



[6450-01-P]

DEPARTMENT OF ENERGY

10 CFR Part 430 and 431

[EERE-2019-BT-TP-0032]

RIN 1904-AE77

Energy Conservation Program: Test Procedures for Consumer Water Heaters and Residential-Duty Commercial Water Heaters

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

ACTION: Request for information.

SUMMARY: The U.S. Department of Energy (DOE) is initiating a data collection process through this request for information (RFI) to consider whether to amend DOE's test procedure for consumer water heaters and residential-duty commercial water heaters. Specifically, DOE seeks data and information pertinent to whether amended test procedures would more accurately or fully comply with the requirement that the test procedure produces results that measure energy use during a representative average use cycle for the product, and not be unduly burdensome to conduct. DOE welcomes written comments from the public on any subject within the scope of this document (including topics not raised in this RFI), as well as the submission of data and other relevant information.

DATES: Written comments and information are requested and will be accepted on or before **[INSERT DATE 45 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

ADDRESSES: Interested persons are encouraged to submit comments using the Federal eRulemaking Portal at <http://www.regulations.gov>. Follow the instructions for submitting comments. Alternatively, interested persons may submit comments, identified by docket number EERE–2019–BT–TP–0032 and/or RIN 1904-AE77, by any of the following methods:

1. *Federal eRulemaking Portal:* <http://www.regulations.gov>. Follow the instructions for submitting comments.
2. *E-mail:* to WaterHeaters2019TP0032@ee.doe.gov. Include docket number EERE–2019–BT–TP–0032 and/or RIN 1904-AE77 in the subject line of the message.
3. *Postal Mail:* Appliance and Equipment Standards Program, U.S. Department of Energy, Building Technologies Office, Mailstop EE-5B, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. Telephone: (202) 287-1445. If possible, please submit all items on a compact disc (CD), in which case it is not necessary to include printed copies.
4. *Hand Delivery/Courier:* Appliance and Equipment Standards Program, U.S. Department of Energy, Building Technologies Office, 950 L’Enfant Plaza, SW., Suite 600, Washington, DC, 20024. Telephone: (202) 287-1445. If possible,

please submit all items on a CD, in which case it is not necessary to include printed copies.

No telefacsimilies (faxes) will be accepted. For detailed instructions on submitting comments and additional information on this process, see section III of this document.

Docket: The docket for this activity, which includes *Federal Register* notices, comments, and other supporting documents/materials, is available for review at <http://www.regulations.gov>. All documents in the docket are listed in the <http://www.regulations.gov> index. However, some documents listed in the index, such as those containing information that is exempt from public disclosure, may not be publicly available.

The docket webpage can be found at:
<https://www.regulations.gov/docket?D=EERE-2019-BT-TP-0032>. The docket webpage contains instructions on how to access all documents, including public comments, in the docket. See section III for information on how to submit comments through <http://www.regulations.gov>.

FOR FURTHER INFORMATION CONTACT: Ms. Catherine Rivest, 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) 586-7335. E-mail: ApplianceStandardsQuestions@ee.doe.gov.

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For further information on how to submit a comment or review other public
comments and the docket, contact the Appliance and Equipment Standards Program staff
at (202) 287-1445 or by e-mail: *ApplianceStandardsQuestions@ee.doe.gov*.

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I. Introduction

Consumer water heaters are included in the list of “covered products” for which DOE is authorized to establish and amend energy conservation standards and test procedures. (42 U.S.C. 6292(a)(4)) DOE’s test procedures for consumer water heaters are prescribed at Title 10 of the Code of Federal Regulations (CFR) Part 430, Subpart B, Appendix E (Appendix E). As discussed below, residential-duty commercial water heaters, for which DOE is also authorized to establish and amend energy conservation standards and test procedures (42 U.S.C. 6311(k)), also must be tested according to Appendix E. (See 42 U.S.C. 6295(e)(6)(H)) The following sections discuss DOE’s authority to establish and amend test procedures for consumer water heaters and residential-duty commercial water heaters, as well as relevant background information regarding DOE’s consideration of test procedures for this product and equipment.

A. Authority and Background

The Energy Policy and Conservation Act, as amended (EPCA)¹, among other things, authorizes DOE to regulate the energy efficiency of a number of consumer products and certain industrial equipment. (42 U.S.C. 6291–6317) Title III, Part B² of EPCA, Public Law 94-163 (42 U.S.C. 6291-6309, as codified), established the Energy Conservation Program for Consumer Products Other Than Automobiles, which sets forth a variety of provisions designed to improve energy efficiency. These products include

¹ All references to EPCA in this document refer to the statute as amended through America’s Water Infrastructure Act of 2018, Public Law 115–270 (Oct. 23, 2018).

² For editorial reasons, upon codification in the U.S. Code, Part B was redesignated Part A.

consumer water heaters, the subject of this RFI. (42 U.S.C. 6292(a)(4)) Title III, Part C³ of EPCA, Public Law 94-163 (42 U.S.C. 6311-6317, as codified), added by Public Law 95-619, Title IV, section 441(a), established the Energy Conservation Program for Certain Industrial Equipment, which again sets forth a variety of provisions designed to improve energy efficiency. This equipment includes commercial water heaters, which are also the subject of this RFI. (42 U.S.C. 6311(1)(k))

The energy conservation program under EPCA consists essentially of four parts: (1) testing, (2) labeling, (3) Federal energy conservation standards, and (4) certification and enforcement procedures. Relevant provisions of EPCA specifically include definitions (42 U.S.C. 6291; 42 U.S.C. 6311), energy conservation standards (42 U.S.C. 6295; 42 U.S.C. 6313), test procedures (42 U.S.C. 6293; 42 U.S.C. 6314), labeling provisions (42 U.S.C. 6294; 42 U.S.C. 6315), and the authority to require information and reports from manufacturers (42 U.S.C. 6296; 42 U.S.C. 6316).

