	R-12.5	

* V_m is the measured storage volume, and V_r is the rated volume, both in gallons. Q is the nameplate input rate in Btu/h.

** For hot water supply boilers with a capacity of less than 10 gallons: (1) the standards are mandatory for units manufactured on and after October 21, 2005 and (2) units manufactured on or after October 23, 2003, but prior to October 21, 2005, must meet either the standards listed in this table or the applicable standards in Subpart E of 10 CFR 431 for a "commercial packaged boiler."

† For oil-fired storage water heaters: (1) the standards are mandatory for equipment manufactured on and after October 9, 2015, and (2) equipment manufactured prior to that date must meet a minimum thermal efficiency level of 78 percent.

†† Water heaters and hot water supply boilers having more than 140 gallons of storage capacity need not meet the standby loss requirement if: (1) the tank surface area is thermally insulated to R-12.5 or more, (2) a standing pilot light is not used, and (3) for gas-fired or oil-fired storage water heaters, they have a fire damper or fan-assisted combustion.

††† Energy conservation standards for electric instantaneous water heaters are included in EPCA. (42 U.S.C. 6313(a)(5)(D)-(E)) The compliance date for these energy conservation standards is January 1, 1994. In a NOPR for energy conservation standards for commercial water heating equipment published on May 31, 2016, DOE proposed to codify these standards for electric instantaneous water heaters in its regulations at 10 CFR 431.110. 81 FR 34440.

On December 18, 2012, the American Energy Manufacturing Technical Corrections Act (AEMTCA), Public Law 112–210, was signed into law. In relevant part, it amended EPCA to require that DOE publish a final rule establishing a uniform efficiency descriptor and accompanying test methods for consumer water heaters and certain commercial water heating equipment[4] within one year of the enactment of AEMTCA. (42 U.S.C. 6295(e)(5)(B)) AEMTCA requires that the final rule must replace the energy factor (EF), thermal efficiency (TE), and standby loss (SL) metrics with a uniform efficiency descriptor. (42 U.S.C. 6295(e)(5)(C)) On July 11, 2014, DOE published a final rule that fulfilled these requirements. 79 FR 40542 (July 2014 final rule). AEMTCA further requires that, beginning one year after the date of publication of DOE's final rule establishing the uniform descriptor (i.e., July 13, 2015), the efficiency standards for the consumer water heaters and residential-duty commercial water heaters identified in the July 2014 final rule must be denominated according to the uniform efficiency descriptor established in that final rule (42 U.S.C. 6295(e)(5)(D)), and that DOE must develop a mathematical conversion for converting the measurement of efficiency from the test procedures and metrics in effect at that time to the uniform efficiency descriptor. (42 U.S.C. 6295(e)(5)(E)(i)–(ii))

[4] The uniform efficiency descriptor and accompanying test procedure apply to commercial water heating equipment with residential applications defined in the test procedure final rule published July 11, 2014, as a "residential-duty commercial water heater." See 79 FR 40542, 40586.

EPCA provides that any covered water heater (i.e., under DOE's rulemaking, all consumer water heaters and residential-duty commercial water heaters) manufactured prior to the effective date of the UEF test procedure final rule (i.e., July 13, 2015) that complied with the efficiency standards and labeling requirements applicable at the time of manufacture will be considered to comply with the UEF test procedure final rule and with any revised labeling requirements established by the Federal Trade Commission (FTC) to carry out the UEF test procedure final rule. (42 U.S.C. 6295(e)(5)(K)) DOE's interpretation and application of this provision are discussed in detail in section III.E.

As noted previously, in the July 2014 final rule, DOE amended its test procedure for consumer and certain commercial water heaters. 79 FR 40542. The July 2014 final rule for consumer and certain commercial water heaters satisfied the AEMTCA requirements to develop a uniform efficiency descriptor to replace the EF, TE, and SL metrics. The amended test procedure includes provisions for determining the uniform energy factor (UEF), as well as the annual energy consumption of these products. Furthermore, the uniform descriptor test procedure can be applied to: (1) consumer water heaters (including certain consumer water heaters that are covered products under EPCA's definition of "water heater" at 42 U.S.C. 6291(27), but that were not addressed by the previous test method); and (2) commercial water heaters that have residential applications. The major modifications to the EF test procedure to establish the uniform descriptor test method included the use of multiple draw patterns and different draw patterns, and changes to the set-point temperature. In addition, DOE expanded the scope of the test method to include all storage volumes, specifically by including test procedure provisions that are applicable to water heaters with storage volumes between 2 gallons (7.6 L) and 20

gallons (76 L), and to clarify applicability to electric instantaneous water heaters. DOE also established a new definition for “residential-duty commercial water heater” and re-categorized certain commercial water heaters into this class.

The Energy Efficiency Improvement Act of 2015 (EEIA 2015) (Pub. L. 114-11) was enacted on April 30, 2015. Among other things, EEIA 2015 added a definition of “grid-enabled water heater” to EPCA's energy conservation standards for consumer water heaters. (42 U.S.C. 6295(e)(6)(A)(ii)) These products are intended for use as part of an electric thermal storage or demand response program. One of the criteria in EPCA that defines a "grid-enabled water heater" is the requirement that it meet a certain energy factor (specified by a formula set forth in the statute), or an equivalent alternative standard that DOE may prescribe. Id. On August 11, 2015, DOE published a final rule in the Federal Register to implement the changes to EPCA by placing the energy conservation standards and related definitions in the Code of Federal Regulations (CFR). 80 FR 48004. As the energy conservation standard for grid-enabled water heaters is in terms of energy factor, DOE is addressing these products in this notice to adopt a mathematical conversion to express the energy conservation standard in terms of UEF.

On September 15, 2016, the Federal Trade Commission (FTC) published a final rule (“FTC 2016 Final Rule”) updating the EnergyGuide label to reflect changes to the DOE test procedure. The effective date of the FTC 2016 Final Rule is June 12, 2017. 81 FR 63634.

This final rule satisfies the requirements of AEMTCA to develop a mathematical conversion factor for converting the EF, TE, and SL metrics to the UEF metric. (42 U.S.C. 6295(e)(5)(E)) DOE published a notice of proposed rulemaking on April 14, 2015 and a supplemental notice of proposed rulemaking on August 30, 2016, which included proposed

mathematical conversion factors and the proposed energy conservation standards expressed in terms of the UEF metric. 80 FR 20116 and 81 FR 59736.

II. Summary of the Final Rule

In this final rule, DOE establishes a mathematical conversion factor between the values determined using the EF, TE, and SL test procedures (including the first-hour rating or maximum gallons per minute (GPM) rating, as applicable), and the values that would be determined using the uniform efficiency descriptor test procedure established in the July 2014 final rule (i.e., UEF and first-hour rating or maximum GPM rating).

The mathematical conversion factor required by AEMTCA is a bridge between the efficiency and delivery capacity values obtained through testing under the EF, TE, and SL test procedures and those obtained under the uniform efficiency descriptor test procedure published in the July 2014 final rule. DOE conducted a series of tests on the classes of water heaters included within the scope of this rulemaking (see section III.B for details on the scope) and relied upon that test data and test data submitted by interested parties, along with the approaches summarized in section III.C, to calculate the conversion factors established in this final rule. Subsequently, DOE used the conversion factors to derive minimum energy conservation standards in terms of UEF, as shown in Table II.1 and Table II.2. The standards denominated in UEF are neither more nor less stringent than the EF-denominated standards for consumer water heaters and for commercial water-heating equipment based on the thermal efficiency and standby loss metrics.

Table II.1. Consumer Water Heater Energy Conservation Standards Denominated in UEF

Product Class	Rated Storage Volume and Input Rating (if Applicable)	Draw Pattern	Uniform Energy Factor
Gas-fired Storage Water Heater	≥ 20 gal and ≤ 55 gal	Very Small	0.3456 - (0.0020 x V_r)
		Low	0.5982 - (0.0019 x V_r)
		Medium	0.6483 - (0.0017 x V_r)
		High	0.6920 - (0.0013 x V_r)
	> 55 gal and ≤ 100 gal	Very Small	0.6470 - (0.0006 x V_r)
		Low	0.7689 - (0.0005 x V_r)
		Medium	0.7897 - (0.0004 x V_r)
		High	0.8072 - (0.0003 x V_r)
Oil-fired Storage Water Heater	≤ 50 gal	Very Small	0.2509 - (0.0012 x V_r)
		Low	0.5330 - (0.0016 x V_r)
		Medium	0.6078 - (0.0016 x V_r)
		High	0.6815 - (0.0014 x V_r)
Electric Storage Water Heaters	≥ 20 gal and ≤ 55 gal	Very Small	0.8808 - (0.0008 x V_r)
		Low	0.9254 - (0.0003 x V_r)
		Medium	0.9307 - (0.0002 x V_r)
		High	0.9349 - (0.0001 x V_r)
	> 55 gal and ≤ 120 gal	Very Small	1.9236 - (0.0011 x V_r)
		Low	2.0440 - (0.0011 x V_r)
		Medium	2.1171 - (0.0011 x V_r)
		High	2.2418 - (0.0011 x V_r)
Tabletop Water Heater	≥20 gal and ≤ 120 gal	Very Small	0.6323 - (0.0058 x V_r)
		Low	0.9188 - (0.0031 x V_r)
		Medium	0.9577 - (0.0023 x V_r)
		High	0.9884 - (0.0016 x V_r)
Instantaneous Gas-fired Water Heater**	< 2 gal and >50,000 Btu/h	Very Small	0.80
		Low	0.81
		Medium	0.81
		High	0.81
Instantaneous Electric Water Heater**	< 2 gal	Very Small	0.91
		Low	0.91
		Medium	0.91
		High	0.92
Grid-Enabled Water Heater	>75 gal	Very Small	1.0136 - (0.0028 x V_r)
		Low	0.9984 - (0.0014 x V_r)
		Medium	0.9853 - (0.0010 x V_r)
		High	0.9720 - (0.0007 x V_r)

*V_r is the "Rated Storage Volume" (in gallons), as determined by 10 CFR 429.17.

** For instantaneous water heaters the standard is represented as a single value rather than as a function of storage volume. Because the UEF standard only applies to models with less than 2 gallons of storage volume, the coefficient becomes zero, and the standard does not vary for models between 0 and 2 gallons.

Table II.2. Residential-Duty Commercial Water Heater Energy Conservation Standards Denominated in UEF

Product Class	Draw Pattern	Uniform Energy Factor
Gas-fired Storage	Very Small	$0.2674 - (0.0009 \times V_r)$
	Low	$0.5362 - (0.0012 \times V_r)$
	Medium	$0.6002 - (0.0011 \times V_r)$
	High	$0.6597 - (0.0009 \times V_r)$
Oil-fired Storage	Very Small	$0.2932 - (0.0015 \times V_r)$
	Low	$0.5596 - (0.0018 \times V_r)$
	Medium	$0.6194 - (0.0016 \times V_r)$
	High	$0.6740 - (0.0013 \times V_r)$
Electric Instantaneous**	Very Small	0.80
	Low	0.80
	Medium	0.80
	High	0.80

*V_r is the "Rated Storage Volume" (in gallons), as determined by 10 CFR 429.44.
** For instantaneous water heaters the standard is represented as a single value rather than as a function of storage volume. Because the UEF standard only applies to models with less than 2 gallons of storage volume, the coefficient becomes zero, and the standard does not vary for models between 0 and 2 gallons.

The conversion factor formulas may be used for making representations regarding energy efficiency or energy use until **[INSERT DATE 365 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**. After that, all representations regarding energy efficiency or energy use must be based on testing (either directly or through the application of an AEDM, where permitted). In addition, EPCA requires that a water heater be considered to comply with the July 2014 final rule on and after July 13, 2015 (the effective date of the July 2014 final rule) and with any revised labeling requirements established by the FTC to carry out the July 2014 final rule if that water heater basic model was manufactured prior to July 13, 2015, and complied with the applicable efficiency standards and labeling requirements in effect prior to July 13, 2015. (See 42 U.S.C. 6295(e)(5)(K)) Sections III.E and 0 explain that DOE intends to address various issues related to the transition from the metrics in effect prior to July 13, 2015, through the use of enforcement policies.

III. Discussion

A. Purpose

As discussed in section I, this rulemaking establishes mathematical conversion factors that satisfy requirements added to EPCA by AEMTCA. (42 U.S.C. 6295(e)(5)) EPCA requires DOE to establish a uniform efficiency descriptor for consumer water heaters and commercial water heaters, and to establish a mathematical conversion factor to translate from the EF, TE, and SL descriptors to the uniform efficiency descriptor established by DOE. Id. In the July 2014 test procedure final rule, DOE established UEF as the uniform efficiency descriptor, and adopted a test method for measuring UEF for consumer and certain commercial water heaters. 79 FR 40542 (July 11, 2014). This final rule addresses the mathematical conversion factor required by EPCA (see 42 U.S.C. 6295(e)(5)(E)) and the requirement that the efficiency standard be denominated according to the uniform efficiency descriptor (i.e., UEF) (see 42 U.S.C. 6295(e)(5)(D)(i)).

As discussed in the August 2016 SNOPR, DOE reviewed the test results used to develop the mathematical conversion factors, and found that different water heaters are impacted in different ways by the new test method and metric, depending on the specific design and characteristics of the water heater. 81 FR 59736, 59741-59742 (August 30, 2016). Water heaters have numerous attributes that impact energy efficiency and performance, and the changes to the test method and metrics impact each water heater model differently, often in ways that are difficult to predict. For example, two electric water heaters with the same rated storage volume, input rating, first-hour rating, and energy factor rating (all represented values published under the EF test method as indicators of water heater performance) were shown by testing to have

different measured first-hour ratings and uniform energy factors when tested under the new test procedure.

Given the number of models currently available in the market (756 unique models at the time of the analysis performed for the August 2016 SNOPR), it would not be practical to analyze each model individually to determine the change in represented values under the new test procedure. Rather, DOE analyzed a subset of models that are representative of the market as a whole. This approach is consistent with the statutory mandate, which instructs DOE to develop "a mathematical conversion factor." (42 U.S.C. 6295(e)(5)(E)) In DOE's view, the phrase "mathematical conversion factor" does not require DOE to generate a single number applicable to all water heaters. Rather, DOE believes that, despite the use of the word "factor," in the singular, the statute permits the use of a conversion equation involving several numbers and mathematical operations besides multiplication. Still, the phrasing suggests that DOE should develop a formula that is broadly applicable, rather than generate a table of equivalencies stating the exact UEF equivalent for every individual product on the market.

Because each water heater is impacted differently, it would be impossible to develop a single equation, or reasonable set of equations, that could be used to model the energy performance of every water heater exactly under the new test method. Therefore, DOE interprets the statutory mandate for a "mathematical conversion factor" to call for an equation that will be able to reasonably predict a water heater's energy efficiency under the UEF test method based on values measured under the EF, TE, or SL test methods for that model.

Any mathematical conversion of that type will have some amount of residual difference between predicted and measured values that is inherent when applying a mathematical equation

(or multiple equations for different types of water heaters) to predict the energy efficiency performance or delivery capacity of a large set of models. In this rule, DOE sought to reduce the amount of difference between predicted and actual performance in several ways. DOE incorporated as much test data as was practical and available, and which represented models currently on the market. DOE considered several attributes that could have a large impact on the test results under both the new and old metrics, and included those as appropriate when developing the mathematical conversion, which led to a set of equations for water heaters with certain different characteristics (e.g., different fuel types, different nitrogen oxide (NO_X) emissions levels). DOE also explored several options for developing the mathematical conversion equations (see section III.C for a summary of the approaches considered). In addition, DOE sought feedback from interested parties and incorporated suggestions for improving the mathematical conversions when those suggestions resulted in conversion equations that were better predictors of actual measured performance.

As noted previously, this final rule also addresses the requirement that the efficiency standard be denominated in terms of UEF and establishes energy conservation standard levels using the UEF metric. (42 U.S.C. 6295(e)(5)(D)(i)) As discussed in section I, DOE may not adopt a standard that reduces the stringency of the existing standards, due to EPCA's "anti-backsliding" provisions. (42 U.S.C. 6295(o)(1); 6313(a)(6)(B)(iii)(I)) Further, EPCA requires that the mathematical conversion factor not affect the minimum efficiency requirements. (42 U.S.C 6295(e)(5)(E)(iii)).

The methodology used for translating the standards ensures equivalent stringency between the existing standards (using EF, TE, and SL metrics) and the converted standards

(using UEF). Due to differences in water heater performance under the different test methods discussed in the preceding paragraphs, some models will perform better, and others worse, under the new test method than they did under the previous test method. In principle, a model that was just above the standard level using the old metrics might come out just below the converted standard using the conversion factor, and in principle, one could regard that result as a change in the standard applicable to that particular model. However, such outcomes are unavoidable possibilities if DOE is to prescribe a single equation to convert efficiency measurements across a product class. As noted above, given the complex ways in which detailed design characteristics can affect measurements using both the existing protocols and the UEF test procedure, specifying EF, TE, and SL for a product does not predict UEF for the product with absolute precision. Given that reality, DOE interprets section 325 of EPCA as a whole, including the anti-backsliding provision and the mandate to develop a conversion factor, to permit outcomes in which conversion might shift some products from above to below the standard (and some from below to above)—since this is the natural and foreseeable consequence of using a conversion factor. Because the statute calls for a conversion factor, DOE understands the "standard," in this context, to refer to the efficiency level required on average over a product class. Thus, DOE's goal in developing the conversion factor is to ensure that, on average over a product class, the standard denominated in UEF corresponds to the same maximum energy use and minimum efficiency as the standard denominated in EF, TE, and SL.

B. Scope

This section describes DOE's process for categorizing water heaters and establishing the range of units subject to this mathematical conversion factor final rule. DOE initially outlined

the scope of this rulemaking in the April 2015 NOPR. 80 FR 20116, 20122-20124 (April 14, 2015).

1. Storage Volume and Input Capacity Limitations

In the NOPR, DOE stated that it was not including water heaters that were not previously subject to the test procedures or standards for energy factor established in the Code of Federal Regulations in the scope of the conversion factor. Id. In the August 2016 SNOPR, DOE proposed to make clear its interpretation that the initial consumer water heater standards in EPCA[5] are applicable to the consumer water heaters listed in Table III.1 and, accordingly, proposed mathematical conversion factors for these water heaters in the August 2016 SNOPR. 81 FR 59736, 59743 (August 30, 2016).

Table III.1 - Consumer Water Heaters Not Covered In the NOPR by the Mathematical Conversion Factor

Product Class	**Description of criteria for exclusion from conversion rulemaking**
Gas-fired Storage	Rated Storage Volume ≥2 gal and <20 gal or >100 gal
Oil-fired Storage	Rated Storage Volume >50 gal
Electric Storage	Rated Storage Volume ≥2 gal and <20 gal or >120 gal
Tabletop	Rated Storage Volume ≥2 gal and <20 gal or > 120 gal
Gas-fired Instantaneous	Rated Input ≤50,000 Btu/h; Rated Storage Volume ≥2 gal
Electric Instantaneous	Rated Storage Volume ≥2 gal
Oil-fired Instantaneous	All

[5] The initial energy factor energy conservation standards for consumer water heaters established in EPCA are found at 42 U.S.C. 6295(e)(1), and require that the energy factor be not less than the following for products manufactured on or after January 1, 1990:

Gas Water Heater …..... 0.62 - (0.0019 × Rated Storage Volume in gallons)
Oil Water Heater …….. 0.59 - (0.0019 × Rated Storage Volume in gallons)
Electric Water Heater … 0.95 - (0.00132 × Rated Storage Volume in gallons)

In the August 2016 SNOPR, DOE noted that the definitions for consumer water heaters added to EPCA under the National Appliance Energy Conservation Act of 1987 (NAECA; Pub. L. No. 100-12 (March 17, 1987)) do not place any limitation on the storage volume of consumer water heaters and do not place a minimum fuel input rate on gas-fired instantaneous water heaters. (42 U.S.C. 6291(27)) Thus, DOE proposed to make clear its interpretation that the initial standards for water heaters added to EPCA cover all consumer water heaters meeting the definition of "water heater" at 42 U.S.C. 6291(27), regardless of the storage volume and without a lower limit on the fuel input rating for gas-fired instantaneous water heaters. 81 FR 59736, 59743 (August 30, 2016).