Federal energy efficiency requirements for covered products and covered equipment established under EPCA generally supersede State laws and regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6297(a)-(c); 42 U.S.C. 6316(a) and (b)) DOE may, however, grant waivers of Federal preemption in limited circumstances for particular State laws or regulations, in accordance with the

³ For editorial reasons, upon codification in the U.S. Code, Part C was redesignated Part A-1.

procedures and other provisions of EPCA. (42 U.S.C. 6297(d); 42 U.S.C. 6316(a); 42 U.S.C. 6316(b)(2)(D))

The Federal testing requirements consist of test procedures that manufacturers of covered products and commercial equipment must use as the basis for: (1) certifying to DOE that their products comply with the applicable energy conservation standards adopted pursuant to EPCA (42 U.S.C. 6295(s); 42 U.S.C. 6296; 42 U.S.C. 6316(a)-(b)), and (2) making representations about the efficiency of those products (42 U.S.C. 6293(c); 42 U.S.C. 6314(d)). Similarly, DOE must use these test procedures to determine whether the products comply with relevant standards promulgated under EPCA. (42 U.S.C. 6295(s))

Under 42 U.S.C. 6293, the statute sets forth the criteria and procedures DOE must follow when prescribing or amending test procedures for covered products. Specifically, EPCA requires that any test procedures prescribed or amended shall be reasonably designed to produce test results which measure energy efficiency, energy use, or estimated annual operating cost of a covered product during a representative average use cycle or period of use and not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3)) Under 42 U.S.C. 6314, the statute sets forth the criteria and procedures DOE must follow when prescribing or amending test procedures for covered equipment, reciting similar requirements at 42 U.S.C. 6314(a)(2).

If DOE determines that a test procedure amendment is warranted, it must publish proposed test procedures in the *Federal Register* and offer the public an opportunity to present oral and written comments on them. (42 U.S.C. 6293(b)(2); 42 U.S.C. 6314(b))

In addition, the Energy Independence and Security Act of 2007 (EISA 2007) amended EPCA to require that DOE amend its test procedures for all covered consumer products to integrate measures of standby mode and off mode energy consumption into the overall energy efficiency, energy consumption, or other energy descriptor, taking into consideration the most current versions of Standards 62301 and 62087 of the International Electrotechnical Commission (IEC), unless the current test procedure already incorporates the standby mode and off mode energy consumption, or if such integration is technically infeasible. (42 U.S.C. 6295(gg)(2)(A)) If an integrated test procedure is technically infeasible, DOE must prescribe separate standby mode and off mode energy use test procedures for the covered product, if a separate test is technically feasible. (*Id.*)

The American Energy Manufacturing Technical Corrections Act (AEMTCA), Public Law 112–210, further amended EPCA to require that DOE establish a uniform efficiency descriptor and accompanying test methods to replace the energy factor (EF) metric for covered consumer water heaters and the thermal efficiency (TE) and standby loss (SL) metrics for commercial water-heating equipment⁴ within one year of the

⁴ The initial thermal efficiency and standby loss test procedures for commercial water heating equipment (including residential-duty commercial water heaters) were added to EPCA by the Energy Policy Act of

enactment of AEMTCA. (42 U.S.C. 6295(e)(6)(B)-(C)) The uniform efficiency descriptor and accompanying test method were required to apply, to the maximum extent practicable, to all water-heating technologies in use at the time and to future water-heating technologies, but could exclude specific categories of covered water heaters that do not have residential uses, can be clearly described, and are effectively rated using the TE and SL descriptors. (42 U.S.C. 6295(e)(6)(F) and (H)) In addition, beginning one year after the date of publication of DOE’s final rule establishing the uniform descriptor, the efficiency standards for covered water heaters were required to be denominated according to the uniform efficiency descriptor established in the final rule (42 U.S.C. 6295(e)(6)(D)); and for affected covered water heaters tested prior to the effective date of the test procedure final rule, DOE was required to develop a mathematical factor for converting the measurement of their energy efficiency from the EF, TE, and SL metrics to the new uniform energy descriptor. (42 U.S.C. 6295(e)(6)(E)(i)–(ii))

The Energy Efficiency Improvement Act of 2015 (EEIA 2015), Pub. L. 114–11, was enacted on April 30, 2015. The EEIA 2015 amended EPCA, in relevant part, by adding definitions for “grid-enabled water heater” and “activation lock” at 42 U.S.C. 6295(e)(5)(A). These products are intended for use as part of an electric thermal storage

1992 (EPACT 1992), Public Law 102-486, and corresponded to those referenced in the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and Illuminating Engineering Society of North America (IESNA) Standard 90.1-1989 (*i.e.*, ASHRAE Standard 90.1-1989). (42 U.S.C. 6314(a)(4)(A)) DOE subsequently updated the commercial water heating equipment test procedures on two separate occasions – once in a direct final rule published on October 21, 2004, and again in a final rule published on May 16, 2012 (77 FR 28928). These rules incorporated by reference certain sections of the latest versions of American National Standards Institute (ANSI) Standard Z21.10.3, *Gas Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous*, available at the time (*i.e.*, ANSI Z21.10.3-1998 and ANSI Z21.10.3-2011, respectively). 69 FR 61974, 61983 (Oct. 21, 2004) and 77 FR 28928, 28996 (May 16, 2012).

or demand response program. Among the criteria that define “grid-enabled water heaters” is an energy-related performance standard that is either an EF specified by a formula set forth in the statute, or an equivalent alternative standard that DOE may prescribe. (42 U.S.C. 6295(e)(5)(A)(III)(aa) and (bb)) In addition, the EEIA 2015 amendments to EPCA also directed DOE to require reporting on shipments and activations of grid-enabled water heaters and to establish procedures, if appropriate, to prevent product diversion for non-program purposes. (42 U.S.C. 6295(e)(5)(C)-(D))

EPCA also requires that, at least once every 7 years, DOE evaluate test procedures for each type of covered product and covered equipment, including consumer water heaters and the commercial water heaters that are the subject of this RFI, to determine whether amended test procedures would more accurately or fully comply with the requirements for the test procedures to not be unduly burdensome to conduct and be reasonably designed to produce test results that reflect energy efficiency, energy use, and estimated operating costs during a representative average use cycle (or additionally, period of use for consumer products). (42 U.S.C. 6293(b)(1)(A); 42 U.S.C. 6314(a)) If the Secretary determines, on his own behalf or in response to a petition by any interested person, that a test procedure should be prescribed or amended, the Secretary shall promptly publish in the *Federal Register* proposed test procedures and afford interested persons an opportunity to present oral and written data, views, and arguments with respect to such procedures. The comment period on a proposed rule to amend a test

procedure for consumer products shall be at least 60 days⁵ and may not exceed 270 days. In prescribing or amending a test procedure, the Secretary shall take into account such information as the Secretary determines relevant to such procedure, including technological developments relating to energy use or energy efficiency of the type (or class) of covered products involved. (42 U.S.C. 6293(b)(2)) If DOE determines that test procedure revisions are not appropriate, DOE must publish in the *Federal Register* its determination not to amend the test procedures. (42 U.S.C. 6293(b)(1)(A); 42 U.S.C. 6314(a)(1)(A)(ii)) DOE is publishing this RFI to collect data and information to inform its decision in satisfaction of the 7-year-lookback review requirement specified in EPCA.

B. Rulemaking History

As stated, DOE's current test procedure for consumer water heaters appears at Appendix E.

DOE first established consumer water heater test procedures in a final rule published in the *Federal Register* on October 4, 1977. 42 FR 54110. These original procedures coupled laboratory tests with calculations to obtain estimates of energy efficiency for storage-type electric, gas-fired, and oil-fired water heaters. The laboratory tests consisted of a cold start "recovery efficiency test," which measured the ability of a water heater to heat cold water, and a "standby loss test," which measured the energy loss

⁵ For covered equipment, if the Secretary determines that a test procedure amendment is warranted, the Secretary must publish proposed test procedures in the *Federal Register*, and afford interested persons an opportunity (of not less than 45 days' duration) to present oral and written data, views, and arguments on the proposed test procedures. (42 U.S.C. 6314(b))

of a water heater when not providing heated water. *Id.* at 54118. Recovery efficiency and percent standby loss were mathematically combined to obtain an energy factor (EF), the overall measure of water heater efficiency. *Id.* at 54116. The original procedures also included calculations for determining the average daily energy consumption and annual operating costs. *Id.* at 54116, 54119.

On October 19, 1978, DOE published a final rule to amend the consumer water heater test procedures to correct for an error in the derivation of EF. The correction specified that the useful output (*i.e.*, the numerator in EF equation) shall be the “daily hot water energy consumption,” a new term which was defined in this rule. 43 FR 48986.

DOE amended the consumer water heater test procedures in a final rule published on September 7, 1979, to prescribe a measure of a water heater's useful capacity, which DOE called first-hour rating (FHR). The FHR was defined as the maximum hourly demand which could be met by the water heater. 44 FR 52632.

On October 17, 1990, DOE published a final rule further updating the consumer water heater test procedure. 55 FR 42162. This final rule extended coverage to heat pump water heaters and instantaneous-type water heaters; revised the test procedure to allow for a single test for all types of water heaters, establishing a simulated-use test that included a six-hour draw test; and revised the FHR test from a calculated estimate to a direct measurement to more accurately determine a water heater's ability to supply hot water.

DOE further amended the consumer water heater test procedure by final rules published in the *Federal Register* on May 11, 1998 (May 1998 final rule), July 20, 1998

(July 1998 final rule), and January 17, 2001 (January 2001 final rule). 63 FR 25996; 63 FR 38737; 66 FR 4474. The May 1998 final rule revised the FHR test to more accurately test large storage-type water heaters and updated the testing for electric and gas-fired instantaneous water heaters from the FHR test to the maximum gallons per minute (max GPM) test. The July 1998 final rule was a technical correction that added figures to the test procedure, and the January 2001 final rule added a definition for “tabletop water heater” to the test procedure.

As discussed, the EISA 2007 amendments to EPCA required DOE to amend its test procedures for all covered consumer products to include the measurement of standby mode and off mode energy consumption, unless the current test procedure already incorporates the standby mode and off mode energy consumption, or if such integration is technically infeasible. (42 U.S.C. 6295(gg)(2)(A)) On December 17, 2012, DOE published a final rule that concluded that no modifications were needed to the consumer water heater test procedure to account for standby mode and off mode energy consumption, as the existing test procedure already accounted for those modes of energy consumption. 77 FR 74559.

Pursuant to the requirements of the AEMTCA amendments to EPCA discussed previously, DOE updated the consumer water heater test procedure through a final rule published on July 11, 2014 (July 2014 final rule). 79 FR 40542. The July 2014 final rule established a uniform energy descriptor (*i.e.*, UEF) for all consumer water heaters and for commercial water heaters with consumer applications (*i.e.*, those commercial water heaters that met the newly established definition of a “residential-duty commercial water heater”; extended coverage to eliminate certain gaps in the previous version of the

consumer water heater test procedure including small-volume storage water heaters (*i.e.*, with storage volumes between 2 and 20 gallons), large volume water heaters (*i.e.*, greater than 100 gallons for gas-fired and oil-fired storage water heaters and greater than 120 gallons for electric storage water heaters), and electric instantaneous water heaters; updated the simulated-use test draw pattern to be a function of equipment capacity as measured by the FHR or max GPM test; and updated the outlet water temperature test condition requirement.