The Air-Conditioning, Heating, & Refrigeration Institute (AHRI), Bradford White Corporation (Bradford White), A. O. Smith Corporation (A. O. Smith), and Rheem Manufacturing Company (Rheem) submitted comments opposed to the inclusion of the proposed clarification in the August 2016 SNOPR. Those comments were focused primarily on the application of standards to consumer water heaters with storage tanks of more than 2 gallons (7.6 L) and less than 20 gallons (76 L), with commenters stating that the application of standards to these consumer water heaters would be inconsistent with DOE's historical treatment of such water heaters. (AHRI, No. 27 at p. 7; Bradford White, No. 26 at p. 2; A. O. Smith, No. 28 at p. 1; Rheem No. 32 at p. 2.) AHRI asserted that NAECA codified limitations on the applicability of standards for consumer water heaters consistent with the then-current DOE test procedure, including the exclusion of storage-type residential water heaters less than 20 gallons and greater than 120 gallons. (AHRI, No. 27 at pp. 7-8) Rheem stated that the test procedures for consumer water heaters specifically exempted water heaters with storage tanks of more than 2 gallons (7.6

L) and less than 20 gallons (76 L) from being covered prior to the UEF test procedure that was finalized in July 2014 final rule for consumer and certain commercial water heaters. (Rheem, No. 32 at p. 2) Rheem added that the August 2016 SNOPR was a departure from the April 2015 NOPR, which stated that DOE's current consumer water heater test procedures and energy conservation standards are not applicable to gas or electric water heaters with storage tanks that are at or above 2 gallons (7.6 L) and less than 20 gallons (76 L). (Rheem, No. 32 at p. 3) AHRI stated that it understood DOE to be applying standards to these products based on the 1990 final rule that adopted standards established in EPCA under the NAECA amendments (55 FR 42162 (Oct. 17, 1990)) and that application of standards to the specified products as proposed in the SNOPR would be contrary to EPCA. (AHRI, No. 27 at p. 8) Bradford White stated that it does not support using only input capacity to distinguish between consumer and commercial water heaters, and expressed concern that under the proposed clarification, water heaters that are currently marketed as commercial products will have to be eliminated unless they are able to meet the new UEF established for the consumer water heaters. (Bradford White, No. 26 at p. 2)

AHRI also asserted that it is contrary to administrative law and unfair to include a proposal to apply the standards to these products (i.e., consumer gas-fired storage water heaters with a rated storage volume greater than 100[6] gallons and consumer electric storage water heaters with a rated storage volume greater than 2 gallons and less than 20 gallons) at the "11th hour." (AHRI, No. 27 at p. 9) AHRI stated that given the thirty-day comment period and DOE's prior statements on this issue, manufacturers did not foresee the need to spend time or resources to conduct testing and analysis on this particular class of products, but instead, the industry

[6] AHRI's comment stated 120 gallons; however, the upper limit on storage volume for the energy conservation standards found in 10 CFR 430.32(d) for consumer gas-fired storage water heaters is 100 gallons.

devoted its limited time and available resources to testing the many products which DOE initially identified. (AHRI, No. 27 at p. 9) Rheem stated that based on past practice and DOE's statements in the NOPR, it did not anticipate the current rulemaking addressing the UEF for the specified consumer water heaters, and as a result, the commenter urged DOE to address this matter in a separate rulemaking. (Rheem No. 32 at pp. 2-4) A. O. Smith also questioned whether the clarification in the August 2016 SNOPR may violate the letter if not the spirit of the Administrative Procedures Act (APA). A. O. Smith viewed the August 2016 test procedure SNOPR to represent a change of position, which has placed manufacturers in the position of having to respond within thirty days to new efficiency standards without knowing if they can meet the standards. (A. O. Smith No. 28, pp. 2-3)

DOE acknowledges that it has not previously implemented the standards established by NAECA with respect to gas or electric water heaters with storage tanks between 2 and 20 gallons in capacity or other water heaters listed in Table III.1. However, after careful consideration of both the statutory provisions and the comments received, DOE is reaffirming its interpretation in the August 2016 SNOPR that the standards established in EPCA are applicable to the water heaters listed in Table III.1. As such, the standards initially established by Congress in EPCA are applicable to consumer water heaters identified in the August 2016 SNOPR, including those with storage tanks that are at or above 2 gallons (7.6 L) and less than 20 gallons (76 L). As explained in the following paragraphs, this interpretation is based on the plain language of EPCA that establishes definitions for consumer water heaters and the scope of the statutorily-prescribed standards for consumer water heaters, and a review of the legislative history reveals no congressional intent to the contrary. Nonetheless, as discussed in more detail below, DOE will

not enforce those standards until such time as conversion factors and converted standards are adopted, which DOE is declining to do in this final rule.

EPCA, through the amendments made by NAECA, defines "water heater" for the purpose of delineating which consumer products are subject to energy conservation standards. (42 U.S.C. 6291(27); see also 101 Stat. 103, 104-105) The statutory definition specifies input ratings at or below which water heaters are to be classified as consumer water heaters (e.g., 75,000 Btu/h for gas-fired storage water heaters; 12 kW for electric storage water heaters and electric instantaneous water heaters; 210,000 Btu/h for oil-fired instantaneous water heaters). The statutory definition of "water heater" does not provide for any limitation based on storage volume. (42 U.S.C. 6291(27)) The NAECA amendments also established standards for gas-fired consumer water heaters, oil-fired consumer water heaters, and electric consumer water heaters, once again without any limitation in terms of storage volume. (42 U.S.C. 6295(e)(1); see also 101 Stat. 103, 110)

AHRI argued that the NAECA amendments imposing standards for water heaters do not apply to water heaters smaller than 20 gallons because DOE had no test procedures for such products when NAECA was enacted. According to AHRI, NAECA "codified" DOE's existing test procedures "into law," and the NAECA standards were "based on the pre-existing EF test procedure." DOE does not agree with AHRI's argument that Congress intended its statutory standards to be somehow constrained by DOE's existing test procedure applicability. DOE had, and retains, the discretion to change the test procedures. The provision that AHRI cited as "codif[ying]" DOE's test procedures—which DOE takes to mean adopting them as statute, and thus restricting DOE's authority to alter them—did no such thing. AHRI referred to 42 U.S.C.

6293(a); but, as amended by NAECA, that provision simply says that "[a]ll test procedures and related determinations . . . which are in effect on the date of enactment of [NAECA] shall remain in effect until the Secretary amends such test procedures and related determinations." The point of this provision was to avoid, in a statute that substantially revised the substance of DOE's authority to develop test procedures, any suggestion that the changes would invalidate pre-existing test procedures. The text of the sentence itself makes clear that it did not freeze the test procedures into statute; they remained in effect only until the Secretary "amends such test procedures."

The NAECA amendments also do not support AHRI's contention that the section 6295(e)(1) standards were based specifically on the existing test procedure. The statute does not explicitly say the standards depended solely on that version of the test procedure. AHRI seems to rely on the facts that section 6295(e)(1) prescribed minimum values of "energy factor" and that the NAECA amendments defined "efficiency descriptor," which for water heaters was to be expressed as energy factor, as the ratio of output and input "determined using the test procedures prescribed under section 323." The argument appears to be that, for water heaters, "the test procedures prescribed under section 323" meant the test procedures as they existed when NAECA was enacted. Thus, AHRI infers, the water heater standards in section 6295(e)(1) were minimums for energy factor as the extant test procedures determined that value. However, DOE believes it is sounder to read the definition of "efficiency descriptor" as referring to DOE's test procedures as they change over time. Section 323 authorized DOE to amend or revise test procedures in appropriate circumstances. It would be odd and counterproductive if the concept of "efficiency descriptor" excluded such updates.

Fundamentally, if Congress had intended the section 6295(e)(1) standards to apply only to products for which DOE had already developed test procedures, it could easily have said so. Instead, the statute defined "water heaters" without a minimum storage capacity; it prescribed standards without mention of any minimum; and it invoked a metric, energy factor, that was to be measured using test procedures that the statute authorized DOE to revise. DOE concludes, therefore, that the section 6295(e)(1) were to apply to the full scope of "water heaters" as soon as DOE issued test procedures reaching that scope. Based upon changes in the market and the availability of additional data, DOE determined in the July 2014 test procedure final rule (79 FR 40542, 40545-40549 (July 11, 2014)) that it was appropriate to expand the applicability of the water heaters test procedure and thereby embrace the full scope of the authority provided by Congress. (42 U.S.C. 6295(e)(1); see also 101 Stat. 103, 110).

Based on the foregoing discussion, DOE is reaffirming its interpretation in the August 2016 SNOPR that the statutory standards apply to the water heaters listed in Table III.1, including those with storage volumes between 2 and 20 gallons. DOE acknowledges that its long delay in issuing test procedures for such products as well as statements it has made in the past may have caused confusion about this issue. Coming into compliance with the statutory standards immediately would be quite burdensome for industry.

DOE also received voluminous comments regarding the technical merits of the conversion factors and of the converted standards expressed in UEF for the water heaters listed in Table III.1, for which DOE is going to defer finalizing and implementing these statutory standards and further consider the comments. Since DOE is declining to adopt mathematical conversion factors and converted standards in UEF in this final rule for the water heaters listed in

Table III.1, DOE will not enforce the statutory standards applicable to the consumer water heaters listed in Table III.1 until some point after DOE finalizes the conversion factor and the converted standards applicable to those products. In doing so, DOE will work with industry on making this transition.

2. Water Temperature Limitations

A. O. Smith expressed concern with DOE's position (adopted in the November 2016 commercial water heater test procedure final rule; see 81 FR 79261, 79286 (Nov. 10, 2016)) that electric water heaters with inputs of 12 kW or less are consumer water heaters, regardless of the outlet water temperature delivered. A. O. Smith argued that the 180 °F delineation serves an important function in the marketplace to distinguish between consumer and commercial water heaters. (A. O. Smith, No. 28 at p. 2)

As explained in further detail in the November 10, 2016 commercial water heater test procedure final rule, DOE relies on the temperature threshold when determining how to distinguish a commercial water heater that may be used to serve residential applications (i.e., a "residential-duty commercial water heater") and commercial water heaters generally. 81 FR 79261, 79286. Outlet water temperature is one of several dividing criteria between those types of commercial models. 79 FR 40542, 40546 (July 11, 2014). However, DOE has interpreted the statute to distinguish between water heaters that are commercial equipment under EPCA and those that are consumer products on the basis of the rated input, not the delivery temperature. The November 2016 final rule explained DOE's interpretation on this point, and DOE is not revisiting the issue in this final rule. The application of the conversion factor to residential-duty commercial water heaters is discussed section III.B.4. If manufacturers of water heaters have

additional inquiries they should contact Ashley Armstrong directly using the contact information in the **ADDRESSES** section of this notice.

3. Grid-enabled Water Heaters

As noted in section I, EPCA was recently amended to define and set efficiency requirements for grid-enabled water heaters in terms of EF (see 42 U.S.C. 6295(e)(6)). EPCA provides that the conversion factor may exclude certain covered water heaters from the uniform efficiency descriptor if the Secretary determines that the category of water heaters does not have a residential use and can be clearly described in the final rule, and that the category of water heaters are effectively rated using the thermal efficiency and standby loss descriptors. (42 U.S.C. 6295(e)(5)(F). Grid-enabled water heaters do have residential uses and are not rated using thermal efficiency or standby loss, and thus, do not meet the criteria for exclusion from the UEF metric. As a result, DOE has developed a conversion factor in this final rule to express the standard for these products in terms of UEF. Comments related to the conversion factor and converted UEF standards for grid-enabled water heaters are discussed in sections 0 and section III.D.3.

4. Residential-duty Commercial Water Heaters

DOE notes that only commercial water heaters meeting the definition of "residential-duty commercial water heater" are subject to the uniform efficiency descriptor test method, while all other commercial water heaters are not. EPCA allows DOE to provide an exclusion from the uniform efficiency descriptor for specific categories of otherwise covered water heaters that do not have residential uses, that can be clearly described, and that are effectively rated using the

current thermal efficiency and standby loss descriptors. (42 U.S.C. 6295(e)(5)(F)) In the July 2014 test procedure final rule, DOE determined that covered commercial water heating equipment that did not meet the definition of a "residential-duty commercial water heater" met the criteria in EPCA for exclusion from the uniform efficiency descriptor. 79 FR 40542, 40545-40547 (July 11, 2014). As a result, this final rule only addresses commercial water heaters that meet the definition of "residential-duty commercial water heater." This definition was recently updated in the November 10, 2016 commercial water heater test procedure final rule to remove residential-duty classes where definitional criteria preclude the classification of any products as residential-duty commercial water heaters within that class.[7] 81 FR 79261, 79321-79322. The definition of "residential-duty commercial water heater" adopted in that final rule includes any gas-fired storage, oil-fired storage, or electric instantaneous commercial water heater that meets the following conditions:

(1) For models requiring electricity, uses single-phase external power supply;

(2) Is not designed to provide outlet hot water at temperatures greater than 180 °F; and

(3) Does not meet any of the criteria regarding rated input and storage volume presented in Table III.2.

Table III.2 - Capacity Limitations for Defining Commercial Water Heaters Without Residential Applications (i.e., Non-Residential-Duty)

Water Heater Type	Indicator of non-residential application

[7] For example, DOE has interpreted EPCA to include as consumer products electric storage water heaters as having an input of ≤ 12 kW. (42 U.S.C. 6291(27)) The previous definition of a residential-duty water heater excluded any electric storage water heater with an input of > 12 kW from being residential-duty. Thus, because all electric storage water heaters > 12 kW are not residential-duty, but all electric storage water heaters ≤ 12 kW are consumer water heaters, there could not have been a residential-duty commercial electric storage water heater. The changes adopted in the commercial water heater test procedure final rule amended the definition to remove mention of electric storage water heaters, along with several other types of water heaters, to prevent confusion.

Gas-fired Storage	Rated input >105 kBtu/h; Rated storage volume >120 gal
Oil-fired Storage	Rated input >140 kBtu/h; Rated storage volume >120 gal
Electric Instantaneous	Rated input >58.6 kW; Rated storage volume >2 gal

This final rule establishes mathematical conversion factors for gas-fired storage, oil-fired storage, and electric instantaneous residential-duty commercial water heaters. DOE also uses the conversion factors to express the energy conservation standards for these classes of equipment in the UEF metric.

C. Approaches for Developing Conversions

To develop the conversions between the prior metrics (first-hour rating, maximum GPM, energy factor, thermal efficiency, standby loss) and the new metrics (first-hour rating, maximum GPM, uniform energy factor), DOE considered three different approaches. The first, termed "analytical methods," uses equations based on the fundamental physics of water heater operation to predict how changes in test parameters lead to changes in the performance metrics. The second, termed "empirical regression," is a purely data-driven approach that uses experimental data and regressions to develop equations that relate the prior metrics to the new ones. The third approach, termed "hybrid," uses a regression on the result of an analytical method to account for changes in the test procedure not captured by the analytical method.

1. Analytical Methods Approach

The analytical methods approach relies on basic equations of heat transfer and thermodynamics, as well as established understanding of the behavior of water heaters, to calculate the metric based on a set of known parameters for the water heater, environment, and test pattern. Such an approach typically yields an equation or set of equations that can be solved

to ultimately yield the metric of interest, either an efficiency or delivery capacity. An attempt is then made to modify the equations for the metrics to yield an equation that expresses the new metrics in terms of the old metrics and other known quantities. Analytical methods have the advantage of capturing known effects on performance without conducting a series of experiments. Additionally, a properly formulated relationship would be expected to be applicable to all water heaters on the market. Analytical approaches do have some drawbacks, however. Most notably, these methods only account for factors that are known to impact performance and that can be readily modeled analytically. There may be other unknown phenomena that affect performance that may not be taken into account in the known models. Second, application of these models often require assumptions about conditions. For example, one may need to assume a particular temperature of the water in the water heater despite the fact that it is known that there is variation in that temperature. Lastly, while an analytical model reduces the amount of tests needed to generate a conversion equation, a thorough set of experiments is still necessary to validate the model. Because it is based on fundamental physics, though, an analytical model can typically be extended with more confidence to a water heater that has not been tested than would a model based purely on experimental data.

DOE developed conversion equations based on analytical methods for the maximum GPM test (from the maximum GPM under the prior method to the current method) and simulated-use tests (i.e., from EF to UEF) for all water heaters covered in this rule. DOE created the UEF_{WHAM} parameter for consumer water heaters and the UEF_{rd} parameter for residential-duty commercial water heaters, which represent the converted UEF value for storage water heaters using the Water Heater Analysis Model (WHAM) as a basis for the conversions, along with

several simplifying assumptions. Specifically, DOE assumed that the standby heat loss coefficient (UA) and recovery efficiency are the same for the EF and UEF test procedure, and that the nominal outlet water temperature is a representative approximation of the mean temperature of water within the tank. For consumer and residential-duty commercial instantaneous water heaters, DOE derived an analytical method for the conversion through testing experience and commenter feedback. DOE created the UEF_{model} and $UEF_{model,rd}$ parameters, which represent the converted UEF value for instantaneous water heaters using the analytical methods derived by DOE. DOE presented an in-depth derivation of the analytical methods in the August 2016 SNOPR. 81 FR 59736, 59744-59752 (August 30, 2016).

For the consumer storage uniform energy factor analytical conversion, Bradford White commented that the DOE finding that average delivered temperature versus mean tank temperature is higher for electric than gas-fired storage water heaters is inconsistent with their testing experience and does not fundamentally make sense due to water temperature stacking in gas-fired storage water heaters. (Bradford White, No. 26 at p. 2) Although DOE acknowledges that there is apparently a difference between the testing results observed by Bradford White and those observed by DOE, as the August 2016 SNOPR explained after discussing several potential assumptions about mean tank temperatures, the analytical model that best predicts UEF tested values uses the assumption that the mean tank temperature and delivered temperature were the same, regardless of fuel type. 81 FR 59736, 59747 (August 30, 2016). As a result, DOE did not change its assumptions related to the mean tank temperature and delivered water temperature based on either DOE's data or Bradford White's data, as such changes do not appear as though they would improve the accuracy of the conversion equation. Bradford White also commented

that it does not agree that the UA and recovery efficiency will not change with the change in test procedure. (Bradford White, No. 26 at p. 2) DOE agrees that UA and recovery efficiency are different when testing to the EF test procedure than when testing to UEF test procedures, and so stated in the August 2016 SNOPR in addressing similar comments at that stage. 81 FR 59736, 59747 (August 30, 2016). DOE also stated that the analytical model that best predicts UEF test results uses the assumption that UA and recovery efficiency did not change with a change in test procedure. Id. Bradford White did not provide any data as would cause DOE to alter the tentative conclusion it reached in the August 2016 SNOPR. Accordingly, for this final rule, DOE has decided to continue to use the assumption that UA and recovery efficiency are the same in both the EF and UEF test procedures, as it provides the best prediction of the measured UEF. DOE recognizes that this assumption is a simplification of the realities of how water heaters operate under the old and new test procedures. The use of simplifying assumptions is appropriate in the development of an analytical model. The model is not intended to capture every aspect of the physical behavior of water and heat in these products down to the last detail. Rather, it is meant to provide a physically meaningful description that reflects the most significant features of water-heater physics and engineering so as to enable DOE to develop a mathematically-tractable conversion formula. To serve that purpose, DOE considers it appropriate to make simplifying assumptions like those regarding UA and recovery efficiency where, as discussed above, doing so improves rather than decreases the predictive accuracy of the model.

Although, as noted above, DOE developed a conversion based on analytical methods for converting the EF to UEF for all types of water heaters, as proposed in the August 2016 SNOPR.

For the reasons explained in the SNOPR, DOE is choosing in this rule to use the analytical method approaches only for: (1) the conversion of maximum GPM under the prior test method to maximum GPM under the current test method for consumer instantaneous water heaters; and (2) the conversion of thermal efficiency and standby loss to UEF for electric instantaneous residential-duty commercial water heaters. 81 FR 59736, 59774 and 59778 (August 30, 2016). For the maximum GPM conversion for consumer instantaneous water heaters, DOE concludes that the analytical method predicts the resultant data very closely and will broadly apply to those units not tested, making it preferable to other approaches. For electric instantaneous residential-duty commercial water heaters, DOE did not have test data that would be appropriate for use in a regression analysis, thereby precluding the use of an empirical regression approach or the "hybrid" approach that combines an analytical method with a regression analysis. For the remaining conversion factors, DOE uses either the empirical regression approach (see section III.C.2) or the "hybrid" approach (see section III.C.3).

2. Empirical Regression Approach

The second category of conversion factors considered by DOE is empirical regression. In this approach, a collection of water heaters are tested according to both the former test procedure and the new test procedure. The resultant performance metrics, as well as other data on the units (e.g., storage volume, input rate), are compiled, and statistical techniques are used to create correlations that relate the new performance metrics to the prior metrics and characteristics. No consideration of the underlying physics is used in this approach. Rather, it is purely a data-driven method. The advantage of this approach is that the results are not affected by existing assumptions on how a water heater should behave under given conditions, with the results

representing exactly what is observed in actual comparison testing. This approach should capture all factors that affect the energy efficiency and delivery capacity, even though those factors may not be known *a priori*.

Empirical regression also has some drawbacks. One drawback is that the resulting equations are most confidently applied to water heaters with attributes similar to those that were tested. Consequently, to minimize uncertainties, a large sample for testing is often appropriate to capture more fully many of the nuances in water heater design. If extended to units not sufficiently similar to those that were tested, the equations may produce unacceptably large differences between predicted and measured values if a feature on the untested model has an effect that is not captured in the experimental data. Another major drawback is that empirical regression is susceptible to experimental uncertainties. While uncertainties can be reduced through careful quality checks of experimental data, uncertainty is present in any test. The empirical regressions, being based on many samples across multiple different units, will further reduce the uncertainty, but some amount of uncertainty in the regression may be unavoidable.