As indicated, the uniform energy descriptor and the consumer water heater test procedure apply to “residential-duty commercial water heaters,” which were initially defined in the July 2014 final rule and include commercial water heaters with consumer applications. 79 FR 40542, 40586; 10 CFR 431.106(b)(1) and 10 CFR 431.110(b). DOE later amended the definition of a “residential-duty commercial water heater” in a final rule published on November 10, 2016, to define such equipment as 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 following criteria:

Water heater type	Indicator of non-residential application
Gas-fired Storage	Rated input >105 kBtu/h; Rated storage volume >120 gallons.
Oil-fired Storage	Rated input >140 kBtu/h; Rated storage volume >120 gallons.
Electric Instantaneous	Rated input >58.6 kW; Rated storage volume >2 gallons.

81 FR 79261, 79321-79322 (Nov. 10, 2016); 10 CFR 431.102.

Pursuant to EEIA 2015, DOE published a final rule on August 11, 2015 (August 2015 final rule), which codified the changes required by EEIA 2015. 80 FR 48004. These changes included adding definitions for “grid-enabled water heater” and “activation lock” to 10 CFR 430.2 and adding energy conservation standards with levels set in terms of the EF metric, to 10 CFR 430.32(d). *Id.* at 48009-48010.

On December 29, 2016, DOE published a final rule (December 2016 final rule) that denominated the efficiency standards in terms of the uniform efficiency descriptor (*i.e.*, the UEF metric) and established mathematical conversion factors to translate the EF, TE, and SL metrics to the UEF metric. 81 FR 96204. The published conversion factors were only applicable for converting test results for one year after the publication of the December 2016 final rule as required by EPCA, as amended by AEMTCA. *Id.* at 96204, 96204. Therefore, the conversion factors published to translate previously tested EF, TE, and SL values to converted UEF values were removed from 10 CFR 429.17 on December 29, 2017, at which time all rated UEF values were to be based on actual testing to the test procedure published in the July 2014 final rule (*i.e.*, to the UEF test procedure).

II. Request for Information

In the following sections, DOE has identified a variety of issues on which it seeks input to aid in the development of the technical and economic analyses regarding whether amended test procedures for consumer water heaters and residential-duty commercial water heaters are warranted so as to more accurately or fully comply with the requirements in EPCA that test procedures: (1) be reasonably designed to produce test

results which reflect energy efficiency, energy use, or estimated annual operating cost during a representative average use cycle or period of use, and (2) not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3); 42 U.S.C. 6314(a)(2)) Specifically, DOE is requesting comment on any opportunities to streamline and simplify testing requirements for consumer water heaters and residential-duty commercial water heaters.

Further, the Department recently published an RFI regarding test procedures across the full range of consumer products and commercial equipment that fall under its regulatory authority pursuant to EPCA. In that RFI, DOE noted that over time, many of DOE's test procedures have been amended to account for products' and equipment's increased functionality and modes of operation. DOE's intent in issuing that RFI was to gather information to ensure that the inclusion of measurement provisions in its test procedures associated with such increased functionality has not inadvertently compromised the measurement of representative average use cycles or periods of use, and made some test procedures unnecessarily burdensome. 84 FR 9721 (March 18, 2019). Although the comment period on the March 2019 RFI has since closed, DOE seeks comment on this issue as it specifically pertains to the test procedure for the consumer water heaters and residential-duty commercial water heaters that are the subject of this current RFI.

DOE seeks comment on whether there have been changes in product testing methodology or new products on the market since the last test procedure update that may create the need to make amendments to the test procedure for consumer water heaters and residential-duty commercial water heaters. Specifically, DOE seeks data and information

that could enable the agency to propose that the current test procedure produces results that are representative of an average use cycle for the product and is not unduly burdensome to conduct, and, therefore, does not need amendment. DOE also seeks information on whether an existing private-sector-developed test procedure would produce such results and should be adopted by DOE rather than DOE establishing its own test procedure, either entirely or by adopting only certain provisions of one or more private-sector-developed tests.

Additionally, DOE welcomes comments on other issues relevant to the conduct of this process that may not specifically be identified elsewhere in this document. In particular, DOE notes that under section 1 of Executive Order 13771, “Reducing Regulation and Controlling Regulatory Costs,” Executive Branch agencies such as DOE are directed to manage the costs associated with the imposition of expenditures required to comply with Federal regulations. *See* 82 FR 9339 (Feb. 3, 2017). Consistent with that Executive Order, DOE encourages the public to provide input on measures DOE could take to lower the cost of its test procedure regulations applicable to consumer water heaters and residential-duty commercial water heaters consistent with the requirements of EPCA.

A. Scope and Definitions

This RFI covers those products that meet the definitions for consumer “water heater,” in the statute at 42 U.S.C. 6291(27), as codified at 10 CFR 430.2. This RFI also covers commercial water heating equipment with residential applications meeting the definition of a “residential-duty commercial water heater,” as codified at 10 CFR 431.102.

In the context of covered consumer products, EPCA defines “water heater” as a product which utilizes oil, gas, or electricity to heat potable water for use outside the heater upon demand, including—

- (a) Storage type units which heat and store water at a thermostatically controlled temperature, including gas storage water heaters with an input of 75,000 Btu per hour or less, oil storage water heaters with an input of 105,000 Btu per hour or less, and electric storage water heaters with an input of 12 kilowatts or less;
- (b) Instantaneous type units which heat water but contain no more than one gallon of water per 4,000 Btu per hour of input, including gas instantaneous water heaters with an input of 200,000 Btu per hour or less, oil instantaneous water heaters with an input of 210,000 Btu per hour or less, and electric instantaneous water heaters with an input of 12 kilowatts or less; and
- (c) Heat pump type units, with a maximum current rating of 24 amperes at a voltage no greater than 250 volts, which are products designed to transfer thermal energy from one temperature level to a higher temperature level for the purpose of heating water, including all ancillary equipment such as fans, storage tanks, pumps, or controls necessary for the device to perform its function.

(42 U.S.C. 6291(27); 10 CFR 430.2)

In addition, at 10 CFR 430.2, DOE further defines several specific categories of consumer water heaters, as follows:

- (1) “Electric instantaneous water heater” means a water heater that uses electricity as the energy source, has a nameplate input rating of 12 kW or less, and contains no more than one gallon of water per 4,000 Btu per hour of input.
- (2) “Electric storage water heater” means a water heater that uses electricity as the energy source, has a nameplate input rating of 12 kW or less, and contains more than one gallon of water per 4,000 Btu per hour of input.
- (3) “Gas-fired instantaneous water heater” means a water heater that uses gas as the main energy source, has a nameplate input rating less than 200,000 Btu/h, and contains no more than one gallon of water per 4,000 Btu per hour of input.
- (4) “Gas-fired storage water heater” means a water heater that uses gas as the main energy source, has a nameplate input rating of 75,000 Btu/h or less, and contains more than one gallon of water per 4,000 Btu per hour of input.
- (5) “Grid-enabled water heater” means an electric resistance water heater that—
 - (a) Has a rated storage tank volume of more than 75 gallons;
 - (b) Is manufactured on or after April 16, 2015;
 - (c) Is equipped at the point of manufacture with an activation lock and;
 - (d) Bears a permanent label applied by the manufacturer that—
 - (i) Is made of material not adversely affected by water;
 - (ii) Is attached by means of non-water-soluble adhesive; and
 - (iii) Advises purchasers and end-users of the intended and appropriate use of the product with the following notice printed in 16.5 point Arial Narrow Bold font: “IMPORTANT INFORMATION: This water heater is intended only for use as part

of an electric thermal storage or demand response program. It will not provide adequate hot water unless enrolled in such a program and activated by your utility company or another program operator. Confirm the availability of a program in your local area before purchasing or installing this product.”

(6) “Oil-fired instantaneous water heater” means a water heater that uses oil as the main energy source, has a nameplate input rating of 210,000 Btu/h or less, and contains no more than one gallon of water per 4,000 Btu per hour of input.

(7) “Oil-fired storage water heater” means a water heater that uses oil as the main energy source, has a nameplate input rating of 105,000 Btu/h or less, and contains more than one gallon of water per 4,000 Btu per hour of input.

The definition for “grid-enabled water heater” includes the term “activation lock,” which is defined to mean a control mechanism (either by a physical device directly on the water heater or a control system integrated into the water heater) that is locked by default and contains a physical, software, or digital communication that must be activated with an activation key to enable the product to operate at its designed specifications and capabilities and without which the activation of the product will provide not greater than 50 percent of the rated first-hour delivery of hot water certified by the manufacturer. 10 CFR 430.2.

Issue A.1: DOE requests comment on the definitions currently applicable to consumer water heaters and whether any of the definitions should be revised, and if so, how. Please provide a rationale for any suggested change.

DOE had previously established a separate product class and definition for “tabletop water heater,” which was defined in Appendix E as a water heater in a rectangular box enclosure designed to slide into a kitchen countertop space with typical dimensions of 36 inches high, 25 inches deep, and 24 inches wide. 66 FR 4474, 4497 (Jan. 17, 2001). The definition for “tabletop water heater” was removed from Appendix E as part of the July 2014 final rule, and was inadvertently not added to 10 CFR 430.2. 79 FR 40542, 40567-40568 (July 11, 2014). However, energy conservation standards for tabletop water heaters are still specified at 10 CFR 430.32(d). DOE tentatively plans to consider such products in any rulemaking that would result from this RFI, including adding the definition for these products to 10 CFR 430.2.

Issue A.2: DOE requests feedback on whether the previous definition for “tabletop water heater” is still appropriate, and whether such products should continue to be considered separately from other classes of consumer water heaters.

As stated previously, Appendix E covers certain commercial water heating equipment defined as “residential-duty commercial water heaters” as defined at 10 CFR 431.102. As noted, “residential-duty commercial water heater” is defined as 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 following criteria:

Water heater type	Indicator of non-residential application
Gas-fired Storage	Rated input >105 kBtu/h; Rated storage volume >120 gallons.

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

10 CFR 431.102.

Issue A.3: DOE requests comment on the definition for “residential-duty water heater,” which are subject to the Appendix E test method for consumer water heaters.

Please provide the rationale for any suggested changes.

B. Test Procedure

DOE’s current test procedure for consumer water heaters and residential-duty commercial water heaters includes a storage volume test (if the rated storage volume of the water heater is above 2 gallons), a delivery capacity test (either the FHR or max GPM tests), and a 24-hour simulated-use test. See sections 5.2.1, 5.3, and 5.4 of Appendix E, respectively. The FHR test is conducted on non-flow-activated water heaters and provides an estimate of the maximum volume of hot water that a water heater can supply within an hour. The max GPM test is conducted on flow-activated water heaters and represents the maximum flow rate of hot water that can be supplied by the water heater while maintaining a nominal temperature rise during steady-state operation. The 24-hour simulated-use test approximates an actual day of use for a typical consumer, and it is conducted at one of four possible draw patterns (very small, low, medium, and high) which are determined from the results of the delivery capacity test (*i.e.*, either the FHR or max GPM test). Draw patterns are a specified series of draws for which the draw start time, volume removed, and flow rate are specified. The sections below address specific test procedure issues on which DOE seeks comment and information.