In the April 2015 NOPR and August 2016 SNOPR, DOE noted that it was not aware of an analytical method for determining the first-hour rating, and proposed to use an empirical regression methodology for developing the mathematical conversion factors for first-hour rating. DOE believed this approach would be more accurate than attempting to develop an analytical method. 80 FR 20116, 20125-20128 (April 14, 2015) and 81 FR 59736, 59752 (August 30, 2016). DOE did not receive any comments suggesting an alternate methodology for determining first-hour rating, and, thus, DOE is establishing conversion factors for those metrics and product types based on the use of the empirical regression methodology. In the August 2016 SNOPR,

DOE found that the conversion equations for heat pump water heaters resulting from the analytical method (see section III.C.1) and hybrid regressed-analytical approach (see section III.C.3) had higher root-mean-square deviation (RMSD) values than those resulting from the empirical regression approach. 81 FR 59736, 59752, 59768 (August 30, 2016). Therefore, for the reasons explained in the August 2016 SNOPR and noted above, DOE is establishing a mathematical conversion for heat pump water heaters based on the empirical regression approach. Finally, for the reasons explained in the August 2016 SNOPR (81 FR 59736, 59778 (August 30, 2016)), for residential-duty commercial electric instantaneous water heaters, DOE has concluded that it is appropriate to assume that the delivery capacity would be heavily dependent on the input rating for electric instantaneous water heaters, and, thus, DOE developed an equation to predict maximum GPM as a function of input rate based on a regression analysis.

3. Hybrid Approach

DOE also analyzed a combination of the analytical methods approach and empirical regression approach, termed a hybrid approach. In this approach, a broad range of water heaters are tested, as would be done in using empirical regression. An additional factor is added to the list of attributes that is examined in the regression; this factor uses the analytical methods to first estimate the converted value. This estimate of the revised performance metric (maximum GPM, first-hour rating, or UEF) for each water heater tested is then used as an independent variable in a regression to determine the measured UEF. DOE believes that this approach takes advantage of the ability of the analytical methods approach to capture the major known factors that affect the efficiency, yet adds the additional step of regression to account for any influences that are not well described by the analytical methods. DOE uses this approach for the conversion factors

adopted to convert from EF to UEF for all types of water heaters except for heat pump water heaters, for which the empirical regression approach is used (see section III.C.2), and residential-duty commercial electric instantaneous water heaters, for which the analytical methods approach is used (see section III.C.1).

D. Testing Results and Analysis of Test Data

DOE used actual test data as part of the basis for the conversion factors and to validate the results. DOE selected models for testing based on their characteristics being representative of the broader market. DOE also used test data supplied by AHRI in developing the mathematical conversion factors, and in total, the conversion factors prescribed by this final rule are based on test results for 264 basic models. The August 2016 SNOPR includes a detailed description of the characteristics of the models used in the development of the mathematical conversion factors. 81 FR 59736, 59760-59779 (August 30, 2016).

1. Impact of Certain Water Heater Attributes on Efficiency Ratings

After conducting testing on all of the selected water heaters according to both the prior test procedures and the uniform efficiency descriptor test procedure, DOE examined how particular attributes of water heaters might affect the conversion factors and investigated the approaches discussed in section III.C for obtaining conversion factors. The goal of this analysis was to determine whether or not particular attributes would warrant separate conversion equations. DOE investigated attributes such as: (1) NO_X emission level; (2) short or tall configuration; (3) vent type; (4) standing pilot versus electronic ignition; (5) whether condensing or heat pump technology is used; and (6) whether the unit is tabletop. The RMSD between the

measured values and the values obtained through various conversion methods was compared. The conversion approach with the lowest cumulative RMSD value for a particular fuel type was considered to be the best candidate for the conversion equation.

No comments were received in response to the August 2016 SNOPR suggesting different combinations of water heater attributes to examine in regards to the derivation of conversion factors. Accordingly, in this final rule, DOE does not change the combination of water heater attributes used to derive the mathematical conversion factors. 81 FR 59736, 59760 (August 30, 2016).

2. Conversion Factor Derivation

DOE used the methods described in section III.C to derive the mathematical conversion factor for the different types of water heaters covered within the scope of this rulemaking (as discussed in section III.B). This section describes the methodology that was applied to develop a conversion factor for each type of water heater.

Consumer Storage Water Heaters

In total, DOE conducted testing of 55 consumer storage water heater models using both the EF and UEF test procedures, and likewise, AHRI supplied test data for 130 consumer storage water heater models using both the EF and UEF test procedures.[8, 9] In the August 2016 SNOPR,

[8] The AHRI submitted data points 2-5 and 2-6 were not used in this analysis as the reported recovery efficiencies were 98 percent and not calculated from test data.

[9] If multiple tests were conducted on either the same unit or same basic model of a water heater, the results were averaged to produce the values reported in this final rule. In one instance within the AHRI-submitted data for consumer storage water heaters, three tests were conducted, where two tests were conducted on the same unit and another test was conducted on a unit of the same basic model. The two tests of the same unit were averaged, and this value was then averaged with the results of the test of the unit of the same basic model.

DOE presented the test data used to derive the consumer storage water heater conversion factors and the water heater attributes by unit, respectively. 81 FR 59736, 59761-59767 (August 30, 2016).

In response to the August 2016 SNOPR, Bock Water Heaters, Inc. (Bock) provided test data for its 32E consumer oil-fired storage water heater. Bock stated that the DOE test model labeled in the August 2016 SNOPR as "CS-27" was the most similar to the 32E, but that it was unclear if the 32E was the actual unit tested in the SNOPR due to the measured first-hour rating under the EF test procedure being well below that of 32E. (Bock, No. 29 at p. 1) In response, DOE confirms that CS-27 was the Bock 32E. DOE reviewed its test data and did not identify any errors in the testing, nor does DOE have access to the raw test data from Bock to reconcile the difference in results. Therefore, DOE treated all three points as valid test points and in order to factor in the Bock data, averaged DOE's data point with the test results of the two units provided by Bock and derived the conversion factors with this updated test data. The test data replacing CS-27 is shown in Table III.3.

Table III.3 – Updated Consumer Storage Water Heater Test Data Point

CS No.	AHRI No.	Type	Storage volume (gal)	Input rate (Btu/h)	Prior FHR (gal)	Updated FHR (gal)	Prior recovery efficiency (%)	EF	UEF
27	N/A	Oil	30.2	103,800	153.3	128.5	91.6	0.621	0.641

For consumer storage water heaters, DOE used the regression method described in section III.C.2 to predict first-hour ratings (FHRs) under the UEF test procedure to be used in the conversion to UEF since DOE is not aware of an "analytical approach" that can be used to predict first-hour ratings. Of the factors considered, DOE found that the first-hour rating

determined under the EF test procedure was the best overall predictor of the new first-hour rating. These findings were based on the RMSDs between predicted and measured values. The resulting equations for determining the new FHR of consumer storage water heaters are presented in Table III.4.

Table III.4 – Consumer Storage Water Heater First-Hour Rating Conversion Factor Equations

Product Class	Distinguishing Criteria	Conversion Factor
Consumer Gas-fired Water Heater	Non-Condensing, Standard or Low NO_x	New FHR = 7.9592 + 0.8752 x FHR_P
	Non-Condensing, Ultra-Low NO_x	New FHR = 25.0680 + 0.6535 x FHR_P
	Condensing	New FHR = 1.0570 x FHR_P
Consumer Oil-fired Water Heater	N/A	New FHR = 0.9102 x FHR_P
Consumer Electric Water Heater	Electric Resistance	New FHR = 9.2827 + 0.8092 x FHR_P
	Tabletop	New FHR = 41.5127 + 0.1989 x FHR_P
	Heat Pump	New FHR = -4.2705 + 0.9947 x FHR_P

In the equations, "New FHR" is the predicted first-hour rating that would result under the UEF test method and is used for conversion to UEF; "FHR_P" is the first-hour rating determined under the EF test procedure, and the slope and intercept are constants obtained from a linear regression. While most of the data allowed for such a regression fit, in two cases (condensing gas-fired and oil-fired) the available data were too limited to produce reliable regressions for the full set of parameters. To constrain the regression so as to generate more reliable predictions for those smaller sets of data, the intercepts of the regressions were assigned a value of zero, meaning that a water heater with an FHR_P of zero would also have a New FHR of zero. This assignment is reasonable because if a hypothetical water heater were not able to deliver any water under the EF test procedure, it also would not be able to deliver water under the UEF test procedure.

Bock commented that the first-hour rating conversion proposed in the SNOPR for consumer oil-fired water heaters was different in both direction and magnitude from its supplied test data and requested the conversion be reexamined. (Bock, No. 29 at p. 2) DOE notes, however, that the conversion factor must cover a range of water heaters, including models from manufacturers other than Bock. That the conversion is not the same as what one would get from Bock's tests alone does not invalidate it.

In response to the first-hour rating mathematical conversion developed in the SNOPR, Bradford White commented that the conversion is too inaccurate, but that it did not have an alternative suggestion. (Bradford White, No. 26 at p. 3) AHRI commented that the inaccuracy of the conversion causes models be converted to bins to which they were not tested. (AHRI, No. 27 at p. 6) In response, DOE notes that it explored several possible conversions for developing the first-hour rating conversion. The best trend was observed based on a regression as a function of first-hour rating. The average RMSD value resulting from this approach (7.73 gallons) is the lowest RMSD observed in the FHR analysis, and DOE is unaware of any approaches that would result in lower RMSDs. DOE received no comments suggesting methods that would result in a lower RMSD for the first-hour rating conversion. DOE acknowledges that some models can have a converted FHR that would classify it into one draw pattern and a tested FHR that would classify it into another as a result of the difference inherent with a mathematical representation of a physical system. DOE views such a result as unavoidable; as discussed above in section III.A, any conversion formula applied to a broad set of models will leave some residual differences for many models. Those differences can push a model at the edge of one category into another. However, DOE will not take enforcement action regarding such a model if there is adherence to

the provisions discussed in section III.E. For models entering the market after July 13, 2015, representations will have to be based on tested UEF values, and the appropriate energy conservation standards set forth in section III.D.3 will need to be met. Thus, for such units, the issue of a converted FHR value resulting in classification into the wrong draw pattern bin is not applicable.

After determining the converted first-hour rating, the next step in the conversion process is to determine which draw pattern is to be applied to convert from EF to UEF. After the first-hour rating under the uniform efficiency descriptor is determined using the conversion factor above, that value can be applied to determine the appropriate draw pattern bin (i.e., very small, low, medium, or high) using Table 1 of the uniform efficiency descriptor test procedure. 10 CFR part 430, subpart B, appendix E, section 5.4.1. In the August 2016 SNOPR, DOE proposed to use the "hybrid approach" for all non-heat pump water heaters and the "empirical regression approach" for heat pump water heaters. 81 FR 59736, 59768 (August 30, 2016). DOE received no comments on the SNOPR regarding these conversion approaches and has, therefore, for the reasons provided in the August 2016 SNOPR, adopted the conversion factors found in Table III.6. DOE notes that the UEF conversion factor for consumer oil-fired storage water heaters has been updated based upon the addition of the Bock test data.

With the draw bin known, the UEF value based on the WHAM analytical model (i.e., UEF_{WHAM}) can be calculated using the equation and the coefficient values presented in Table III.5 for all consumer non-heat pump storage water heater types, where EF is the energy factor; η_r is the recovery efficiency in decimal form; and P is the input rate in Btu/h. The UEF value can

be calculated for heat pump storage water heater using the equation in Table III.6, which does not rely on the UEF_{WHAM} value from the analytical model.

$$UEF_{WHAM} = \left[\frac{1}{\eta_r} + \left(\frac{1}{EF} - \frac{1}{\eta_r}\right)\left(\frac{a\ P\ \eta_r - b}{c\ P\ \eta_r - d}\right)\right]^{-1}$$

Table III.5 – Coefficients for the Analytical UEF Conversion Factor for Consumer Storage Water Heaters, Except Consumer Heat Pump Storage Water Heaters

Draw Pattern	a	b	c	d
Very Small	0.250266	57.5	0.039864	67.5
Low	0.065860	57.5	0.039864	67.5
Medium	0.045503	57.5	0.039864	67.5
High	0.029794	57.5	0.039864	67.5

In the equations in Table III.6, UEF_{WHAM} is a predicted value of UEF calculated based on the WHAM analytical model, EF is the measured energy factor, and DV is the drawn volume in gallons.

Table III.6 –Consumer Storage UEF Conversion Factor Equations

Product Class	Distinguishing Criteria	Conversion Factor
Consumer Gas-fired Water Heater	Non-Condensing, Standard or Low NO_X	New UEF = -0.0002 + 0.9858 x UEF_{WHAM}
	Non-Condensing, Ultra-Low NO_X	New UEF = 0.0746 + 0.8653 x UEF_{WHAM}
	Condensing	New UEF = 0.4242 + 0.4641 x UEF_{WHAM}
Consumer Oil-fired Water Heater	N/A	New UEF = -0.0033 + 0.9528 x UEF_{WHAM}
Consumer Electric Water Heater	Conventional	New UEF = 0.4774 + 0.4740 x UEF_{WHAM}
	Tabletop	New UEF = -0.3305 + 1.3983 x UEF_{WHAM}
	Heat Pump	New UEF = 0.1513 + 0.8407 x EF + 0.0043 x DV

Consumer Instantaneous Water Heaters

DOE tested 22 consumer instantaneous water heaters to both the EF and UEF test procedures, and AHRI supplied test data for 36 additional units of this water heater type.[10, 11] DOE presented the consumer instantaneous water heater test data and attributes in the August 2016 SNOPR. 81 FR 59736, 59773-59774 (August 30, 2016).

As proposed in the August 2016 SNOPR, DOE used an analytical method (see III.C.1) to convert the prior measured values of maximum GPM rating for consumer instantaneous water heaters to the measured values under the uniform efficiency descriptor test procedure, because it predicts the resultant data very closely and will broadly apply to those units not tested. 81 FR 59736, 59774 (August 30, 2016). As discussed in section III.C.1, DOE also developed an analytical method to estimate the change in prior measured values of energy factor under the energy factor test procedure to measured values of uniform energy factor under the uniform efficiency descriptor test procedure. DOE found that using the "hybrid approach," which combined the DOE-developed analytical method with a regression analysis based on measured UEF test data (as described in III.C.3), resulted in the lowest RMSD value and proposed to use that conversion factor in the August 2016 SNOPR. Id. DOE received no comments on the consumer instantaneous water heater conversion factors and, therefore, for the reasons given in the SNOPR, adopts the conversion factors proposed in the August 2016 SNOPR, as shown in

[10] The AHRI submitted test data point identified as "CIS-5" was not used because the measured input rate was greater than the maximum allowable deviation from the rated input rate of 2 percent, resulting in an invalid test.
[11] To avoid weighting individual basic models more heavily than others in the development of the conversion factors, if multiple tests were conducted on either the same unit or same basic model of a water heater, the results were averaged to produce the values reported in the SNOPR. 81 FR 59736, 59773 (August 30, 2016). In one instance within the AHRI-submitted data for consumer instantaneous water heaters, three tests were conducted, where two tests were conducted on the same unit and another test was conducted on a unit of the same basic model. The two tests of the same unit were averaged, and this value was then averaged with the results of the test of the unit of the same basic model.

Table III.8. In the equations in Table III.8, Max GPM_P is the maximum GPM based on the prior DOE test procedure, and UEF_{model} is the predicted UEF determined using the analytical model.

With the draw bin known, the UEF_{model} value can be calculated using the equation and the coefficient values presented in Table III.7 below for all consumer instantaneous water heater types, where η_r is the recovery efficiency expressed in decimal form, and A is dependent upon the applicable draw pattern and fuel type.

$$UEF_{model} = \frac{\eta_r}{1 + A\eta_r}$$

Table III.7 – Coefficients for the Analytical UEF Conversion Factor for Consumer Instantaneous Water Heaters

Draw Pattern	A	
	Electric	Gas
Very Small	0.003819	0.026915
Low	0.001549	0.010917
Medium	0.001186	0.008362
High	0.000785	0.005534

Table III.8 – Consumer Instantaneous UEF Conversion Factor Equations

Product Class	Conversion Factor
All Consumer Instantaneous	New Max GPM = 1.1461 x Max GPM_P
Gas-fired Instantaneous	New UEF = 0.1006 + 0.8622 x UEF_{model}
Electric Instantaneous	New UEF = 0.9847 x UEF_{model}

Residential-Duty Commercial Water Heaters

i. Gas-fired Storage and Oil-fired Storage

DOE tested 8 residential-duty commercial storage water heaters to both the thermal efficiency and standby loss and UEF test procedures, and AHRI supplied test data for 12

additional units. [12] The August 2016 SNOPR presented the attributes and test results for residential-duty commercial storage water heaters used in the development of the conversion factors. 81 FR 59736, 59776-59777 (August 30, 2016).

DOE is not aware of an analytical method to use the measured values from the thermal efficiency and standby loss tests conducted under the prior commercial water heater test procedure to estimate the first-hour rating under the new test procedure. Therefore, DOE used the empirical regression approach (see section III.C.2) along with the best combination of water heater attributes to determine the first-hour rating conversion factor. The empirical regression for converting first-hour ratings presented in the August 2016 SNOPR was based on thermal efficiency and rated storage volume. 81 FR 59736, 59777 (August 30, 2016). DOE clarifies here that the storage volumes used in the empirical regression were measured storage volumes. The equations in Table III.10 and in the regulatory text have been updated to reflect this clarification. The next step in the conversion is to determine which draw pattern must be applied to convert to UEF. After the first-hour rating under the uniform efficiency descriptor is determined through the first-hour rating conversion factor, the converted value can be applied to determine the appropriate draw pattern bin (i.e., very small, low, medium, or high) using Table 1 of the uniform efficiency descriptor test procedure. 10 CFR part 430, subpart B, appendix E, section 5.4.1. In the August 2016 SNOPR, DOE proposed to use the hybrid approach (see section III.C.3) to calculate the residential-duty commercial storage water heater conversion factor for the uniform energy factor. 81 FR 59736, 59777 (August 30, 2016). DOE received no comments on the uniform energy factor conversion for residential-duty commercial storage water heaters

[12] If multiple tests were conducted on either the same unit or same basic model of a water heater, the results were averaged to produce the values reported in the August 2016 SNOPR. 81 FR 59736, 59776 (August 30, 2016).

and for the reasons given in the SNOPR, continues use of the hybrid approach in this final rule. Therefore, the resulting conversion factors adopted in this final rule are the same as those proposed in the August 2016 SNOPR, and are shown in Table III.10.

With the draw bin known, the UEF_{rd} value (i.e., the predicted UEF value from the analytical method alone) can be calculated using the equation and the coefficient values presented in Table III.9 below for all residential-duty commercial storage water heater types, where P is the input rate in Btu/h; E_t is the thermal efficiency; SL is the standby loss in Btu/h; and F and G are coefficients as specified in the table below based on the applicable draw pattern.

$$UEF_{rd} = \left[\frac{1}{E_t} + F * SL\left(G - \frac{1}{P\,E_t}\right)\right]^{-1}$$

Table III.9 – Coefficients for the Analytical UEF Conversion Factor for Residential-Duty Commercial Storage Water Heaters

Draw Pattern	F	G
Very Small	0.821429	0.0043520
Low	0.821429	0.0011450
Medium	0.821429	0.0007914
High	0.821429	0.0005181

In Table III.10, V_m is the measured storage volume, in gallons.

Table III.10 – Residential-Duty Commercial Storage UEF Conversion Factor Equations

Product Class	Conversion Factor
All Residential-Duty Commercial Storage Water Heaters	New FHR = -35.8233 + 0.4649 x V_m + 160.5089 x E_t
	New UEF = -0.0022 + 1.0002 x UEF_{rd}

ii. Electric Instantaneous

As stated in the August 2016 SNOPR, the maximum GPM conversion for residential-duty commercial electric instantaneous water heaters was found using the empirical regression approach (see section III.C.2), and the uniform energy factor conversion was found using the analytical methods approach (see section III.C.1). 81 FR 59736, 59778 (August 30, 2016). DOE received no comments about the maximum GPM or UEF conversions for residential-duty commercial electric instantaneous water heaters, and, therefore, for the reasons given in the August 2016 SNOPR, adopts the equations below, where Q is the input rate in kBtu/h; E_t is the thermal efficiency; and A is found using the coefficients presented in Table III.11. The appropriate draw pattern bin (i.e., very small, low, medium, or high) can be found by using the converted New Max GPM value and Table 1 of the uniform efficiency descriptor test procedure. 10 CFR part 430, subpart B, appendix E, section 5.4.1. There is no further UEF conversion equation needed, as the analytical method was used directly, rather than the "hybrid" regression-analytical approach used for other water heaters, and $UEF_{rd,model}$ is equal to the New UEF.

$$New\ Max\ GPM = 0.0146 + 0.0295 * Q$$

$$UEF_{rd,model} = \frac{E_t}{1 + AE_t}$$

Table III.11 – Coefficients for the Analytical UEF Conversion Factor for Residential-Duty Commercial Electric Instantaneous Water Heaters

Draw Pattern	A
Very Small	0.003819
Low	0.001549
Medium	0.001186
High	0.000785

Grid-Enabled Storage Water Heaters

EPCA defines a "grid-enabled water heater" as an electric resistance water heater that has a rated storage volume above 75 gallons, is equipped with an activation lock that prevents the water heater from delivering more than 50 percent of the rated first-hour rating unless unlocked, and bears a permanent label advising end-users of the intended and appropriate use of the product. (42 U.S.C. 6295(e)(6)(A)(ii))

At the time of the analysis for the SNOPR, DOE was unable to identify any grid-enabled water heaters available on the market which met the statutory definition, nor does it have test data specific to grid-enabled water heaters. However, due to the similarities in design between grid-enabled water heaters (which by definition are electric resistance water heaters) and consumer electric storage water heaters below 55 gallons that use electric resistance elements, DOE based its proposed conversion factor and energy conservation standard derivation for grid-enabled water heaters on the consumer electric storage water heater test data and the associated conversions for below-55-gallon consumer electric storage water heaters. 81 FR 59736, 59778-59779 (August 30, 2016).