1. Updates to Industry Standards

ASHRAE maintains a published water heater test procedure titled, “ANSI/ASHRAE Standard 118.2-2006 (RA 2015), Method of Testing for Rating Residential Water Heaters.” The ANSI/ASHRAE 118.2-2006 (RA 2015) test procedure is similar to the DOE test procedure that was in effect prior to the July 2014 final rule, although there is no direct relationship between the ANSI/ASHRAE and DOE test method (*i.e.*, neither the former nor the current DOE consumer water heater test procedure include any reference to ANSI/ASHRAE Standard 118.2). In March 2019, ASHRAE published the second public review draft of Board of Standards Review (BSR) ANSI/ASHRAE Standard 118.2-2006R, “Method of Testing for Rating Residential Water Heaters and Residential-Duty Commercial Water Heaters” (ASHRAE Draft 118.2). ASHRAE Draft 118.2 is very similar to the DOE consumer water heater test procedure but includes some differences throughout, some of which would result in test procedure results different from the DOE test procedure. While DOE would only consider incorporation by reference (IBR) of a finalized version of ASHRAE Draft 118.2, DOE is interested in receiving comments on the merits of the draft in anticipation of such a possibility, or to consider incorporating aspects of the draft into a revised DOE test procedure. The differences between ASHRAE Draft 118.2 and the DOE test procedure are discussed in the paragraphs that follow.

a. Temperature and Humidity Test Conditions

ASHRAE Draft 118.2 replaces the use of specified values for inlet water temperature, outlet water temperature, ambient temperature, and relative humidity with

variables used as placeholders. This approach generalizes the test method to be applicable to any set of test conditions for these four parameters. Consequently, for each individual test, the testing laboratory must decide which specific values to use for each parameter. The test conditions corresponding to DOE's consumer water heater test procedure are provided in an appendix to ASHRAE Draft 118.2 for reference only. As such, if DOE were to incorporate a finalized version of ASHRAE Draft 118.2, the Department would need to specify the test conditions at which to perform the test.

ASHRAE Draft 118.2 includes additional criteria to the start of the FHR test, as compared to DOE's test procedure. Section 5.3.3.3 of Appendix E of the current DOE test procedure states that prior to the start of the FHR test, if the water heater is not operating (heating water), initiate a draw until cut-in (*i.e.*, when the water heater begins heating water). The draw is then terminated any time after cut-in, and the water heater is allowed to operate until cut-out (*i.e.*, when the water heater stops heating water). When the maximum mean tank temperature is observed after cut-out, the initial draw of the FHR test begins. ASHRAE Draft 118.2 specifies that the draw preceding the initial draw of the FHR test must proceed until the outlet temperature drops 15 °F below the maximum outlet temperature observed, or until a cut-in occurs, whichever is longer. Requiring the outlet temperature to drop 15 °F below the maximum outlet temperature may provide a more consistent starting condition for the FHR test compared to the pre-conditioning method specified in the current DOE test procedure since draws of varying lengths can create different internal tank temperature profiles. Thus, the additional requirement to end the pre-conditioning draw, which in some cases would extend the draw length as compared to the current DOE test procedure, could increase the

repeatability of the FHR test. However, DOE has found that there are models on the market with low storage volumes and high input rates that would be required to be tested to the FHR test but that are capable of delivering hot water indefinitely at the conditions specified in the FHR test. Such water heaters would never deliver an outlet temperature 15 °F below the maximum outlet temperature observed. Therefore, the FHR test could not start since this criterion of a 15 °F drop below the outlet temperature, which would require a longer period than the cut-in, would never be met.

Issue B.1: DOE requests feedback on whether the addition of an outlet temperature drop criterion for terminating the water draw prior to the start of the FHR test is appropriate and/or necessary. If an outlet temperature drop criterion is appropriate, DOE requests comment and data on whether 15 °F is sufficiently representative, given consumer expectation, or whether a different threshold should be considered. DOE also requests information on any potential impact to the testing burden that would result from an outlet temperature drop criterion. Further, DOE requests comment on how to address water heaters that would not meet both initiation criteria (*i.e.*, both a cut-in and an outlet temperature drop) due to the ability to continuously deliver hot water at the prescribed test conditions.

ASHRAE Draft 118.2 includes additional criteria regarding water draws during the FHR test, as compared to DOE's test procedure. The FHR test required in section 5.3.3 of Appendix E of the current test procedure specifies a series of water draws over the course of one hour. After each water draw is initiated, the draw is terminated when the outlet water temperature decreases 15 °F from the maximum outlet water temperature measured during the draw. (For example, if after initiating a water draw, the outlet water

temperature reaches a maximum temperature of 125 °F, the water draw would continue until the outlet water temperature drops to 110 °F, at which time the water draw would be terminated.) ASHRAE Draft 118.2 specifies that water draws during the FHR test terminate if either: (1) the outlet water temperature decreases 15 °F from the maximum outlet water temperature measured during the draw, or (2) the outlet water temperature decreases to 105 °F, regardless of the maximum outlet water temperature measured during the draw. Setting a minimum temperature threshold of 105 °F may contribute to a more representative result by ensuring that the unit provides sufficiently “hot” water (*i.e.*, representative of what a consumer would expect from a water heater) throughout the duration of the test. DOE could similarly consider implementing a minimum delivery temperature as a criterion for terminating water draws during the FHR test.

Issue B.2: DOE requests feedback on whether the addition of a minimum delivery temperature as a criterion for terminating draws during the FHR test is appropriate and/or necessary. If a minimum delivery temperature criterion is appropriate, DOE requests comment and data on whether 105 °F is sufficiently representative given consumer expectation, or whether a different threshold should be considered. DOE also requests information on any potential impact to the testing burden that would result from a minimum delivery temperature criterion.

b. Definitions, Symbols, and Figures

ASHRAE Draft 118.2 defines “gas-fired heat pump storage water heaters,” as water heaters that:

- (a) use gas as the main energy source,
- (b) have a nameplate input rating of 20,000 Btu/h (26.4 MJ/h) or less,
- (c) have a maximum current rating of 24 amperes (including all auxiliary equipment such as fans, pumps, controls, and, if on the same circuit, any resistive elements) at an input voltage of no greater than 250 volts,
- (d) have a rated storage volume not more than 120 gallons (450 liters), and
- (e) are designed to transfer thermal energy from one temperature level to a higher temperature level to deliver water at a thermostatically controlled temperature less than or equal to 180 °F (82 °C).