In response, A. O. Smith commented that while the commenter would have preferred using test data from electric storage water heaters at or above 75 gallons, DOE's approach to the conversion was reasonable. (A. O. Smith, No. 28 at p. 5) In contrast, the NRECA Joint Stakeholders[13] stated that the conversion for grid-enabled water heaters should be based on real

[13] The National Rural Electric Cooperative Associations (NRECA) submitted a comment on behalf of itself, the Natural Resources Defense Council, Edison Electric Institute, Steffes Corporation, Rheem Manufacturing Company, Vaughn Thermal Corporation, and American Public Power Association under the title "Joint Stakeholders." This comment is referred to as "NRECA Joint Stakeholders" throughout this final rule, as another joint comment was also submitted.

test data and that there was not enough time to review the conversion. (NRECA Joint Stakeholders, No. 30 at p. 2) Similarly, Rheem stated that the differences in design and functionality from regular electric resistance water heaters to grid-enabled water heaters resulting from the additional requirements on grid-enabled water heaters (e.g., the activation lock), as well as the change in storage volume, may affect test results, and this cannot be represented through data extrapolation and regression analysis. Rheem further stated that it expects grid-enabled models to be introduced into the market in the near term, and suggested that DOE should postpone the development of a conversion factor for grid-enabled water heaters until such time that test data can be used to derive the conversion. (Rheem, No. 32 at pp. 4-6) In addition, AHRI and several manufacturers raised concerns regarding the test method for grid-enabled water heaters. AHRI stated that the UEF test procedure does not clearly specify how the activation lock first-hour rating requirement will be validated or how the thermostat should be set for a grid-enabled water heater. (AHRI, No. 27 at p. 3) A. O. Smith and Rheem supported AHRI's test procedure comments and urged DOE to adopt a specific method of test for grid-enabled water heaters. (A. O. Smith, No. 28 at p. 4; Rheem, No. 32 at p. 5)

Since the publication of the August 2016 SNOPR, four models of grid-enabled storage water heaters have been added to the AHRI database.[14] DOE was able to find product literature published on the manufacturer's website for only one the four models, which is manufactured by Vaughn. The Vaughn model is an 80-gallon electric resistance water heater with an input of 4.5 kW and an EF of 0.93. Product literature indicates the model has 3 inches of polyurethane foam insulation, two heating elements, and is equipped with a software activation lock to prevent the

[14] See: https://www.ahridirectory.org/ahridirectory/pages/home.aspx.

unit being used outside of a utility-sponsored load management or demand response program.[15] As one would expect, this model appears to be essentially the same as an electric resistance storage water heater, but with an activation lock control that limits the capacity unless the unit is used in a utility-sponsored load management or demand response program. DOE has no reason to expect that future designs for grid-enabled water heaters would differ significantly from Vaughn's design, and after considering the design of the grid-enabled water heater currently on the market from Vaughn, DOE disagrees that there are significant differences in design and functionality between regular electric resistance water heaters and grid-enabled water heaters that would affect the results under either the old or the current test procedure. DOE notes that a typical consumer electric water heater at or below 55 gallons would have a rated input of 4.5 kW, two resistance heating elements, and three to four inches of insulation, which is similar to the characteristics of the Vaughn model. One significant difference is the change in storage volume; however, DOE continues to conclude that the difference is a matter of scale, not technology, and, thus, would be well modeled by the WHAM analytical model. Further, DOE tested one 80 gallon electric storage water heater (which, as noted above, is expected to be similar in design to grid-enabled water heaters), and the measured UEF for the high draw pattern was 0.94, which is greater than the UEF standard level proposed in the August 2016 SNOPR of 0.92 for this size unit. 81 FR 59736, 59784 (August 30, 2016).

Regarding concerns related to the applicability of the test procedure, DOE notes that there is no separate test method for grid-enabled water heaters. Grid-enabled water heaters should be tested pursuant to the test procedure in Appendix E to Subpart B of part 430. As

[15] See: http://www.vaughncorp.com/utilities/.

discussed above, DOE expects that designs for grid-enabled water heaters will, for the most part, consist of an electric resistance storage water heater that is equipped with a control mechanism to limit the capacity until activated by a utility company (i.e., an activation lock). Thus, DOE sees no reason why the current Federal test method would not be applicable and representative of grid-connected water heaters. DOE believes manufacturers may have questions regarding set-up of grid-connected water heaters pursuant to the test method for which DOE is willing to work through. To the extent that the current test procedure is inapplicable, any interested person may submit a petition for waiver for a particular basic model from any requirements of the Federal test procedure, upon the grounds that the basic model contains one or more design characteristics which either prevent testing of the basic model according to the prescribed test procedures or cause the prescribed test procedures to evaluate the basic model in a manner so unrepresentative of its true energy and/or water consumption characteristics as to provide materially inaccurate comparative data. 10 CFR 430.27(a)(1).

After considering the comments, DOE has decided to use the conversion factors for consumer electric storage water heaters below 55 gallons of storage volume for grid-enabled water heaters as initially proposed in the August 2016 SNOPR and shown below. In the equation for the converted first-hour rating ("New FHR"), FHR_P is the first-hour rating based on the EF test procedure in gallons. The converted UEF ("New UEF") equation is based on the UEF_{WHAM} (resulting from the analytical method), which is calculated as shown in the equation below where η_r is the recovery efficiency based on the EF test procedure, P is the input rate in Btu/h, and a, b, c, and d are coefficients to the WHAM analytical model and can be found using Table III.5.

$$\text{New FHR} = 9.2827 + 0.8092 \times FHR_P$$

$$UEF_{WHAM} = \left[\frac{1}{\eta_r} + \left(\frac{1}{EF} - \frac{1}{\eta_r}\right)\left(\frac{a\ P\ \eta_r - b}{c\ P\ \eta_r - d}\right)\right]^{-1}$$

$$\text{New UEF} = 0.4474 + 0.4740 \text{ x } UEF_{WHAM}$$

3. Energy Conservation Standard Derivation

After developing the mathematical conversion factors to convert from the prior tested values under the EF metric to the tested values under the UEF metric, DOE used the conversion factors to translate the energy conservation standards to be in terms of UEF. In the August 2016 SNOPR, DOE developed a methodology for translating the existing energy conservation standards to UEF, termed the "representative model" method. 81 FR 59736, 59779-59780. The "representative model" method, consists of the following steps for determining the minimum UEF standard:

1. Using the DOE compliance certification database and AHRI Directory, for minimally-compliant models, determine the unique rated storage volumes available on the market prior to July 13, 2015 (the date on which DOE's requirement that rated storage volume equal the mean of the measured storage volume was effective).[16]

2. For each rated storage volume identified in step 1, find average values of conversion factor inputs (i.e., input rating and recovery efficiency for consumer water heaters (except consumer heat pump water heaters), and input rating for residential-duty commercial water heaters) for minimally-compliant basic models in each product class. (For product

[16] As discussed in section III.D.3.a, in the July 2014 final rule, DOE amended the certification requirements for consumer water heaters to specify that the rated storage volume of a water heater must be the mean of the storage volumes measured over the sample of tested units. 79 FR 40542, 40565-40566 (July 11, 2014)

classes where no minimally-compliant models exist on the market, DOE used other methods to estimate the characteristics of minimally-compliant models, which were discussed in detail in the August 2016 SNOPR. 81 FR 59736, 59780-59782 (August 30, 2016))

3. Calculate the energy conservation standard (in terms of energy factor for consumer water heaters and thermal efficiency/standby loss for residential-duty commercial water heaters (with input rate for determining standards found from step 2)) for each product class based on the rated storage volume, as reported in the DOE compliance certification database and AHRI Directory at the time of this analysis (before DOE's requirement that rated storage volume equal the mean of the measured storage volume was effective).

4. Using applicable average values for conversion factor inputs determined in step 2 and the applicable minimum energy conservation standards calculated in step 3, calculate the equivalent UEF for minimally-compliant models at each discrete rated storage volume (determined in step 1) using the appropriate conversion factor for the product class.

5. Adjust the rated storage volumes to estimate the rated storage volume that would reflect DOE's requirement at 10 CFR 429.17(a)(1)(ii)(C) that rated storage volume equal the mean of the measured storage volume of all units within the sample. DOE estimated that for electric storage water heaters, the rated storage volume would decrease by 10 percent, and for gas-fired and oil-fired water heaters, the rated storage volume would decrease by 5 percent.

6. For each product class and draw pattern, using a simple regression, find the slope and intercept where the independent variable is the range of adjusted rated storage volumes (determined in step 5) and the dependent variable is the UEF values associated with the rated storage volumes and specific draw pattern calculated in step 4.

AHRI commented that for models at a discrete rated volume and with equivalent efficiency characteristics, the highest input rate should be used instead of the average input rate, as a higher input rate would result in a lower measured EF or UEF. AHRI commented further that DOE should release the actual derivations of the values used by DOE, as it believes the use of average input rates reflects an error in the DOE analysis. (AHRI, No. 27 at p. 3) DOE notes that the "representative model" method was not intended to analyze the worst-case EF or UEF at a particular volume, but rather to examine typical units that are representative of minimally compliant models at that volume. Thus, this method does not ensure all models on the market convert to at or above the standards. Rather, as the last step is the application of a linear regression, some of the representative models will be below the standards. This corresponds to the potential for some models on the market to have UEF ratings below the converted standards, which is to be expected as discussed in section III.A. Models that fall below the converted UEF standards may qualify for DOE's enforcement policy, as discussed in section III.E. Thus, DOE continued to use a representative value for the input rate in its calculations, rather than using the maximum input rate as suggested by AHRI. Based on the other comments received from AHRI and other stakeholders, in regards to the mathematical method DOE implemented and discussed subsequently in the next paragraph, DOE does not believe releasing the actual derivations would provide any benefit to the analysis. DOE has released the summary data in docket for each step

in the rulemaking process such that its data is transparent and the results of the calculations are published as well. Any stakeholder can run a regression analysis in Excel on the dataset it wishes to mirror. Minor adjustments to specific standard levels were requested and addressed independently.

Several commenters submitted an analysis of converted UEF values based on published data, and compared those values to the proposed UEF standards. DOE notes that many of the comments received in response to the SNOPR appear to contain calculation errors. Thus, DOE seeks to clarify the process for applying the conversion factors, and has slightly re-organized the regulatory text at the end of this document in an attempt to clarify the process for applying the conversion factors. When converting the first-hour rating or maximum GPM values, apply the appropriate delivery capacity conversion equation, and round to the nearest gallon for the converted first-hour rating and nearest 0.1 gpm for the converted maximum GPM. Use this rounded delivery capacity value to determine the appropriate draw pattern bin (very small, low, medium, or high) as initially specified in either Table 1 or Table 2 of the uniform efficiency descriptor test procedure, and as also adopted in 10 CFR 429.17 in this final rule. 10 CFR part 430, subpart B, appendix E, section 5.4.1. With the draw pattern known, apply the appropriate UEF conversion for that draw pattern and water heater type, and round the result to the hundredths decimal place. To calculate the applicable minimum EF standard for a particular model, use the rated storage volume, as determined before July 13, 2015 (i.e., before the requirement that the rated storage volume equal the mean of the measured storage volumes from testing was applicable) directly in the applicable equation. To calculate the minimum UEF for a particular model, either use the measured storage volume from testing or, if that information is

not available, correct the rated storage volume to approximate the rated storage volume under the requirement that the rated storage volume be the mean of the measured volumes of the test sample. For electric storage water heaters and fossil fuel-fired storage water heaters, DOE applied a 10 percent and 5 percent decrease, respectively, to the rated storage volume to approximate the measured storage volume. Round the approximated measured storage volume to the nearest gallon, and use it to determine the minimum UEF requirement. Round the minimum EF and UEF values to the hundredths decimal place. DOE notes that in order to de-identify the models tested, the August 2016 SNOPR did not present rated values, so commenters, therefore, could not determine the minimum EF standard (as they did not have the rated storage volume) or compare the measured EF results to the rated EF. Minimum UEF values could be determined by using the stated measured storage volume rounded to the hundredths decimal place. In the discussion below, when comparing either a measured or converted EF or UEF value to the appropriate energy conservation standard, all values have been rounded to the hundredths decimal place.

California Investor Owned Utilities[17] (CA IOUs) stated that they support the proposed conversion equations. (CA IOUs, No. 25 at p. 2) ASAP Joint Stakeholders[18] provided a table with the number of models, by water heater type, in the AHRI Directory that did not meet the proposed UEF standards after having the appropriate conversion factors applied. The ASAP Joint Stakeholders stated that the distribution of non-compliant models is not evenly distributed

[17] Pacific Gas and Electric Company, Southern California Gas Company, San Diego Gas and Electric, and Southern California Edison collectively submitted a comment under the title California Investor Owned Utilities (CA IOUs).
[18] The Appliance Standards Awareness Project (ASAP) submitted a joint comment on behalf of itself, the American Council for an Energy Efficient Economy, the Northeast Energy Efficiency Partnerships, the Northwest Energy Efficiency Alliance, and the Alliance to Save Energy collectively. This comment is referred to as "ASAP Joint Stakeholders" throughout this final rule.

across the water heater product classes, and in particular, that DOE should reexamine its converted standard for tabletop water heaters. For all other product classes, the ASAP Joint Stakeholders commented in support of the proposed conversions. (ASAP Joint Stakeholders, No. 31 at pp. 1-3) Rheem also stated that none of the tabletop water heaters convert to pass the proposed standards and requested the levels be decreased by 0.04. (Rheem, No. 32 at p. 11) DOE examined the commenters' results for tabletop water heaters and believes that the commenters made an error in the calculation of non-complying models. After applying the proposed conversions for consumer electric storage and tabletop water heaters, DOE found that no models would have converted UEF values below the proposed UEF standards. However, for all other water heater types, DOE found similar results to those reported by ASAP Joint Stakeholders. Therefore, DOE has determined that no adjustments to the proposed energy conservation standards for tabletop storage water heaters are necessary.

For consumer gas-fired storage water heaters greater than or equal to 20 gallons but less than or equal to 55 gallons in the high draw pattern, Bradford White recommended the proposed level be decreased by 0.015. (Bradford White, No. 26 at p. 4) AHRI commented that 16 of the 62 consumer gas-fired storage water heater basic models tested for this rulemaking tested into the high draw pattern had measured UEF values below the proposed standard and requested the proposed level be decreased by 0.02. (AHRI, No. 27 at p. 2) Rheem commented that 37 of the 86 consumer gas-fired storage water heater basic models in the high draw pattern in the AHRI Directory convert to below the proposed standard and requested the proposed level be decreased by 0.01. (Rheem, No. 32 at p. 9) In reviewing its test data for the August 2016 SNOPR, DOE

has found that 9 of the 61[19] models tested had measured UEF values below the proposed standard, but that 6 of these 9 models also had measured EF values below the existing EF standard. Thus, most models with measured EF values at or above the current EF standard had measured UEF values at or above the proposed UEF standard. Further, as discussed in section III.A, DOE expects certain models that meet the current EF standard will not meet the UEF standard when tested. DOE accounts for this possibility through applying an enforcement policy to certain models, as discussed in section III.E. Further, when DOE analyzed converted values for models on the market based on their published ratings, as was done by Rheem,[20] DOE found that for consumer gas-fired storage water heaters that would be classified in the high draw pattern based on their converted first-hour rating, none have converted UEF values below the UEF standard level proposed in the August 2016 SNOPR. Thus, DOE concludes an adjustment to the proposed UEF standard for consumer gas-fired storage water heaters in the high-use draw pattern bin is not warranted.

For consumer gas-fired storage water heaters less than or equal to 55 gallons in the low-draw-pattern bin, Rheem stated that it found two EF-compliant models that would have a converted UEF 0.01 below the proposed standard, the data for which was supplied to DOE by AHRI during the development of the SNOPR. Further, Rheem stated that the SNOPR test data does not include any consumer gas-fired storage water heaters with a measured first-hour rating that would place the model in the low draw pattern and that it cannot identify these models

[19] CS-95 has a measured first-hour rating of 74.6 gallons and was tested to the medium draw pattern. If the first-hour rating is rounded to the nearest gallon, it would have been tested in the high draw pattern.

[20] To convert from represented values under the previous metrics (i.e., EF, TE, and SL) to represented values under the UEF metric, manufacturers should utilize measured values obtained during testing under the previous test methods, where those values are required in the conversion factor equations. DOE provides an analysis of converted values based on published ratings for illustrative purposes only, in order to respond to commenters who performed analysis based on the rated values.

within the tested data. Therefore, Rheem requested the proposed standards be decreased by 0.01. (Rheem, No. 32 at p. 9) In examining the August 2016 SNOPR test data, DOE notes that AHRI supplied test data for the consumer gas-fired storage water heaters identified as CS-66, CS-70, CS-89, CS-99, and CS-137, for which the application of the NOPR conversion factors for first-hour ratings would result in a converted first-hour rating that would classify the models in the low-draw-pattern bin. However, when applying the August 2016 SNOPR conversion factors, these models have converted first-hour ratings that would classify them in the medium-draw-pattern bin, and no models within the entire test data set have a converted first-hour rating that would result in testing to the low draw pattern. CS-89 and CS-90 (identified by AHRI as models CGS-17 and CGS-18, respectively) were tested to the low draw pattern, and AHRI provided those test results in response to the NOPR. DOE notes that CS-89 has a measured EF 0.05 above the minimum EF and a measured UEF 0.06 above the minimum UEF, while CS-90 has a measured EF 0.01 above the minimum EF and a measured UEF 0.01 above the minimum UEF. Therefore, DOE has determined that a decrease in the efficiency level for consumer gas-fired storage water heaters in the low draw pattern is not warranted.

For consumer electric storage water heaters less than or equal to 55 gallons in the low draw pattern, Bradford White recommended the proposed level be decreased by approximately 0.01 UEF to make the associated formula to $0.9160 - (0.0003 \times V_r)$. (Bradford White, No. 26 at p. 4) For those same water heaters, AHRI commented that all 11 basic models that were tested had measured UEF values below the proposed standard and requested the proposed standard be decreased by 0.01. (AHRI, No. 27 at p. 2) Rheem stated that 21 of the 31 electric storage water heaters that would have a converted first-hour rating that would classify them in the low draw

pattern in the AHRI directory have converted UEF values below the proposed UEF standard, and that most of those models are around 30 gallons. Rheem requested that either the proposed standard be decreased by 0.01 or the slope be adjusted to allow the 30 gallon units to pass. (Rheem, No. 32 at pp. 9-10)

Rheem also commented that under the EF test procedure, electric storage water heaters only had to be tested once, and provisions were in place to allow multiple wattage configurations to be rated using the one test. Under the UEF test procedure, Rheem noted that electric storage water heaters now have to test each wattage to the first-hour rating test, and if a lower wattage puts the model in a different draw bin, the different UEF standard in that lower bin may not be met, whereas that configuration complied with the corresponding EF standard. Rheem commented that this essentially means the UEF standards for these draw patterns are more stringent than the EF standards. (Rheem, No. 32 at p. 10)

In examining the August 2016 SNOPR test data, DOE found that 12 of the 13 consumer electric storage water heaters with storage volumes below 55 gallons that were tested in the low draw pattern had measured UEF values below the proposed standard; however, 9 of those 12 models also had measured EF values below the EF energy conservations standards. This indicates that for most models, the relationship between the measured EF and EF standard (i.e., whether the measured EF is higher or lower than the standard) holds true for UEF as well. In response to Rheem's comment regarding testing of electric storage water heaters, DOE acknowledges that more testing is required under the UEF test procedure as compared to the EF test procedure. DOE notes that the UEF standards in the lower draw patterns are less stringent and are based on models with characteristics representative of that draw pattern. Thus, they

should be applicable to electric storage water heaters being tested at lower element wattages and avoid the situation that Rheem describes where an electric storage water heater is compliant with one heating element wattage, but not with another. In addition, DOE reiterates that it expects certain models that meet the current EF standard will not meet the UEF standard when tested, and accounts for this possibility through an enforcement policy for certain models, as discussed in section III.E. Based on the foregoing, DOE has determined an adjustment to the proposed standard for electric storage water heaters is not warranted.

For consumer gas-fired instantaneous water heaters less than 2 gallons, Bradford White, AHRI, and Rheem recommended that the proposed level be decreased to those proposed in the April 2015 NOPR (i.e., 0.80 for all draw patterns). AHRI argued that the actual difference between the NOPR and SNOPR levels of 0.003 (0.804 as compared to 0.807) resulted in a 0.01 change in the UEF standard level due to rounding. AHRI commented further that the converted UEF values for 20 of the 96 basic models in the AHRI Directory are less than the minimum UEF values proposed in the August 2016 SNOPR. Rheem stated that many models, specifically those in the low and medium draw pattern, are not meeting the proposed standard through the use of the conversion factor. (Bradford White, No. 26 at p. 4; AHRI, No. 27 at p. 2; Rheem, No. 32 at p. 11) In examining the August 2016 SNOPR test data, DOE found that 5 of the 53 consumer gas-fired instantaneous water heater models that were tested had measured UEF values below the proposed standards; however, 4 of the 5 models also had measured EF values below the existing EF standards. This indicates that for most models the relationship between the measured EF and EF standard (i.e., whether the measured EF is higher or lower than the standard) holds true for UEF as well. Further, as was done by commenters, DOE also examined the number of models

that would pass the proposed UEF standard based on their converted UEF determined using published values, and found that about 20 percent of the consumer gas-fired instantaneous water heaters on the market would have converted UEF values less than the SNOPR proposed standards, and all of the converted values were 0.01 below. All of these models were in the medium and high draw pattern bins. As stated above, the "representative model" method was not derived to ensure all models on the market convert to pass the converted standards. Rather, some models are expected to fall below the converted UEF standards, and these models are accounted for by the enforcement policy provisions discussed in section III.E. Therefore, DOE has decided to adopt the conversion factors proposed in the August 2016 SNOPR.

For consumer oil-fired storage water heaters in the high draw pattern, AHRI and Bock commented that two Bock 32E oil-fired storage water heaters were tested to the EF and UEF test procedures, and the average tested UEF value was below the proposed UEF standard. Further, the commenters noted that a similar model tested by DOE, identified in the August 2016 SNOPR as CS-27, tested below the proposed minimum. Therefore, AHRI and Bock requested that the proposed level be decreased by 0.02. (AHRI, No. 27 at p. 2; Bock, No. 29 at p. 2) As stated in section 0, CS-27 is the Bock 32E, so DOE included the two Bock supplied test data points by averaging the results with those of CS-27, and derived new first-hour rating and UEF conversion factors. These conversion factors were carried through the analysis to derive updated energy conservation standards. The Bock 32E has a rated storage volume of 32 gallons (which DOE assumed would be adjusted to 30 gallons after the 5 percent decrease is applied to represent the value based on the mean of the measured volumes, and the value is rounded to the nearest gallon) and is in the high draw pattern which corresponds to a minimum UEF of 0.64. This

updated minimum UEF value is equal to the mean of the measured UEF values for the Bock 32E that were submitted by Bock. Therefore, for the final rule, DOE is adopting the standards derived using the test data supplied by Bock.

For residential-duty commercial gas-fired storage water heaters in the high draw pattern, Rheem commented that the proposed standard is more stringent than the existing minimum thermal efficiency and maximum standby loss standards. Rheem stated that a unit with a storage volume of 100 gallons that meets the existing energy conservation standards would have a converted UEF that is 0.01 below the proposed UEF standard. Therefore, Rheem recommended lowering the proposed standard by 0.01. (Rheem, No. 32 at p. 10) In examining the August 2016 SNOPR test data, DOE found that 4 of the 5 minimally compliant residential-duty commercial gas-fired storage water heater models that were tested had measured UEF values below the proposed standards; however, 2 of the 4 models also had measured TE and SL values below and the above the existing standards, respectively. This indicates that for most models, the relationship between the measured EF and EF standard (i.e., whether the measured EF is higher or lower than the standard) holds true for UEF as well. Further, as was done by Rheem, DOE examined the minimally compliant residential-duty commercial gas-fired water heaters on the market by applying the conversions based on rated values, and found that fewer than half of the models would have a converted UEF value below the proposed UEF standard based on their rated values. As stated above, the "representative model" method was not intended to ensure all models on the market convert to pass the converted standards, and existing models that have UEF values below the converted standard could be addressed through DOE's enforcement policy, as discussed in section III.E. Further, as discussed in III.A, because DOE's goal is to

maintain the same stringency of the existing standards under EF, SL and TE, and because individual models are impacted differentially by the change in test method and metric, some models that were previously minimally compliant will perform better than the translated UEF minimum, and others will perform worse. The possibility of such outcomes does not mean that the conversion methodology is improper and, based on the results of testing, DOE believes the UEF standard that was proposed is equivalent in stringency to the minimum thermal efficiency and maximum standby loss standards. Therefore, DOE is adopting the conversion factors for residential-duty commercial gas-fired water heaters. DOE notes that the residential-duty commercial gas-fired conversion factors adopted in this final rule vary slightly[21] from those presented in the August 2016 SNOPR. 81 FR 59736, 59798 (August 30, 2016). To improve the accuracy and maintain consistency with other product classes, DOE removed certain individual models, which were found to be duplicates (i.e., models with identical designs that were listed under different model numbers by manufacturers), from the final rule dataset (so as not to give additional weight to models sold under various brand names). However, DOE notes that the resultant equations are essentially the same as those presented in the August 2016 SNOPR, and when rounded to the nearest 0.01, do not impact the UEF standard level for any models currently available on the market.

For consumer gas-fired storage water heaters below 55 gallons, DOE requested comment on whether its tentative decision to use the standard and low NO_X conversion to derive the proposed standard was appropriate, as well as its tentative decision that a separate standard for

[21] For example, for the high draw pattern for residential-duty commercial gas-fired water heaters, the constant in the equation has changed from 0.6592 in the August 2016 SNOPR to 0.6597 in this final rule, a difference of 0.0005. The coefficient multiplied by the volume remains 0.0009, which is the same as proposed in the August 2016 SNOPR.

ultra-low NO_X water heaters was not necessary. CA IOUs, Bradford White, AHRI, A. O. Smith, and Rheem all stated that that there should not be separate standards for ultra-low NO_X. (CA IOUs, No. 25 at p. 3; BWC, No. 26 at p. 6; AHRI, No. 27 at p. 10; A. O. Smith, No. 28 at p. 5; Rheem, No. 32 at p. 12) CA IOUs also commented that in future rulemakings, ultra-low NO_X water heaters should continue to be examined separately from standard and low NO_X water heaters. (CA IOUs, No. 25 at p. 3) Therefore, DOE has decided not to create separate standards for ultra-low NO_X water heaters and will continue use the standard and low NO_X conversion to derive the converted energy conservation standards.

For consumer gas-fired storage water heaters above 55 gallons, DOE requested comment on whether the assumptions it used to create representative models were reasonable. Bradford White, AHRI, A. O. Smith, and Rheem all stated that the assumptions made in the August 2016 SNOPR were reasonable. (BWC, No. 26 at p. 6; AHRI, No. 27 at p. 10; A. O. Smith, No. 28 at p. 5; Rheem, No. 32 at p. 12) Therefore, DOE continued to use the assumptions presented in the August 2016 SNOPR for this final rule.

For consumer electric instantaneous water heaters, no minimally-compliant models are available on the market. DOE sought comment regarding whether the assumption of 0.93 recovery efficiency reasonably approximated a minimally-compliant model. Rheem stated that the 0.93 recovery efficiency was reasonable and correct. (Rheem, No. 32 at p. 12) Therefore, DOE continued to use 0.93 as the assumed recovery efficiency for a representative consumer electric instantaneous water heater in this final rule. In the August 2016 SNOPR, DOE proposed one set of standards for consumer electric instantaneous water heaters with storage volumes below 2 gallons and another at or above 2 gallons. 81 FR 59736, 59781 (August 30, 2016). As

discussed in section III.B.1, DOE is not adopting UEF conversion factors or converting the energy conservation standards to UEF for the water heater listed in Table III.1, which include consumer electric instantaneous water heaters with storage volumes greater than or equal to 2 gallons. Therefore, DOE has updated the consumer electric instantaneous water heater energy conservation standards to be based solely on representative units with storage volumes less than 2 gallons, and will consider electric instantaneous water heaters with storage volumes greater than or equal to 2 gallons in a future proceeding.

For grid-enabled water heaters, AHRI and A. O. Smith commented that the proposed minimum energy conservation standard levels are acceptable. (AHRI, No. 27 at p. 9; A. O. Smith, No. 28 at p. 5) NRECA Joint Stakeholders stated that any establishment of a UEF for grid-enabled water heaters should await product development, and DOE should explicitly state that products meeting the EF energy conservation standard in the Energy Efficiency Improvement Act of 2015 (EEIA 2015) are compliant. (NRECA Joint Stakeholders, No. 30 at pp. 1-3) Rheem asserted that as grid-enabled water heaters have only recently been introduced into the market and no test data are available for them, they will not be able to use the conversion factor to rate the UEF. Further, Rheem argued that it is not reasonable for industry to be required to determine UEF values for grid-enabled water heaters by testing in accordance with the UEF test procedure, when no testing of this class was performed by DOE to establish adequate UEF standards. Rheem also argued that DOE should postpone establishing a conversion factor and converted UEF standard for grid-enabled water heaters until a future rulemaking once more models are available to be tested. (Rheem, No. 32 at pp. 4-6) In response, DOE notes that when EEIA 2015 was enacted, there were no grid-enabled storage water heaters on the market. As

explained in section 0, DOE has concluded that, with respect to characteristics that might affect the outcome of the old and current test procedures, grid-enabled water heaters are not designed and do not function differently than consumer electric storage water heaters below 55 gallons. For the one grid-enabled storage water heater that has subsequently become available on the market and for which published product literature is available, the rated EF value is equal to the minimum EF standard (when rounded to the nearest 0.01), and the converted UEF value (estimated based on its rated values in the AHRI Directory) is equal to the proposed standard. This suggests that the conversion factor and proposed standards appropriately reflect the operation of grid-enabled water heaters. For these reasons, DOE has determined that its conversion of existing EF standards for grid-enabled water heaters to UEF standards are adequate for use at this time.

As originally stated in the August 2016 SNOPR and noted several times previously in this notice, DOE acknowledges that the test data that serves as the basis for the August 2016 SNOPR show that some units which previously passed the EF, thermal efficiency, and/or standby loss energy conservation standards might fail the proposed UEF standards, while other units which previously failed might now pass. As discussed in section III.A, DOE recognizes that the conversion factors presented cannot perfectly model the behavior of all water heaters, as each water heater model will react differently to the changes in the test procedure based on the characteristics of that particular model. The standards presented in Table III.12 and Table III.13 were derived using a method that was intended to reduce the number of units that would either be non-compliant under the EF test method and compliant under the UEF test method or vice versa, so as to maintain the stringency of the updated standard. Nevertheless, to ensure that

water heaters which previously passed the energy conservation standards under the "old" metrics (i.e., EF, thermal efficiency, and/or standby loss) will continue to comply, pre-existing models that were first distributed in commerce prior to July 13, 2015 and that are compliant with the energy conservation standards denominated in the old metric are eligible to have compliance determined based on the old metric, as described below in section III.E, if the design of the model is unchanged.

DOE restates the standards denominated in terms of uniform energy factor, as shown in Table III.12 and Table III.13 by product class and draw pattern.

Table III.12 - Consumer Water Heater Energy Conservation Standards

Product Class	**Rated Storage Volume and Input Rating (if Applicable)**	**Draw Pattern**	**Uniform Energy Factor**
Gas-fired Storage Water Heater	≥ 20 gal and ≤ 55 gal	Very Small	$0.3456 - (0.0020 \times V_r)$
		Low	$0.5982 - (0.0019 \times V_r)$
		Medium	$0.6483 - (0.0017 \times V_r)$
		High	$0.6920 - (0.0013 \times V_r)$
	> 55 gal and ≤ 100 gal	Very Small	$0.6470 - (0.0006 \times V_r)$
		Low	$0.7689 - (0.0005 \times V_r)$
		Medium	$0.7897 - (0.0004 \times V_r)$
		High	$0.8072 - (0.0003 \times V_r)$
Oil-fired Storage Water Heater	≤ 50 gal	Very Small	$0.2509 - (0.0012 \times V_r)$
		Low	$0.5330 - (0.0016 \times V_r)$
		Medium	$0.6078 - (0.0016 \times V_r)$
		High	$0.6815 - (0.0014 \times V_r)$
Electric Storage Water Heaters	≥ 20 gal and ≤ 55 gal	Very Small	$0.8808 - (0.0008 \times V_r)$
		Low	$0.9254 - (0.0003 \times V_r)$
		Medium	$0.9307 - (0.0002 \times V_r)$
		High	$0.9349 - (0.0001 \times V_r)$
	> 55 gal and ≤ 120 gal	Very Small	$1.9236 - (0.0011 \times V_r)$
		Low	$2.0440 - (0.0011 \times V_r)$
		Medium	$2.1171 - (0.0011 \times V_r)$
		High	$2.2418 - (0.0011 \times V_r)$
Tabletop Water Heater	≥ 20 gal and ≤ 120	Very Small	$0.6323 - (0.0058 \times V_r)$
		Low	$0.9188 - (0.0031 \times V_r)$
		Medium	$0.9577 - (0.0023 \times V_r)$

		High	0.9884 - (0.0016 x V_r)
Instantaneous Gas-fired Water Heater	< 2 gal and > 50,000 Btu/h	Very Small	0.80
		Low	0.81
		Medium	0.81
		High	0.81
Instantaneous Electric Water Heater	< 2 gal	Very Small	0.91
		Low	0.91
		Medium	0.91
		High	0.92
Grid-Enabled Water Heater	>75 gal	Very Small	1.0136 - (0.0028 x V_r)
		Low	0.9984 - (0.0014 x V_r)
		Medium	0.9853 - (0.0010 x V_r)
		High	0.9720 - (0.0007 x V_r)

*V_r is the Rated Storage Volume (in gallons), as determine pursuant to 10 CFR 429.17.

Table III.13 - Residential-Duty Commercial Water Heater Energy Conservation Standards

Product Class	Draw Pattern	Uniform Energy Factor
Gas-fired Storage	Very Small	0.2674 - (0.0009 x V_r)
	Low	0.5362 - (0.0012 x V_r)
	Medium	0.6002 - (0.0011 x V_r)
	High	0.6597 - (0.0009 x V_r)
Oil-fired Storage	Very Small	0.2932 - (0.0015 x V_r)
	Low	0.5596 - (0.0018 x V_r)
	Medium	0.6194 - (0.0016 x V_r)
	High	0.6740 - (0.0013 x V_r)
Electric Instantaneous	Very Small	0.80
	Low	0.80
	Medium	0.80
	High	0.80

*V_r is the Rated Storage Volume (in gallons), as determined pursuant to 10 CFR 429.44.

Storage Volume Requirements

In the July 2014 final rule, DOE amended the certification requirements for consumer water heaters to specify that the rated storage volume of a water heater must be the mean of the storage volumes measured over the sample of tested units. DOE also added enforcement provisions that state that if the rated storage volume is within 5 percent of the mean of the measured values of storage volume, then that rated value will be used as the basis for calculation

of the required uniform energy factor for the basic model; otherwise, the mean of the measured storage volume values will be used as the basis for calculation of the required uniform energy factor for the basic model. 79 FR 40542, 40565-40566 (July 11, 2014).

In the August 2016 SNOPR, DOE proposed to decrease the 5 percent tolerance to 2 percent of the mean of the measured value of storage volume. 81 FR 59736, 59786 (August 30, 2016). As discussed in the August 2016 SNOPR, based on testing performed on a sample of 24 units, DOE observed that a tolerance of 2 percent more accurately reflects the actual level of variability that manufacturers are currently able to achieve and allows for slightly more variability than what was observed in the sample set. Id.

Bradford White, AHRI, Rheem, and Giant Factories, Inc. (Giant) commented that they are opposed to the decrease in storage volume tolerance from ± 5 percent to ± 2 percent. Bradford White and AHRI also argued that the sample size used as the basis for the new requirements was too small and not statistically sound. (Bradford White, No. 26 at p. 3; AHRI, No. 27 at p. 4; Rheem, No. 32 at p. 8; Giant, No. 33 at p. 2) Bradford White and Rheem alleged that DOE did not consider the manufacturing costs associated with controlling tank volume variability. (Bradford White, No. 26 at p. 3; Rheem, No. 32 at p. 8) Rheem also stated that the costs of this change could amount to hundreds of thousands of dollars. (Rheem, No. 32 at p. 6) Giant and Rheem commented that because the rated volume is part of the water heater safety certification, any change in the rated storage volume would require a manufacturer to update its safety certification reports and perform validation testing at a cost that is not negligible. (Rheem, No. 32 at pp. 7-8; Giant, No. 33 at p. 2) Rheem requested clarification as to whether manufacturers will be permitted to advertise a different ANSI/UL 174 rated volume than the

DOE UEF test procedure rated volume. (Rheem, No. 32 at pp. 7-8) Bradford White, AHRI, and Rheem argued that the requirement to round to the nearest gallon uses up some of the 2 percent tolerance and causes the tolerance to become more stringent than 2 percent. For smaller gallon sizes, the commenters asserted this results in almost no tolerance.[22] (Bradford White, No. 26 at p. 3; AHRI, No. 27 at p. 4; Rheem, No. 32 at pp. 7-10) AHRI requested clarification of the exact consequences of measuring a volume that is beyond 2 percent of the rated volume during a test with a passing measured UEF, particularly if the measured volume places the water heater into a different product category such as not a grid-enabled or above 55 gallons. (AHRI, No. 27 at p. 5) A. O. Smith also urged DOE to provide further clarification regarding any potential liability that a manufacturer may incur if the measured volume during an enforcement test is more than 2 percent outside the newly defined DOE rated volume, and if there is any further consequence beyond that the measured volume will be used for the enforcement test and to determine the minimum efficiency. (A. O. Smith, No. 28 at p. 2) Giant stated that for products such as grid-enabled water heaters, a model with a measured volume of 70 gallons and a rated volume of 76 gallon model would now have a maximum rated volume of 71.4 gallons and no longer meet the definition of a grid-enabled water heater. (Giant, No. 33 at p. 2) Bradford White and Giant commented that reducing the tolerance to 2 percent could result in an increase in energy use as manufacturers redesign their products to increase the tank size to a nominal value, adding that this change would lead to significant confusion in the market. (Bradford White, No. 26 at p. 3; Giant, No. 33 at pp. 2; Rheem, No. 32 at pp. 7-10)

[22] AHRI cited an example of a water heater with 27.5 gallons of measured storage volume. The rated storage volume would be rounded to 28 gallons, and the 0.5 gallon difference would represent a 1.8 percent deviation from the rated volume.

After considering the comments, DOE performed a statistical analysis based on a t-distribution rather than a normal distribution as was done for the August 2016 SNOPR, which DOE concluded to be more appropriate for the number of samples available. For each model, DOE calculated the t-based 95-percent confidence interval, which corresponds to the maximum amount of deviation from the mean one would expect if a new sample were tested. DOE found a maximum percent deviation from the mean of three percent using this method; therefore, DOE is adopting a three-percent tolerance on measured storage volume instead of the proposed two percent. The three-percent tolerance more accurately reflects the level of variability that manufacturers are currently able to achieve. In addition, if manufacturers do not certify the rated storage volume in accordance with the requirements of 10 CFR 429.17 (i.e., as the mean of the measured storage volume of the sample), the certified value may be considered invalid which could lead to DOE investigating the data underlying the certification in accordance with 10 CFR 429. With regard to the manufacturing costs associated with controlling tank volume variability, DOE notes that its test data show that manufacturers already control tank volume variability within the bounds being adopted, and thus, additional costs are not expected as manufacturers already appear to have this capability. Regarding potential increased energy usage, DOE acknowledges that a redesign of the tank size to a nominal value is possible. If the redesigned tank is larger than the previous tank, then it would likely use slightly more energy. DOE also acknowledges that there may be costs associated with safety certification of a re-designed model. However, DOE notes that the requirement that the rated volume be the mean of the measured volumes in the test sample already exists at 10 CFR 429.17(a)(1)(ii)(C), and this change only modifies the existing tolerance in response to comments. Thus, the rated efficiency should already be equal to the mean of the measured volumes in the test sample, and as discussed above,

DOE's data show that manufacturers already control their volume within this tolerance. Finally, in response to Giant's comments that certain products that have a volume threshold, such as grid-enabled water heaters, may need to be reclassified based on the new storage volume requirements, that is correct. However, DOE contends that if the manufacturer was properly certifying to the July 2014 test procedure, there would be no reclassification needed.