The current DOE test method does not define the term “gas-fired heat pump storage water heater.”

Issue B.3: DOE requests feedback on the need for creating a separate definition for “gas-fired heat pump storage water heater,” or whether the current DOE definitions in 10 CFR 430.2 for “gas-fired storage water heater” and “water heater,” which includes “heat pump type units,” would adequately cover such products for the purpose of performing the DOE test procedure.

ASHRAE Draft 118.2 also defines “electric heat pump storage water heaters,” as water heaters that:

- (a) use electricity as the energy source,
- (b) have a nameplate input rating of 12 kW (40,956 Btu/h) or less,

- (c) have a rated storage capacity of 120 gallons (450 L) or less,
- (d) are designed to transfer thermal energy from one temperature level to a higher temperature level for the purpose of heating water, and
- (e) are designed to heat and store water at a thermostatically-controlled temperature less than or equal to 180°F (82°C).

Issue B.4: DOE requests feedback on the need for creating a separate definition for “electric heat pump storage water heater,” or whether the current DOE definitions in 10 CFR 430.2 for “electric storage water heater” and “water heater,” which includes “heat pump type units,” would adequately cover such products for the purpose of performing the DOE test procedure.

DOE also notes that several definitions in ASHRAE Draft 118.2 limit the scope of products covered by the standard more narrowly than the definitions for consumer water heaters and relevant commercial water heater definitions contained in EPCA. (42 U.S.C. 6291(27) and 42 U.S.C. 6311(12)(A)-(B)) For example, ASHRAE Draft 118.2 limits the storage volume for storage-type water heaters to 120 gallons or less and limits the maximum delivery temperature to 180°F (82°C) (whereas EPCA does not define limits on storage volume or maximum delivery temperature).

Issue B.5: DOE requests comment on whether the ASHRAE Draft 118.2 test method could be applied to water heaters beyond the scope defined in ASHRAE Draft 118.2 to cover all water heaters included within the scope of DOE’s definitions for consumer water heaters and residential-duty commercial water heaters. If modifications

to ASHRAE Draft 118.2 would be required to address testing of water heaters not within the scope of that draft, DOE requests comment on what those modifications would be.

ASHRAE Draft 118.2 includes new figures that provide greater detail illustrating how to set up a water heater for test. For example, a purge (by-pass) loop is added to the inlet water line in all figures. Additional figures include a test set-up for an instantaneous water heater with connections on the top, a figure describing the placement of a thermal break⁶ in the inlet water line, and two figures showing configurations for the thermocouple tree, if it needs to be installed through the outlet water line. The thermal break is added to the test set-up to prevent heat from travelling up the inlet piping into the purge loop section. When purging before a draw, any heat that is transferred from the water heater through the inlet piping to the purge loop section would be lost, as the purge loop is replenished with cold supply water. The thermal break helps to prevent this heat loss.

Issue B.6: DOE requests feedback on whether the figures in Appendix E should be updated to include additional detail, including the detail provided in the figures in ASHRAE Draft 118.2. If so, please address whether the additional specificity provided in the figures could be too restrictive for the purpose of the DOE test procedure, or whether such specificity would be justified by improving reproducibility of test results.

⁶ A “thermal break” is defined in ASHRAE Draft 118.2 as a nipple made of material that has thermal insulation properties (*e.g.*, plastics) to insulate the by-pass loop from the inlet piping. It should be able to withstand a pressure of 150 psi and a temperature of 150 °F.

Issue B.7: DOE requests feedback on whether a definition of “thermal break” should be added to DOE’s consumer water heater test procedure.

Issue B.8: DOE requests feedback on the necessity of a thermal break if no bypass or purge loop is included in the test set-up.

Issue B.9: DOE requests feedback on whether the maximum temperature the thermal break must be able to withstand would appropriately be set at 150 °F. If another threshold would be more appropriate, please provide a rationale for the alternate value.

c. Standby Loss Test

The DOE test method includes a standby period measured between draw clusters one and two, during which data is recorded that is used to calculate the standby heat loss coefficient. See section 5.4.2 of Appendix E. ASHRAE Draft 118.2 adds a condition that the standby period data can only be recorded between the first and second draw clusters if the time between the observed maximum mean tank temperatures after cut-out⁷ following the first draw cluster to the start of the second draw cluster is greater than or equal to 6 hours. Otherwise, ASHRAE Draft 118.2 states that the standby period data would be recorded after the last draw of the test. This condition is intended to ensure that a sufficiently long standby period is used to determine standby loss, which might make this calculation more repeatable and the results more representative of standby losses experienced in an average period of use. However, this might also cause the test to

⁷ Section 1.2 of Appendix E defines “cut-out” as the time when or water temperature at which a water heater control or thermostat acts to reduce to a minimum the energy or fuel input to the heating elements, compressor, or burner.

extend beyond a 24-hour duration. DOE could consider implementing a similar minimum standby period within the DOE test procedure.

Issue B.10: DOE requests feedback on whether it should consider the addition of a minimum standby period length of 6 hours for use in the standby loss calculations, and on the appropriateness of recording this data after the final draw cluster when less than 6 hours of standby time occur between draw clusters one and two.