E. Enforcement Policy

In the August 2016 SNOPR, DOE acknowledged that the nature of the conversion process could conceivably result in models very close to the standard falling below the converted standard. Recognizing that there is value in reducing the uncertainty for manufacturers and that there is no significant public harm in letting manufacturers continue sales of certain models, DOE explained its planned approach for basic models where units of individual models within the basic model were manufactured prior to July 13, 2015. 81 FR 59736, 59876-59787 (August 30, 2016). Specifically, DOE explained that in assessment and enforcement testing, DOE will evaluate the compliance of a basic model using the test procedure in effect prior to July 13, 2015, under the following circumstance: the basic model must have been in distribution in commerce prior to July 13, 2015; the basic model must have been tested and properly certified to DOE as compliant with the applicable standard prior to July 13, 2015; and the units manufactured prior to July 13, 2015, must be essentially identical to the units manufactured on or after July 13, 2015.[23]

[23] The last requirement for this policy—that units must be essentially identical—bears explanation. DOE generally permits manufacturers great latitude in assigning basic model numbers, and manufacturers normally are not required to certify a model as a new basic model if modifications make the model more efficient. In the August 2016 SNOPR, DOE stated that, if a manufacturer makes changes to a model (that make it either more efficient or less), then it should conduct the requisite testing using the UEF test procedure and ensure the compliance of the model with the converted standard. The proposed policy was intended to give certainty to manufacturers with respect to

In the August 2016 SNOPR, DOE also recognized that manufacturers seek certainty that models introduced (i.e., first distributed in commerce) on or after July 13, 2015, will not be subject to civil penalties. In enforcing the standard(s) for models introduced on or after July 13, 2015, and before the effective date of this final rule, DOE stated that it would consider whether these models meet the standard(s) as denoted using the "old" metric(s), the deviation from the UEF standard when tested using the UEF test procedure, and efforts taken by the manufacturer to ensure compliance with the converted UEF standards. 81 FR 59736, 59787 (August 30, 2016).

In response to the number of comments and questions DOE received in response to its enforcement policy as presented in the August 2016 SNOPR, DOE is explaining its enforcement policy in greater detail in this final rule, as well as offering minor clarifications in response to comments.

In the event that DOE selects a model for assessment testing that was first distributed in commerce prior to July 13, 2015, DOE will first assess compliance with the UEF standard. If testing indicates that an individual model is noncompliant with the UEF standard, DOE will then evaluate compliance using the "old" metrics (i.e., EF or thermal efficiency/standby loss, as applicable). DOE may request that the manufacturer provide information to show that the selected model met the minimum efficiency standard using the test procedure in effect prior to July 13, 2015, and that it has not been redesigned since that time. (DOE discusses the issue of whether a model has been redesigned later within this section.) The model will continue to be subject to the enforcement policy as long as all units of that model manufactured remain

historical models; it was not intended to provide a mechanism to perpetuate an obsolete test method and obsolete metrics.

identical[24] to the units of that model that were being manufactured prior to July 13, 2015. These models will continue to remain subject to the enforcement policy until compliance with amended energy conservation standards is required.

To address any confusion regarding this enforcement policy, the policy will apply to individual models, rather than basic models. DOE generally permits manufacturers great latitude in assigning basic model numbers, and manufacturers normally are not required to certify a model as a new basic model if modifications make the model more efficient. However, in implementing this policy, DOE believes that if a manufacturer makes changes to the design of an individual model, then DOE would no longer consider the individual model "identical" to the units manufactured prior to July 13, 2015, and the model would not be subject to the enforcement policy. In such a case, the manufacturer should conduct the requisite testing using the UEF test procedure and ensure the compliance of the model with the converted standard. Further, if a manufacturer groups, within the same basic model, an individual model subject to DOE's enforcement policy with one or more individual models not subject to the policy, DOE would not treat the individual model as subject to the policy. Thus, if certain individual models within a basic model are redesigned, those individual models would have to be recertified as a separate basic model (or basic models) from the original basic model.

[24] DOE acknowledges that in the August 2016 SNOPR it used the term "essentially identical" to refer to the similarities between units manufactured prior to July 13, 2015, and units manufactured on or after that date, one factor relevant to application of the enforcement policy set forth here. DOE realizes that, due to that term's presence in the definition of "basic model" at 10 CFR 430.2, including this term in its statement of enforcement policy may cause confusion, particularly given DOE's application of the enforcement policy on an individual model basis. Thus, DOE is adopting the use of the term identical in this final enforcement policy and has included additional explanation to help manufacturers understand how it applies.

A. O. Smith requested clarification as to what is meant by the requirement that units for "grandfathered" models must be essentially identical to those manufactured prior to July 13, 2015, as DOE proposed in the August 2016 SNOPR. (A. O. Smith, No. 28 at p. 4) Rheem also sought clarification regarding what will be considered sufficient evidence to demonstrate a "grandfathered" model met the provisions laid out by DOE. (Rheem, No. 32 at p. 16)

Regarding the term "essentially identical" used in the August 2016 SNOPR, as well as the term "identical" used in this final rule and intended to have the same meaning, units of models that were manufactured after July 13, 2015, must have the same design as those manufactured before July 13, 2015, to be subject to the enforcement policy described above. If an individual model is redesigned in any way, it would no longer be subject to the policy. However, DOE recognizes that manufacturers may need to make small changes, such as a change in component supplier, that do not change the design and, thus, would not constitute a different "design" from the units of that model that were manufactured prior to July 13, 2015. One example of such a change would be a change in foam suppliers, where the properties of the foam were the same. Such changes would not be considered as a re-design of the model as long as the new component is identical to the component it replaces in the original model. In such instances, DOE would consider the design identical to that of the original model, and units of that model would be subject to the enforcement policy provided they, at a minimum, meet the energy conservation standards in place under the "old" metrics (i.e., energy factor, thermal efficiency, and standby loss). DOE understands that manufacturers typically change suppliers of components or source raw materials (e.g., foam or metals) as part of their day-to-day operations, and DOE does not consider sourcing decisions for the same components to constitute a non-

identical model. In contrast, if a manufacturer were to redesign the product by introducing a new burner design for a gas water heater or by changing the formulation of the foam for a storage-type water heater, DOE would consider these changes as redesigns because such changes affect the performance and operation of the model. In these instances, a manufacturer should: (1) arrive at represented values expressed in UEF in accordance with the test procedure and the amendments in this final rule; (2) ensure that the redesigned individual model complies with the applicable UEF standard; and (3) properly certify the individual model before distribution in commerce (either as its own basic model or as part of a basic model that does not have any other individual models which are subject to the enforcement policy). As part of considering whether units of an individual model were identical, DOE would consider a manufacturer's records of the bills of materials for models initially distributed in commerce before July 13, 2015, and for which they wish to demonstrate compliance based on the "old" metrics that show all components in the model prior to July 13, 2015. Such evidence would aid DOE in assessing whether units manufactured after July 13, 2015, remain identical to those manufactured prior to that date.

Bradford White requested clarification as to whether updating a product's rated volume would void "grandfathering" of a model that was introduced prior to July 13, 2015, assuming the other conditions DOE has laid out are met. (Bradford White, No. 26 at p. 2) As stated above, a model will not be eligible for DOE's enforcement policy if there was any design change. A change in the rated volume would not be a change in the design of the products themselves in that sense; it would be a change only in representations about the products. However, if rather than simply changing the rated value, the manufacturer chooses to redesign the model with a

different volume such that the design would not be identical, such a model would not be subject to the policy.

The ASAP Joint Stakeholders noted that the water heater industry has called for explicit grandfathering of water heaters that comply with minimum efficiency standards when expressed in terms of EF, but not in terms of UEF, and argued that AEMTCA does not provide for such grandfathering. ASAP Joint Stakeholders' also expressed their understanding of the proposed grandfathering provisions as allowing EF-compliant water heaters to be sold for a year following the publication of the final rule, after which DOE would not enforce the UEF standards for an unlimited period of time for essentially identical, but UEF non-compliant, models. The ASAP Joint Stakeholders commented that adopting non-enforcement as a tool for energy efficiency standards implementation would set a terrible precedent, would create the need for DOE to continually monitor UEF non-compliant models, and would create uncertainty for industry and uncertainty about the ultimate impacts of the water heater efficiency standards. (ASAP Joint Stakeholders, No. 31 at p. 4)

To be clear, this enforcement policy is not "grandfathering" – DOE is not allowing manufacture of products that do not meet a standard. As discussed above, the conversion factor can, for some models, change the compliance status as a result of changes in the test method; this enforcement policy ensures that a model that complied with the former metrics is not harmed by the transition to UEF. However, as soon as a manufacturer makes any change to a model, the manufacturer must test and ensure compliance with the new metric. This enforcement policy allows a smooth transition through a metric change but does not allow manufacture of non-compliant products. Moreover, this is not a policy of non-enforcement—DOE is adopting a

policy of conducting additional testing, where needed, for a limited subset of models in order to assess compliance using a second metric. DOE emphasizes that only models manufactured and certified prior to July 13, 2015, are eligible for the full enforcement policy; therefore, DOE has a known, finite list of models eligible for this relief.

With respect to the "transition" models first distributed in commerce between July 13, 2015, and the publication date of this rule, DOE has committed to consider compliance using the former test method as a factor only and expects manufacturers to take appropriate, timely steps to ensure those models meet the standard as measured using the UEF test method – which was the applicable test method at the time of manufacture. Further, because DOE is not permitting manufacturers to "overrate" to the minimum UEF standard, manufacturers are required to disclose the actual performance in the same metric as all other products.

F. Certification

In this final rule, DOE adopts its position as stated in the August 2016 SNOPR, that upon the effective date of this final rule, certification of compliance with energy conservation standards will be exclusively in terms of UEF. 81 FR 59736, 59788 (August 30, 2016). In implementing the provisions of 42 U.S.C. 6295(e)(5), DOE has concluded that there will be three possible paths available to manufacturers for certifying compliance of basic models of consumer water heaters that were certified before July 13, 2015: (1) in the year following the publication of this final rule, convert the energy factor values obtained using the test procedure contained in appendix E to subpart B of 10 CFR part 430 of the January 1, 2015 edition of the CFR from energy factor to uniform energy factor using the applicable mathematical conversion factor, and then use the converted uniform energy factors along with the applicable sampling provisions in

10 CFR part 429 to determine the represented uniform energy factor; or (2) conduct testing using the test procedure contained at appendix E to subpart B of 10 CFR part 430, effective July 13, 2015, along with the applicable sampling provisions in 10 CFR part 429; or (3) where permitted, apply an alternative efficiency determination method (AEDM) pursuant to 10 CFR 429.70 to determine the represented efficiency of basic models for those categories of consumer water heaters where the "tested basic model" was tested using the test procedure contained at appendix E to subpart B of 10 CFR part 430, effective July 13, 2015.

Similarly, DOE has concluded that there will be three possible paths available to manufacturers for certifying compliance of basic models of commercial residential-duty water heaters that were certified before July 13, 2015: (1) in the year following the publication of this final rule, convert the thermal efficiency and standby loss values obtained using the test procedure contained in 10 CFR 431.106 of the January 1, 2015 edition of the CFR from thermal efficiency and standby loss to uniform energy factor using the applicable mathematical conversion factor, and then use the converted uniform energy factors along with the applicable sampling provision in 10 CFR part 429 to determine the represented uniform energy factor; or (2) conduct testing using the test procedure at 10 CFR 431.106, effective July 13, 2015, along with the applicable sampling provisions in part 429; or (3) where permitted, apply an alternative efficiency determination method (AEDM) pursuant to 10 CFR 429.70 to determine the represented efficiency of basic models for those categories of commercial water heaters where the "tested basic model" was tested using the test procedure at 10 CFR 431.106, effective July 13, 2015.

Bradford White, AHRI, Rheem, and Giant commented that it would take at least 6 months after the publication of this final rule to convert efficiency and performance ratings to those under the UEF test method. (Bradford White, No. 26 at p. 5; AHRI, No. 27 at p. 5; Rheem, No. 32 at pp. 14-15; Giant, No. 33 at p. 2) AHRI, Rheem, and Giant further stated that the FTC EnergyGuide compliance date is June 12, 2017, and if this final rule is delayed past December 12, 2016, DOE and FTC should coordinate actions to delay the effective date of the revised FTC label so as to maintain the 6-month period. AHRI, Rheem, and Giant added that because the next annual certification date is May 1, 2017, DOE should delay the annual certification requirement until the effective date of the FTC EnergyGuide label, due to the potential for confusion resulting from different values in certification data in the DOE compliance certification database and EnergyGuide labels on products. (AHRI, No. 27 at p. 5; Rheem, No. 32 at pp. 14-15; Giant, No. 33 at p. 2) A. O. Smith stated the next annual certification date should be delayed to the expiration date of the conversion factor rulemaking. (A. O. Smith, No. 28 at p. 4)

DOE recognizes stakeholder concerns related to the timing of the FTC requirements and certification reports, and the Department agrees that harmonizing the dates for submitting certification reports and complying with the EnergyGuide labels is desirable to prevent consumer confusion and reduce burden on manufacturers. DOE has already issued an enforcement policy with respect to certification of water heaters subject to this rule. In that policy, DOE stated that the policy would be amended when this rule was finalized. DOE hereby revises that policy such that DOE will not seek civil penalties for failure to submit a UEF certification report, prior to June 12, 2017, for any basic model of water heater subject to this final rule. DOE may seek civil

penalties for failure to submit a UEF certification report for each basic model of water heater subject to this final rule starting June 12, 2017.

Thus, while manufactures are required to submit certifications by the May 1, 2017 annual deadline for existing basic models of consumer water heaters, as set forth at 10 CFR 429.12(d), DOE will not seek civil penalties for failure to submit required certifications by this deadline. However, if a manufacturer does not submit its annual certification report for each basic model by June 12, 2017, it will be subject to civil penalties that will begin accruing on a per day per basic model basis as of that date.

This enforcement policy will not apply to basic models first distributed in commerce on or after the publication date of this rule. Manufacturers of any such basic model must certify the compliance of the basic model before distribution in commerce of the basic model, as required by 10 CFR 429.12(a), or be subject to civil penalties for failure to do so.

Rheem also made several comments specifically related to content of the FTC EnergyGuide label. (Rheem, No. 32 at pp. 12-14) As noted in section I, FTC published a final rule on September 15, 2016 updating the EnergyGuide label to reflect changes to the DOE test procedure. 81 FR 63634. DOE notes that it has no authority to make changes the FTC EnergyGuide label; however, DOE has passed Rheem's comments to FTC for consideration in future updates to the EnergyGuide label for water heaters.

Rheem stated it is unclear when DOE will transition the ability of its compliance certification database to collect the UEF metric rather than EF, thermal efficiency, and/or standby loss. AHRI and Rheem requested that data be identified as either converted or tested in

the reporting template to ensure that enforcement testing is not conducted based on converted ratings. (AHRI, No. 27 at p. 6; Rheem, No. 32 at p. 15) AHRI also requested DOE to make a pronouncement that enforcement testing will be conducted using the test procedure which was used to establish the model's ratings. (AHRI, No. 27 at p. 5) Finally, AHRI commented that there should be no risk of a false-positive enforcement action based on converted ratings once the conversion factor expires. That is, if a model converted into one draw pattern and tested into another, enforcement action should be based on the tested ratings and energy conservation standards associated with the tested draw pattern. (AHRI, No. 27 at p. 6)

DOE will transition the ability of its compliance certification database to collect UEF metrics prior to the date by which manufacturers must submit certification reports (i.e., June 12, 2017, as discussed previously in this section). The information required for certification for the various types of water heaters and methods for determining UEF (i.e., based on testing or based on converted values) is detailed in the regulatory text at the end of this final rule and will appear in 10 CFR part 429 once this final rule is effective. Thus, manufacturers will be aware of the certification information that DOE will collect. DOE proposed specific data elements based on whether a certification was based on converted or tested values, and AHRI and Rheem requested that data be identified as either converted or tested in the reporting template. Although whether a value was converted or tested would be implicit based on the information provided, DOE will, as suggested by AHRI and Rheem, explicitly require manufacturers to report how the certified values were determined. DOE will also permit manufacturers to provide at their option a declaration of whether they are requesting that the enforcement policy apply to a basic model, in

which case the manufacturer must also provide the certified value for that model using the old metric(s) and corresponding test data.

Bradford White requested that DOE provide guidance on how to translate back to the "old" metrics, so that utility rebate programs and codes may have time to transition to the "new" metrics. (Bradford White, No. 26 at p. 5) In response, DOE shares Bradford White's concern about utility rebate programs. However, DOE believes that facilitating calculation back to the old metrics for use in utility rebate programs would simply prolong the transition to the new metrics and could possibly result in consumer confusion regarding water heater efficiency ratings. Accordingly, DOE is not adopting the commenter's suggestion.

In the August 2016 SNOPR, DOE requested comment about its decision not to include standby heat loss coefficient (UA), Annual Energy Consumption (E_{annual}), Annual Electrical Energy Consumption ($E_{annual,e}$), and Annual Fossil Fuel Energy Consumption ($E_{annual,f}$) in the parameters manufacturers are required to certify to DOE. 81 FR 59736, 59787 (August 30, 2016). In response, Bradford White, AHRI, and A. O. Smith commented that they supported DOE's decision not to include these parameters in the annual certification report. (Bradford White, No. 26 at p. 3; AHRI, No. 27 at p. 10; A. O. Smith, No. 28 at p.5) Bradford White stated that certifying the additional parameters could increase burden due to additional paperwork, while A. O. Smith argued that the additional parameters could result in consumer confusion. AHRI stated that the values are not necessary for establishing compliance with DOE efficiency regulations and the information is not necessary for consumers to be able to compare the efficiency of models. CA IOUs requested that recovery efficiency continue to be included in the CCMS directory. (CA IOUs, No. 25 at p. 2) Having considered these comments, DOE will not

require the certification of standby heat loss coefficient (UA), Annual Energy Consumption (E_{annual}), Annual Electrical Energy Consumption ($E_{annual,e}$), and Annual Fossil Fuel Energy Consumption ($E_{annual,f}$), as these values are not necessary for establishing compliance with DOE efficiency regulations and requiring reporting of them could unnecessarily create additional burden for manufacturers. However, as requested by the CA IOUs, DOE will continue to require manufacturers to report recovery efficiency in their annual certification reports. Manufacturers are currently required to certify the recovery efficiency (see 10 CFR 429.17(b)(2)), so maintaining this requirement would not create additional burden, nor does is DOE aware of any consumer confusion resulting from the inclusion of this specific parameter.

AHRI, A. O. Smith, and Rheem provided their understanding of how "grandfathered" models will be handled and requested that DOE confirm that it is correct. (AHRI, No. 27 at pp. 6-7; A. O. Smith, No. 28 at pp. 3-4; Rheem, No. 32 at p. 16)

In response, DOE reiterates that the statute did not grandfather any models. With respect to models that do not meet the UEF standard when converted or tested using the UEF test procedure, manufacturers of models certified prior to July 13, 2015, may continue to certify compliance on the basis of the then-applicable test procedure but must disclose the UEF rating as discussed above. Manufacturers should not represent the efficiency at the minimum UEF standard for models that, when rated in accordance with 10 CFR 429.17, would have a UEF rating below the minimum standard.

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866

The Office of Management and Budget (OMB) has determined that test procedure rulemakings do not constitute "significant regulatory actions" under section 3(f) of Executive Order 12866, "Regulatory Planning and Review," 58 FR 51735 (Oct. 4, 1993). Accordingly, this action was not subject to review under the Executive Order by the Office of Information and Regulatory Affairs (OIRA) in the Office of Management and Budget.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq*., as amended by the Small Business Regulatory Enforcement Fairness Act of 1996) requires preparation of an initial regulatory flexibility analysis (IRFA) for any rule that by law must be proposed for public comment and a final regulatory flexibility analysis (FRFA) for any such rule that an agency adopts as a final rule, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities.

A regulatory flexibility analysis examines the impact of the rule on small entities and considers alternative ways of reducing negative effects. Also, as required by Executive Order 13272, "Proper Consideration of Small Entities in Agency Rulemaking," 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the DOE rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's website at: http://energy.gov/gc/office-general-counsel.

This final rule prescribes a mathematical conversion that can be used on a limited basis to determine the represented values for consumer water heaters and certain commercial water heaters. For consumer water heaters and certain commercial water heaters, the mathematical conversion establishes a bridge between the rated values based on the results under the energy factor, thermal efficiency, and standby loss test procedures (as applicable) and the uniform energy factor test procedure. DOE reviewed this final rule under the provisions of the Regulatory Flexibility Act and the policies and procedures published on February 19, 2003. 68 FR 7990.

For the manufacturers of the covered water heater products, the Small Business Administration (SBA) has set a size threshold, which defines those entities classified as "small businesses" for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. 65 FR 30836, 30849 (May 15, 2000), as amended at 65 FR 53533, 53545 (Sept. 5, 2000), at 77 FR 49991, 50008-50011 (August 20, 2012), and at 81 FR 4469, 4490 (Jan. 26, 2016), and codified at 13 CFR part 121. The size standards are listed by North American Industry Classification System (NAICS) code and industry description and are available at *https://www.sba.gov/sites/default/files/files/Size_Standards_Table.pdf.* Consumer water heater manufacturing is classified under NAICS code 335228—"Other Major Household Appliance Manufacturing." The SBA sets a threshold of 1,000 employees or less for an entity to be considered as a small business under that code number. Commercial water heater manufacturing is classified under NAICS code 333318 –"Other Commercial and Service Industry Machinery

Manufacturing," for which SBA sets a size threshold of 1,000 employees or fewer as being considered a small business.

DOE has identified 11 manufacturers of consumer water heaters that can be considered small businesses. DOE identified five manufacturers of "residential-duty" commercial water heaters that can be considered small businesses. Four of the "residential-duty" commercial water heater manufacturers also manufacture consumer water heaters, so the total number of small water heater manufacturers impacted by this rule would be 12. DOE's research involved reviewing several industry trade association membership directories (e.g., AHRI), product databases (e.g., DOE Compliance Certification Database, AHRI, CEC, and ENERGY STAR databases), individual company websites, and marketing research tools (e.g., Hoovers reports) to create a list of all domestic small business manufacturers of products covered by this rulemaking.

For the reasons explained below, DOE has concluded that the test procedure amendments contained in this final rule will not have a significant economic impact on any manufacturer, including small manufacturers.

For consumer water heaters that were covered under the energy factor test procedure and energy conservation standards, the conversion factor in this final rule converts the rated values based on the energy factor test procedure to values based on the uniform energy factor test procedure. Likewise, for certain commercial water heaters, defined under the term "residential-duty commercial water heater," the conversion factor in this final rule converts the rated values based on the previous test procedure to the uniform descriptor which is based on the UEF test procedure. The energy conservation standards for commercial water heating equipment is denominated using the uniform descriptor.

The conversion factors established in this final rule accomplish two tasks: (1) translating the EF-, TE-, and SL-denominated (as applicable) energy conservation standards for consumer water heaters and certain commercial water heaters to being expressed in terms of the metric and test procedure for uniform energy factor; and (2) providing a limited conversion factor that manufacturers can use to translate represented values established for basic models certified prior to July 13, 2015. This limited conversion is a burden-reducing measure which helps to ease the transition of the market to the new test procedure and uniform metric over the one-year period instead of the typical 180-day timeframe allotted by statute. In addition, as discussed in section III.E, DOE will implement an enforcement policy that DOE will not seek civil penalties for the continued manufacture and distribution in commerce of units of certain basic models that meet certain conditions (as described in III.E), thereby further reducing any burden on small business manufacturers. Accordingly, DOE concludes and certifies that this rule will not have a significant economic impact on a substantial number of small entities, so DOE has not prepared a regulatory flexibility analysis for this rulemaking. DOE has provided its certification and supporting statement of factual basis to the Chief Counsel for Advocacy of the SBA for review under 5 U.S.C. 605(b).

C. Review Under the Paperwork Reduction Act of 1995

Manufacturers of water heaters must certify to DOE that their products comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their products according to the DOE test procedures for water heaters, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial

equipment, including consumer and commercial water heaters. 76 FR 12422 (March 7, 2011); 79 FR 25486 (May 5, 2014). The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement was approved by OMB under OMB control number 1910-1400, and this conversion-factor rule does not constitute a significant change to the requirement. Public reporting burden for the certification is estimated to average 30 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

D. Review Under the National Environmental Policy Act of 1969

In this final rule, DOE establishes conversion factors to convert results from prior efficiency and delivery capacity metrics (and related energy conservation standard requirements) for consumer and certain commercial water heaters to the uniform efficiency descriptor. DOE has determined that this rule falls into a class of actions that are categorically excluded from review under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) and DOE's implementing regulations at 10 CFR part 1021. Specifically, this final rule amends the existing rule without affecting the amount, quality, or distribution of energy usage, and, therefore, is not expected to not result in any environmental impacts. Thus, this rulemaking is covered by Categorical Exclusion A5 under 10 CFR part 1021, subpart D, which applies to any

rulemaking that interprets or amends an existing rule without changing the environmental effect of that rule. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

E. Review Under Executive Order 13132

Executive Order 13132, "Federalism," 64 FR 43255 (August 10, 1999) imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have Federalism implications. The Executive Order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive Order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have Federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE has examined this final rule and has determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of this final rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297(d)) No further action is required by Executive Order 13132.

F. Review Under Executive Order 12988

Regarding the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, "Civil Justice Reform," 61 FR 4729 (Feb. 7, 1996), imposes on Federal agencies the general duty to adhere to the following requirements: (1) eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; (3) provide a clear legal standard for affected conduct rather than a general standard; and (4) promote simplification and burden reduction. Regarding the review required by section 3(a), section 3(b) of Executive Order 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) clearly specifies the preemptive effect, if any; (2) clearly specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in sections 3(a) and 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, the final rule meets the relevant standards of Executive Order 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Public Law No. 104-4, sec. 201 (codified at 2 U.S.C. 1531). For a regulatory action likely to result in a rule that may cause the expenditure by State, local, and

Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed "significant intergovernmental mandate," and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect them. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820. (This policy is also available at http://energy.gov/gc/office-general-counsel.) DOE examined this final rule according to UMRA and its statement of policy and determined that the rule contains neither an intergovernmental mandate, nor a mandate that may result in the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector, of $100 million or more in any year. Accordingly, no further assessment or analysis is required under UMRA.

H. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Public Law 105-277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

I. Review Under Executive Order 12630

Pursuant to Executive Order 12630, "Governmental Actions and Interference with Constitutionally Protected Property Rights," 53 FR 8859 (March 18, 1988), DOE has determined that this regulation would not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

J. Review Under Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516 note) provides for agencies to review most disseminations of information to the public under information quality guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). DOE has reviewed this final rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

Executive Order 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use," 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OIRA at OMB, a Statement of Energy Effects for any significant energy action. A "significant energy action" is defined as any action by an agency that promulgates or is expected to lead to promulgation of a final rule, and that: (1) is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant

adverse effect on the supply, distribution, or use of energy; or (3) is designated by the Administrator of OIRA as a significant energy action. For any significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use if the regulation is implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

This regulatory action, which develops conversion factors to amend the energy conservation standards for consumer and certain commercial water heaters in light of new test procedures is not a significant regulatory action under Executive Order 12866 or any successor order. Moreover, it will not have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as a significant energy action by the Administrator of OIRA. Therefore, it is not a significant energy action, and, accordingly, DOE has not prepared a Statement of Energy Effects for this rulemaking.

L. Review Under Section 32 of the Federal Energy Administration Act of 1974

Under section 301 of the Department of Energy Organization Act (Public Law 95–91; 42 U.S.C. 7101 *et seq.*), DOE must comply with all laws applicable to the former Federal Energy Administration, including section 32 of the Federal Energy Administration Act of 1974 (Public Law 93-275), as amended by the Federal Energy Administration Authorization Act of 1977 (Public Law 95-70). (15 U.S.C. 788; FEAA) Section 32 essentially provides in relevant part that, where a proposed rule authorizes or requires use of commercial standards, the notice of proposed rulemaking must inform the public of the use and background of such standards. In addition, section 32(c) requires DOE to consult with the Attorney General and the Chairman of the

Federal Trade Commission (FTC) concerning the impact of the commercial or industry standards on competition.

This final rule to implement conversion factors between the existing water heaters test procedure and the amended test procedure does not incorporate testing methods contained in commercial standards.

M. Congressional Notification

As required by 5 U.S.C. 801, DOE will report to Congress on the promulgation of this rule before its effective date. The report will state that it has been determined that the rule is not a "major rule" as defined by 5 U.S.C. 804(2).

V. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this final rule.

List of Subjects

10 CFR Part 429

Confidential business information, Energy conservation, Household appliances, Imports, Reporting and recordkeeping requirements.

10 CFR Part 430

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Incorporation by reference, Intergovernmental relations, Small businesses.

10 CFR Part 431

Administrative practice and procedure, Confidential business information, Test procedures, Incorporation by reference, Reporting and recordkeeping requirements.

Issued in Washington, DC, on December 6, 2016.

Kathleen B. Hogan
Deputy Assistant Secretary for Energy Efficiency
Energy Efficiency and Renewable Energy

For the reasons stated in the preamble, DOE amends parts 429, 430, and 431 of Chapter II Subchapter D of Title 10, Code of Federal Regulations as set forth below:

PART 429—CERTIFICATION, COMPLIANCE, AND ENFORCEMENT FOR CONSUMER PRODUCTS AND COMMERCIAL AND INDUSTRIAL EQUIPMENT

1. The authority citation for part 429 continues to read as follows:

Authority: 42 U.S.C. 6291–6317; 28 U.S.C. 2461 note.

2. Section 429.17 is revised to read as follows:

§ 429.17 Water heaters.

(a) *Determination of represented value*.

(1) As of July 13, 2015, manufacturers must determine the represented value for each new basic model of water heater by applying an alternative efficiency determination method (AEDM) in accordance with 10 CFR 429.70 or by testing for the uniform energy factor, in conjunction with the applicable sampling provisions as follows:

(i) If the represented value is determined through testing, the general requirements of 10 CFR 429.11 are applicable; and

(ii) For each basic model selected for testing, a sample of sufficient size shall be randomly selected and tested to ensure that—

(A) Any represented value of the energy consumption or other measure of energy use of a basic model for which consumers would favor lower values shall be greater than or equal to the higher of:

(1) The mean of the sample, where:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

and, $\bar{x}$ is the sample mean; n is the number of samples; and x_i is the i^{th} sample;

Or,

(2) The upper 95-percent confidence limit (UCL) of the true mean divided by 1.10, where

$$UCL = \bar{x} + t_{.95}\left(\frac{s}{\sqrt{n}}\right)$$

And $\bar{x}$ is the sample mean; s is the sample standard deviation; n is the number of samples; and $t_{0.95}$ is the t statistic for a 95-percent one-tailed confidence interval with n-1 degrees of freedom (from Appendix A).

(B) Any represented value of energy efficiency or other measure of energy consumption of a basic model for which consumers would favor higher values shall be less than or equal to the lower of:

(1) The mean of the sample, where:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

and, $\bar{x}$ is the sample mean; n is the number of samples; and x_i is the i^{th} sample;

Or,

(2) The lower 95-percent confidence limit (LCL) of the true mean divided by 0.90, where:

$$LCL = \bar{x} - t_{.95}\left(\frac{s}{\sqrt{n}}\right)$$

And $\bar{x}$ is the sample mean; s is the sample standard deviation; n is the number of samples; and $t_{0.95}$ is the t statistic for a 95-percent one-tailed confidence interval with n-1 degrees of freedom (from Appendix A).

(C) Any represented value of the rated storage volume must be equal to the mean of the measured storage volumes of all the units within the sample.

(D) Any represented value of first-hour rating or maximum gallons per minute (GPM) must be equal to the mean of the measured first-hour ratings or measured maximum GPM ratings, respectively, of all the units within the sample.

(2) For basic models initially certified before July 13, 2015 (using either the energy factor test procedure contained in appendix E to subpart B of 10 CFR part 430 of the January 1, 2015 edition of the Code of Federal Regulations or the thermal efficiency and standby loss test procedures contained in 10 CFR 431.106 of the January 1, 2015 edition of the Code of

Federal Regulations, in conjunction with applicable sampling provisions), manufacturers must:

(i) Determine the represented value for each basic model by applying an AEDM in accordance with 10 CFR 429.70 or by testing for the uniform energy factor, in conjunction with the applicable sampling provisions of paragraph (a)(1); or

(ii) Calculate the uniform energy factor for each test sample by applying the following mathematical conversion factors to test data previously obtained through testing according to appendix E to subpart B of 10 CFR part 430 of the January 1, 2015 edition of the Code of Federal Regulations or the thermal efficiency and standby loss test procedures contained in 10 CFR 431.106 of the January 1, 2015 edition of the Code of Federal Regulations. Represented values of uniform energy factor, first-hour rating, and maximum GPM rating based on a calculation using this mathematical conversion factor must be determined using the applicable sampling provisions in paragraphs (a)(1)(i) and (a)(1)(ii).

(A) Calculate the New First Hour Rating (New FHR) or New Max Gallons per Minute (New Max GPM), as applicable, using the equations presented in the table below.

Product Class	Distinguishing Criteria	Conversion Factor*
Consumer Gas-fired Water Heater	Non-Condensing, Standard and Low NOx	New FHR = 7.9592 + 0.8752 x FHR_P
	Non-Condensing, Ultra-Low NOx	New FHR = 25.0680 + 0.6535 x FHR_P
	Condensing	New FHR = 1.0570 x FHR_P
Consumer Oil-fired Water Heater	N/A	New FHR = 0.9102 x FHR_P

Consumer Electric Water Heater	Electric Resistance	New FHR = 9.2827 + 0.8092 x FHR_P
	Heat Pump	New FHR = -4.2705 + 0.9947 x FHR_P
Tabletop Water Heater	N/A	New FHR = 41.5127 + 0.1989 x FHR_P
Instantaneous Gas-fired Water Heater	N/A	New Max GPM = 1.1461 x Max GPM_P
Instantaneous Electric Water Heater	N/A	New Max GPM = 1.1461 x Max GPM_P
Grid-Enabled Water Heater	N/A	New FHR = 9.2827 + 0.8092 x FHR_P
Residential-Duty Commercial Gas-fired Water Heater	N/A	New FHR = -35.8233 + 0.4649 x V_m + 160.5089 x E_t
Residential-Duty Commercial Oil-fired Water Heater	N/A	New FHR = -35.8233 + 0.4649 x V_m + 160.5089 x E_t
Residential-Duty Commercial Electric Instantaneous Water Heater	N/A	New Max GPM = 0.0146 + 0.0295 x Q

FHR_P = prior first-hour rating.
Max GPM_P = prior maximum GPM rating.
Q = nameplate input rate, in kBtu/h.
E_t = thermal efficiency rating.
V_m = measured storage volume in gallons.

(B) Determine the applicable draw pattern as follows:

(1) For consumer gas-fired water heaters, consumer oil-fired water heaters, consumer electric water heaters, tabletop water heaters, grid-enabled water heaters, residential-duty commercial gas water heaters, residential-duty commercial oil-fired water heaters: Use the New FHR (as defined in sub-paragraph (A)) to select the applicable draw pattern from the table below:

New FHR greater than or equal to:	…and New FHR less than:	Draw Pattern
0 gallons	18 gallons	Very Small
18 gallons	51 gallons	Low
51 gallons	75 gallons	Medium

75 gallons	No upper limit	High

(2) For instantaneous gas-fired water heaters, instantaneous electric water heaters, and residential-duty commercial electric instantaneous water heaters: Use New Max GPM (as defined in sub-paragraph (A)) to select the applicable draw pattern from the table below:

New Max GPM greater than or equal to:	And New Max GPM rating less than:	Draw Pattern
0 gallons/minute	1.7 gallons/minute	Very Small
1.7 gallons/minute	2.8 gallons/minute	Low
2.8 gallons/minute	4 gallons/minute	Medium
4 gallons/minute	No upper limit	High

(C) For consumer electric heat pump water heaters, use the draw pattern to determine the applicable drawn volume (DV) from the table below.

Draw Pattern	DV
Very Small	10 gallons
Low	38 gallons
Medium	55 gallons
High	84 gallons

(D) For each class besides consumer electric heat pump water heaters, use the applicable equation to calculate: UEF_{WHAM} (for consumer storage water heaters-except heat pumps), UEF_{model} (for consumer instantaneous water heaters), UEF_{rd} (for residential-duty commercial storage water heaters), and $UEF_{rd,\ model}$ (for residential-duty commercial electric instantaneous water heaters) as follows:

(1) For consumer storage water heaters (except consumer electric heat pump water heaters):

$$UEF_{WHAM} = \left[\frac{1}{\eta_r} + \left(\frac{1}{EF} - \frac{1}{\eta_r}\right)\left(\frac{a\ P\ \eta_r - b}{c\ P\ \eta_r - d}\right)\right]^{-1}$$

Where a, b, c, and d are coefficients based on the applicable draw pattern as specified in the table below; EF is the energy factor; η_r is the recovery efficiency in decimal form; and P is the input rate in Btu/h.

Draw Pattern	a	b	c	d
Very Small	0.250266	57.5	0.039864	67.5
Low	0.065860	57.5	0.039864	67.5
Medium	0.045503	57.5	0.039864	67.5
High	0.029794	57.5	0.039864	67.5

(2) For consumer instantaneous water heaters:

$$UEF_{model} = \frac{\eta_r}{1 + A\eta_r}$$

Where η_r is the recovery efficiency expressed in decimal form and A is dependent upon the applicable draw pattern and fuel type as specified in the table below.

Draw Pattern	A	
	Electric	Gas
Very Small	0.003819	0.026915
Low	0.001549	0.010917
Medium	0.001186	0.008362
High	0.000785	0.005534

(3) For residential-duty commercial storage water heaters:

$$UEF_{rd} = \left[\frac{1}{E_t} + F * SL\left(G - \frac{1}{P\ E_t}\right)\right]^{-1}$$

Where P is the input rate in Btu/h; E_t is the thermal efficiency; SL is the standby loss in Btu/h; and F and G are coefficients as specified in the table below based on the applicable draw pattern.

Draw Pattern	F	G
Very Small	0.821429	0.0043520
Low	0.821429	0.0011450
Medium	0.821429	0.0007914
High	0.821429	0.0005181

(4) For residential-duty commercial electric instantaneous water heaters:

$$UEF_{rd,model} = \frac{E_t}{1 + AE_t}$$

Where E_t is the thermal efficiency expressed in decimal form and A is dependent upon the applicable draw pattern, as specified in the table below.

Draw Pattern	A
Very Small	0.003819
Low	0.001549
Medium	0.001186
High	0.000785

(E) Calculate the "New UEF" (i.e., the converted UEF) using the applicable equation in the table below.

Product Class	Distinguishing Criteria	Conversion Factor
Consumer Gas-fired Water Heater	Non-Condensing, Standard and Low NOx	New UEF = -0.0002 + 0.9858 x UEF_{WHAM}
	Non-Condensing, Ultra-Low NOx	New UEF = 0.0746 + 0.8653 x UEF_{WHAM}
	Condensing	New UEF = 0.4242 + 0.4641 x UEF_{WHAM}
Consumer Oil-fired Water Heater	N/A	New UEF = -0.0033 + 0.9528 x UEF_{WHAM}
Consumer Electric Water Heater	Electric Resistance	New UEF = 0.4774 + 0.4740 x UEF_{WHAM}

	Heat Pump	New UEF = 0.1513 + 0.8407 x EF + 0.0043 x DV
Tabletop Water Heater	N/A	New UEF = -0.3305 + 1.3983 x UEF_{WHAM}
Instantaneous Gas-fired Water Heater	N/A	New UEF = 0.1006 + 0.8622 x UEF_{model}
Instantaneous Electric Water Heater	N/A	New UEF = 0.9847 x UEF_{model}
Grid-Enabled Water Heater	N/A	New UEF = 0.4774 + 0.4740 x UEF_{WHAM}
Residential-Duty Commercial Gas-fired Water Heater	N/A	New UEF = -0.0022 + 1.0002 x UEF_{rd}
Residential-Duty Commercial Oil-fired Water Heater	N/A	New UEF = -0.0022 + 1.0002 x UEFrd
Residential-Duty Commercial Electric Instantaneous Water Heater	N/A	New UEF = $UEF_{rd, model}$

New UEF = converted UEF
EF = Energy Factor

(b) *Certification reports.*

(1) The requirements of 10 CFR 429.12 apply; and

(2) Pursuant to 10 CFR 429.12(b)(13), a certification report must include the following public, product-specific information:

(i) For storage-type water heater basic models previously certified for energy factor pursuant to §429.17(a) of the January 1, 2015 edition of the Code of Federal Regulations, and for which uniform energy factor is calculated pursuant to 10 CFR 429.17(a)(2)(ii): The energy factor (EF, rounded to the nearest 0.01), the uniform energy factor (UEF, rounded to the nearest 0.01), the rated storage volume in gallons (gal, rounded to the nearest 1 gal), the uniform

energy factor test procedure first-hour rating in gallons (gal, rounded to the nearest 1 gal) as determined under subparagraph (a)(2)(ii)(A), the previously certified first-hour rating under the energy factor test procedure in gallons (gal, rounded to the nearest 1 gal), and the recovery efficiency in percent (%, rounded to the nearest 1%);

(ii) For storage-type water heater basic models rated pursuant to 10 CFR 429.17(a)(1) or 10 CFR 429.17(a)(2)(i): The uniform energy factor (UEF, rounded to the nearest 0.01), the rated storage volume in gallons (gal, rounded to the nearest 1 gal), the first-hour rating in gallons (gal, rounded to the nearest 1 gal), and the recovery efficiency in percent (%, rounded to the nearest 1%);

(iii) For instantaneous-type water heater basic models previously certified for energy factor pursuant to §429.17(a) of the January 1, 2015 edition of the Code of Federal Regulations, and for which uniform energy factor is calculated pursuant to 10 CFR 429.17(a)(2)(ii): The energy factor (EF, rounded to the nearest 0.01), the uniform energy factor (UEF. rounded to the nearest 0.01), the rated storage volume in gallons (gal, rounded to the nearest 1 gal), the uniform energy factor test procedure maximum gallons per minute (gpm, rounded to the nearest 0.1 gpm) as determined under subparagraph (a)(2)(ii)(A), the previously certified maximum gallons per minute (gpm, rounded to the nearest 0.1 gpm) under the energy factor test procedure, and the recovery efficiency in percent (%, rounded to the nearest 1%);

(iv) For instantaneous-type water heater basic models rated pursuant to 10 CFR 429.17(a)(1) or 10 CFR 429.17(a)(2)(i): The uniform energy factor (UEF, rounded to the nearest 0.01), the rated storage volume in gallons (gal, rounded to the nearest 1 gal), the maximum gallons per

minute (gpm, rounded to the nearest 0.1 gpm), and the recovery efficiency in percent (%, rounded to the nearest 1%);

(v) For grid-enabled water heater basic models previously certified for energy factor pursuant to 10 CFR 429.17(a) of the January 1, 2015 edition of the Code of Federal Regulations, and for which uniform energy factor is calculated pursuant to 10 CFR 429.17(a)(2)(ii): The energy factor (EF, rounded to the nearest 0.01), the uniform energy factor (UEF, rounded to the nearest 0.01), the rated storage volume in gallons (gal, rounded to the nearest 1 gal), the uniform energy factor test procedure first-hour rating in gallons (gal, rounded to the nearest 1 gal) as determined under subparagraph (a)(2)(ii)(A), the previously certified first-hour rating under the energy factor test procedure in gallons (gal, rounded to the nearest 1 gal), the recovery efficiency in percent (%, rounded to the nearest 1%), a declaration that the model is a grid-enabled water heater, whether it is equipped at the point of manufacture with an activation lock, and whether it bears a permanent label applied by the manufacturer that advises purchasers and end-users of the intended and appropriate use of the product; and

(vi) For grid-enabled water heater basic models rated pursuant to 10 CFR 429.17(a)(1) or 10 CFR 429.17(a)(2)(i): The uniform energy factor (UEF, rounded to the nearest 0.01), the rated storage volume in gallons (gal, rounded to the nearest 1 gal), the first-hour rating in gallons (gal, rounded to the nearest 1 gal), and the recovery efficiency in percent (%, rounded to the nearest 1%), a declaration that the model is a grid-enabled water heater, whether it is equipped at the point of manufacture with an activation lock, and whether it bears a permanent label applied by the manufacturer that advises purchasers and end-users of the intended and appropriate use of the product.

3. Section 429.17 is further revised, effective **[INSERT DATE ONE YEAR AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, to read as follows:

§429.17 Water heaters.

(a) *Determination of represented value*.

(1) Manufacturers must determine the represented value for each water heater by applying an AEDM in accordance with 10 CFR 429.70 or by testing for the uniform energy factor, in conjunction with the applicable sampling provisions as follows:

(i) If the represented value is determined through testing, the general requirements of 10 CFR 429.11 are applicable; and

(ii) For each basic model selected for testing, a sample of sufficient size shall be randomly selected and tested to ensure that—

(A) Any represented value of the estimated annual operating cost or other measure of energy consumption of a basic model for which consumers would favor lower values shall be greater than or equal to the higher of:

(1) The mean of the sample, where:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

and, $\bar{x}$ is the sample mean; n is the number of samples; and x_i is the i^{th} sample;

Or,

(2) The upper 95-percent confidence limit (UCL) of the true mean divided by 1.10, where:

$$UCL = \bar{x} + t_{.95}\left(\frac{s}{\sqrt{n}}\right)$$

And $\bar{x}$ is the sample mean; s is the sample standard deviation; n is the number of samples; and $t_{0.95}$ is the t statistic for a 95-percent one-tailed confidence interval with n-1 degrees of freedom (from Appendix A).

(B) Any represented value of the uniform energy factor, or other measure of energy consumption of a basic model for which consumers would favor higher values shall be less than or equal to the lower of:

(1) The mean of the sample, where:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

and, x is the sample mean; n is the number of samples; and x_i is the i^{th} sample;

Or,

(2) The lower 95-percent confidence limit (LCL) of the true mean divided by 0.90, where:

$$LCL = \bar{x} - t_{.95}\left(\frac{s}{\sqrt{n}}\right)$$

And $\bar{x}$ is the sample mean; s is the sample standard deviation; n is the number of samples; and $t_{0.95}$ is the t statistic for a 95-percent one-tailed confidence interval with n-1 degrees of freedom (from Appendix A).

(C) Any represented value of the rated storage volume must be equal to the mean of the measured storage volumes of all the units within the sample.

(D) Any represented value of first-hour rating or maximum gallons per minute (GPM) must be equal to the mean of the measured first-hour ratings or measured maximum GPM ratings, respectively, of all the units within the sample.

(b) *Certification reports.*

(1) The requirements of 10 CFR 429.12 are applicable to water heaters; and

(2) Pursuant to 10 CFR 429.12(b)(13), a certification report shall include the following public, product-specific information:

(i) For storage-type water heater basic models: The uniform energy factor (UEF, rounded to the nearest 0.01), the rated storage volume in gallons (rounded to the nearest 1 gal), the first-hour rating in gallons (gal, rounded to the nearest 1 gal), and the recovery efficiency in percent (%, rounded to the nearest 1%);

(ii) For instantaneous-type water heater basic models: The uniform energy factor (UEF, rounded to the nearest 0.01), the rated storage volume in gallons (gal, rounded to the nearest 1 gal), the maximum gallons per minute (gpm, rounded to the nearest 0.1 gpm), and the recovery efficiency in percent (%, rounded to the nearest 1%); and

(iii) For grid-enabled water heater basic models: The uniform energy factor (UEF, rounded to the nearest 0.01), the rated storage volume in gallons (gal, rounded to the nearest 1 gal), the first-hour rating in gallons (gal, rounded to the nearest 1 gal), the recovery efficiency in percent (%, rounded to the nearest 1%), a declaration that the model is a grid-enabled water heater, whether it is equipped at the point of manufacture with an activation lock, and whether it bears a permanent label applied by the manufacturer that advises purchasers and end-users of the intended and appropriate use of the product.

4. Section 429.44 is amended by revising paragraph (d) to read as follows:

§ 429.44 Commercial water heating equipment.

* * * * *

(d) Certification reports for residential-duty commercial water heaters.

(1) The requirements of §429.12 apply; and

(2) Pursuant to §429.12(b)(13), a certification report must include the following public, equipment-specific information:

(i) Residential-duty commercial gas-fired and oil-fired storage water heaters previously certified for thermal efficiency and standby loss pursuant to 10 CFR 429.44(b) of the January 1, 2015 edition of the Code of Federal Regulations, and for which uniform energy factor is calculated pursuant to 10 CFR 429.17(a)(2)(ii): The thermal efficiency in percent (%), the standby loss in

British thermal units per hour (Btu/h), the uniform energy factor (UEF, rounded to the nearest 0.01), the rated storage volume in gallons (gal), and the nameplate input rate in Btu/h.

(ii) Residential-duty commercial gas-fired and oil-fired storage water heaters rated for uniform energy factor pursuant to 10 CFR 429.17(a)(2)(i): The uniform energy factor (UEF, rounded to the nearest 0.01), the rated storage volume in gallons (rounded to the nearest 1 gal), the first-hour rating in gallons (gal, rounded to the nearest 1 gal), and the recovery efficiency in percent (%, rounded to the nearest 1%).

(iii) Residential-duty commercial electric instantaneous water heaters previously certified for thermal efficiency and standby loss pursuant to 10 CFR 429.44(b) of the January 1, 2015 edition of the Code of Federal Regulations, and for which uniform energy factor is calculated pursuant to 10 CFR 429.17(a)(2)(ii): The thermal efficiency in percent (%), the standby loss in British thermal units per hour (Btu/h), the uniform energy factor (UEF, rounded to the nearest 0.01), the rated storage volume in gallons (gal), and the nameplate input rate in kilowatts (kW).

(iv) Residential-duty commercial electric instantaneous water heaters rated for uniform energy factor pursuant to 10 CFR 429.17(a)(2)(i): The uniform energy factor (UEF, rounded to the nearest 0.01), the rated storage volume in gallons (gal, rounded to the nearest 1 gal), the maximum gallons per minute (gpm, rounded to the nearest 0.1 gpm), and the recovery efficiency in percent (%, rounded to the nearest 1%)).

* * * * *

5. Section 429.44 is further revised, effective **[INSERT DATE ONE YEAR AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, by amending paragraph (d) to read as follows:

§ 429.44 Commercial water heating equipment.

* * * * *

(d) * * *

(1) * * *

(2) Pursuant to §429.12(b)(13), a certification report for equipment must include the following public, equipment-specific information:

(i) Residential-duty commercial gas-fired and oil-fired storage water heaters: The uniform energy factor (UEF, rounded to the nearest 0.01), the rated storage volume in gallons (gal, rounded to the nearest 1 gal), the first-hour rating in gallons (gal, rounded to the nearest 1 gal), and the recovery efficiency in percent (%, rounded to the nearest 1%).

(ii) Residential-duty commercial electric instantaneous water heaters: The uniform energy factor (UEF, rounded to the nearest 0.01), the rated storage volume in gallons (gal, rounded to the nearest 1 gal), the maximum gallons per minute (gpm, rounded to the nearest 0.1 gpm), and the recovery efficiency in percent (%, rounded to the nearest 1%).

* * * * *

6. Section 429.134 is revised by amending paragraph (d)(2) to read as follows:

§ 429.134 Product-specific enforcement provisions.

* * * * *

(d) * * *

(2) Verification of rated storage volume. The storage volume of the basic model will be measured pursuant to the test requirements of appendix E to subpart B of 10 CFR part 430 for each unit tested. The mean of the measured values will be compared to the rated storage volume as certified by the manufacturer. The rated value will be considered valid only if the measurement is within 3 percent of the certified rating.

(i) If the rated storage volume is found to be within 3 percent of the mean of the measured value of storage volume, then the rated value will be used as the basis for calculation of the required uniform energy factor for the basic model.

(ii) If the rated storage volume is found to vary more than 3 percent from the mean of the measured values, then the mean of the measured values will be used as the basis for calculation of the required uniform energy factor for the basic model.

* * * * *

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

7. The authority citation for part 430 continues to read as follows:

Authority: 42 U.S.C. 6291–6309; 28 U.S.C. 2461 note.

8. Section 430.23 is amended by revising paragraph (e) to read as follows:

§ 430.23 Test procedures for the measurement of energy and water consumption.

* * * * *

(e) *Water Heaters.*

(1) For water heaters tested using energy factor and for which uniform energy factor is determined using the conversion factors in accordance with 10 CFR 429.17(a)(2):

(i) The estimated annual operating cost is calculated as—

(A) For a gas-fired or oil-fired water heater, the product of the annual energy consumption, determined according to section 6.3.7 or 6.4.4 of appendix E of this subpart, times the representative average unit cost of gas or oil, as appropriate, in dollars per Btu as provided by the Secretary. Round the resulting product to the nearest dollar per year.

(B) For an electric water heater, the product of the annual energy consumption, determined according to section 6.3.7 or 6.4.4 of appendix E of this subpart, times the representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary, divided by 3412 Btu per kilowatt-hour. Round the resulting product to the nearest dollar per year.

(ii) For an individual unit, determine the tested energy factor in accordance with section 6.1.7 or 6.2.4 of appendix E to subpart B of 10 CFR part 430 of the January 1, 2015 edition of the Code of Federal Regulations, and round the value to the nearest 0.01. Determine the converted uniform energy factor in accordance with 10 CFR 429.17(a)(2), and round the value to the nearest 0.01.

(2) For water heaters tested using uniform energy factor:

(i) The estimated annual operating cost is calculated as:

(A) For a gas-fired or oil-fired water heater, the sum of: The product of the annual gas or oil energy consumption, determined according to section 6.3.9 or 6.4.6 of appendix E of this subpart, times the representative average unit cost of gas or oil, as appropriate, in dollars per Btu as provided by the Secretary; plus the product of the annual electric energy consumption, determined according to section 6.3.8 or 6.4.5 of appendix E of this subpart, times the representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary. Round the resulting sum to the nearest dollar per year.

(B) For an electric water heater, the product of the annual energy consumption, determined according to section 6.3.7 or 6.4.4 of appendix E of this subpart, times the representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary. Round the resulting product to the nearest dollar per year.

(ii) For an individual unit, determine the tested uniform energy factor in accordance with section 6.3.6 or 6.4.3 of appendix E of this subpart, and round the value to the nearest 0.01.

* * * * *

9. Section 430.23 paragraph (e) is further revised, effective **[INSERT DATE ONE YEAR AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, to read as follows:

§ 430.23 Test procedures for the measurement of energy and water consumption.

* * * * *

(e) *Water Heaters.*

(1) The estimated annual operating cost is calculated as:

(i) For a gas-fired or oil-fired water heater, the sum of: The product of the annual gas or oil energy consumption, determined according to section 6.3.9 or 6.4.6 of appendix E of this subpart, times the representative average unit cost of gas or oil, as appropriate, in dollars per Btu as provided by the Secretary; plus the product of the annual electric energy consumption, determined according to section 6.3.8 or 6.4.5 of appendix E of this subpart, times the representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary. Round the resulting sum to the nearest dollar per year.

(ii) For an electric water heater, the product of the annual energy consumption, determined according to section 6.3.7 or 6.4.4 of appendix E of this subpart, times the representative average unit cost of electricity in dollars per kilowatt-hour as provided by the Secretary. Round the resulting product to the nearest dollar per year.

(2) For an individual unit, determine the tested uniform energy factor in accordance with section 6.3.6 or 6.4.3 of appendix E of this subpart, and round the value to the nearest 0.01.

* * * * *

10. Section 430.32 is amended by revising paragraph (d) to read as follows:

§ 430.32 Energy and water conservation standards and their compliance dates.

* * * * *

(d) *Water heaters.* The uniform energy factor of water heaters shall not be less than the following:

Product Class	**Rated Storage Volume and Input Rating (if Applicable)**	**Draw Pattern**	**Uniform Energy Factor**
Gas-fired Storage Water Heater	≥ 20 gal and ≤ 55 gal	Very Small	0.3456 - (0.0020 x V_r)
		Low	0.5982 - (0.0019 x V_r)
		Medium	0.6483 - (0.0017 x V_r)
		High	0.6920 - (0.0013 x V_r)
	> 55 gal and ≤ 100 gal	Very Small	0.6470 - (0.0006 x V_r)
		Low	0.7689 - (0.0005 x V_r)
		Medium	0.7897 - (0.0004 x V_r)
		High	0.8072 - (0.0003 x V_r)
Oil-fired Storage Water Heater	≤ 50 gal	Very Small	0.2509 - (0.0012 x V_r)
		Low	0.5330 - (0.0016 x V_r)
		Medium	0.6078 - (0.0016 x V_r)
		High	0.6815 - (0.0014 x V_r)
Electric Storage Water Heaters	≥ 20 gal and ≤ 55 gal	Very Small	0.8808 - (0.0008 x V_r)
		Low	0.9254 - (0.0003 x V_r)
		Medium	0.9307 - (0.0002 x V_r)
		High	0.9349 - (0.0001 x V_r)
	> 55 gal and ≤ 120 gal	Very Small	1.9236 - (0.0011 x V_r)
		Low	2.0440 - (0.0011 x V_r)
		Medium	2.1171 - (0.0011 x V_r)
		High	2.2418 - (0.0011 x V_r)
Tabletop Water Heater	≥ 20 gal and ≤ 120 gal	Very Small	0.6323 - (0.0058 x V_r)
		Low	0.9188 - (0.0031 x V_r)
		Medium	0.9577 - (0.0023 x V_r)
		High	0.9884 - (0.0016 x V_r)
Instantaneous Gas-fired Water Heater	< 2 gal and >50,000 Btu/h	Very Small	0.80
		Low	0.81
		Medium	0.81
		High	0.81
Instantaneous Electric Water Heater	< 2 gal	Very Small	0.91
		Low	0.91
		Medium	0.91
		High	0.92
	> 75 gal	Very Small	1.0136 - (0.0028 x V_r)

Grid-Enabled Water Heater		Low	0.9984 - (0.0014 x V_r)
		Medium	0.9853 - (0.0010 x V_r)
		High	0.9720 - (0.0007 x V_r)

* V_r is the Rated Storage Volume (in gallons), as determined pursuant to 10 CFR 429.17.

* * * * *

PART 431—ENERGY EFFICIENCY PROGRAM FOR CERTAIN COMMERCIAL AND INDUSTRIAL EQUIPMENT

11. The authority citation for part 431 continues to read as follows:

Authority: 42 U.S.C. 6291–6317; 28 U.S.C. 2461 note.

12. Section 431.110 is revised to read as follows:

§ 431.110 Energy conservation standards and their effective dates.

(a) Each commercial storage water heater, instantaneous water heater, unfired hot water storage tank and hot water supply boiler[1] (excluding residential-duty commercial water heaters) must meet the applicable energy conservation standard level(s) as follows: ½

[1]Any packaged boiler that provides service water that meets the definition of "commercial packaged boiler" in subpart E of this part, but does not meet the definition of "hot water supply boiler" in subpart G, must meet the requirements that apply to it under subpart E.

Equipment category	Size	Energy conservation standard[a]		
		Maximum standby loss[c] (equipment manufactured on and after October 29, 2003)[b]	Minimum thermal efficiency (equipment manufactured on and after October	Minimum thermal efficiency (equipment manufactured on

			29, 2003 and before October 9, 2015)[b]	and after October 9, 2015)[b]
Electric storage water heaters	All	$0.30 + 27/V_m$ (%/hr)	N/A	N/A
Gas-fired storage water heaters	≤155,000 Btu/hr	$Q/800 + 110(V_r)^{½}$ (Btu/hr)	80%	80%
	>155,000 Btu/hr	$Q/800 + 110(V_r)^{½}$ (Btu/hr)	80%	80%
Oil-fired storage water heaters	≤155,000 Btu/hr	$Q/800 + 110(V_r)^{½}$ (Btu/hr)	78%	80%
	>155,000 Btu/hr	$Q/800 + 110(V_r)^{½}$ (Btu/hr)	78%	80%
Gas-fired instantaneous water heaters and hot water supply boilers	<10 gal	N/A	80%	80%
	≥10 gal	$Q/800 + 110(V_r)^{½}$ (Btu/hr)	80%	80%
Oil-fired instantaneous water heaters and hot water supply boilers	<10 gal	N/A	80%	80%
	≥10 gal	$Q/800 + 110(V_r)^{½}$ (Btu/hr)	78%	78%

Equipment Category	**Size**	**Minimum thermal insulation**
Unfired hot water storage tank	All	R-12.5

[a] V_m is the measured storage volume (in gallons), and V_r is the rated volume (in gallons). Q is the nameplate input rate in Btu/hr.

[b] For hot water supply boilers with a capacity of less than 10 gallons: (1) The standards are mandatory for products manufactured on and after October 21, 2005, and (2) products manufactured prior to that date, and on or after October 23, 2003, must meet either the standards listed in this table or the applicable standards in subpart E of this part for a “commercial packaged boiler.”

[c] Water heaters and hot water supply boilers having more than 140 gallons of storage capacity need not meet the standby loss requirement if: (1) The tank surface area is thermally insulated to R-12.5 or more; (2) a standing pilot light is not used; and (3) for gas or oil-fired storage water heaters, they have a fire damper or fan-assisted combustion.

(b) Each residential-duty commercial water heater must meet the applicable energy conservation standard level(s) as follows:

Product Class	**Specifications**[a]	**Draw Pattern**	**Uniform Energy Factor**[b]
Gas-fired Storage	>75 kBtu/hr and ≤105 kBtu/hr and ≤120 gal	Very Small	0.2674 - (0.0009 x V_r)
		Low	0.5362 - (0.0012 x V_r)
		Medium	0.6002 - (0.0011 x V_r)
		High	0.6597 - (0.0009 x V_r)
Oil-fired Storage	>105 kBtu/hr and ≤140 kBtu/hr and ≤120 gal	Very Small	0.2932 - (0.0015 x V_r)
		Low	0.5596 - (0.0018 x V_r)
		Medium	0.6194 - (0.0016 x V_r)
		High	0.6740 - (0.0013 x V_r)
Electric Instantaneous	> 12 kW and ≤58.6 kW and ≤ 2 gal	Very Small	0.80
		Low	0.80
		Medium	0.80
		High	0.80

[a] Additionally, to be classified as a residential-duty commercial water heater, a commercial water heater must meet the following conditions: (1) if the water heater requires electricity, it must use a single-phase external power supply; and (2) the water heater must not be designed to heat water to temperatures greater than 180 °F.
[b] V_r is the rated storage volume (in gallons), as determined pursuant to 10 CFR 429.44.