For instances where the standby period occurs after the last draw of the test, ASHRAE Draft 118.2 includes a different method to end the 24-hour simulated-use test, as compared to the method specified in the DOE test procedure at Appendix E. In section 5.4.2 of Appendix E, power to the main burner, heating element, or compressor is disabled during the last hour of the test. In ASHRAE Draft 118.2, power is not disabled, but, if a recovery occurs between an elapsed time of 23 hours following the start of the test (hour 23) and 24 hours following the start of the test (hour 24), the following alternate approach is applied to determine the energy consumed during the 24-hour test: The time, total energy used, and mean tank temperature are recorded at 1 minute prior to the start of the recovery occurring between hour 23 and hour 24, along with the average ambient temperature from 1 minute prior to the start of the recovery occurring between hour 23 and hour 24 to hour 24 of the simulated-use test. These values are used to determine the total energy used by the water heater during the 24-hour simulated-use test. This alternate calculation combines the total energy used 1 minute prior to the start of the recovery occurring between hours 23 and 24 and the standby loss experienced by the tank during the time between the minute prior to the recovery start and hour 24. This change is included in ASHRAE Draft 118.2 so as not to artificially de-energize a water heater

during the standby period. The modification should reduce the burden on test laboratories by eliminating the need to ensure that the unit is switched off for this one hour.

Issue B.11: DOE requests feedback on whether it should consider an alternate procedure, similar to that in ASHRAE Draft 118.2, for the last hour of the 24-hour simulated-use test.

Issue B.12: DOE requests feedback on whether the addition of standby loss in the total energy use calculation adequately represents the auxiliary energy use that is not measured between the minute prior to the start of the recovery occurring between hours 23 and 24, and hour 24 of the 24-hour simulated-use test.

d. Calculations

The DOE test method includes a provision for the FHR test requiring that, if a draw is not in progress at one hour from the start of the test and, therefore, a final draw is imposed at the elapsed time of one hour, calculations are used to scale the volume drawn during the final draw. Sections 5.3.3.3 and 6.1 of Appendix E, respectively. The scaling of the final draw is based on the temperature of the water delivered during the final draw as compared to the temperature of the water delivered during the previous draw. The scaled final draw volume is then added to the total volume drawn during other draws to determine the FHR. ASHRAE Draft 118.2 removed the scaling calculation for the case in which a draw is not in progress at one hour from the start of the test and a final draw is imposed at the elapsed time of one hour. Instead, the ASHRAE Draft 118.2 method calculates FHR as the sum of the volume of hot water delivered without any scaling to

the final draw. The methodology for conducting the FHR test, and in particular the issue of whether to scale the final draw, was considered during the May 1998 final rule, and DOE determined at that time that a temperature correction factor was appropriate and was included to adjust the volume of the last draw to account for the lower heat content of the last draw compared to the earlier draws with fully heated water. 63 FR 25996, 26004-26005 (May 11, 1998).

Issue B.13: DOE requests feedback on whether the temperature correction scaling calculation should be maintained for the final draw in calculation of FHR for the case in which a draw is not in progress at one hour from the start of the test and is imposed at the elapsed time of one hour.

Issue B.14: DOE requests feedback on the effect that removing the temperature correction factor would have on the rated FHR, draw pattern, and rated UEF values of the various types of non-flow-activated water heaters that are tested to the FHR test.

ASHRAE Draft 118.2 includes language clarifying that when the first recovery of the simulated-use test extends during a draw, the first recovery period extends until the end of that draw. The first recovery period is used in ASHRAE Draft 118.2 and section 6.3.2 of DOE's test procedure to calculate recovery efficiency. DOE's test procedure does not directly address how to calculate recovery efficiency if the first recovery period ends during a draw. Each of the parameters in the recovery efficiency equation are recorded at the end of the first recovery period (*e.g.*, the total mass removed is recorded at the end of the first recovery period and not the end of the draw).

Issue B.15: DOE requests feedback on whether additional specification should be added to Appendix E addressing the first recovery period ending during a draw.

Issue B.16: DOE requests feedback on whether it is appropriate to extend the first recovery period to the end of the draw, or to end the recovery period at the end of the recovery. If extending the first recovery period to the end of the draw is appropriate, please address the situation where a second recovery is initiated prior to the ending of the draw. Please also address the appropriate calculation of the maximum mean tank temperature recorded after cut-out following the first recovery, $\bar{T}_{\max,1}$.

ASHRAE Draft 118.2 updated the recovery efficiency equation for water heaters with a rated storage volume greater than or equal to 2 gallons (7.6 L) to address situations in which the recovery period lasts for more than one draw, as can occur while testing water heaters with long recovery times such as heat pump water heaters recovering using only the heat pump. The energy removed from the tank during each draw is summed and added to the change in stored energy in the tank from the start of the test to the maximum mean tank temperature observed after the end of the recovery period. Section 6.3.2 of the DOE test procedure also uses the total energy removed from the tank when more than one draw occurs during the first recovery period.

Issue B.17: DOE requests feedback on whether the equation for recovery efficiency for water heaters with a rated storage volume greater than or equal to 2 gallons (7.6 L) should be updated to address when the recovery period lasts for more than one draw.

2. Other Potential Updates to the Federal Test Method

Beyond considering the updates in the ASHRAE Draft 118.2 test method discussed in the previous section, DOE is also considering a number of potential updates to its test method in Appendix E that are not addressed in ASHRAE Draft 118.2. These updates are discussed in the paragraphs that follow.

a. Test Conditions

Section 2.3 of Appendix E specifies maintaining the supply water temperature at $58\text{ }^{\circ}\text{F} \pm 2\text{ }^{\circ}\text{F}$ ($14.4\text{ }^{\circ}\text{C} \pm 1.1\text{ }^{\circ}\text{C}$). During the 24-hour simulated-use test, maintaining the supply water temperature within this range can be difficult at the immediate start of a draw due to the short time between draw initiation and the first measurement at 5 seconds (with subsequent measurements every 3 seconds thereafter), as required by section 5.4.2 or 5.4.3 of Appendix E. In some test configurations, particularly during the lower-flow water draws, the inlet water and piping may retain heat from a previous draw, causing the water entering the unit during the initial measurements to be slightly outside of tolerance. Any supply water temperature reading outside of the test tolerances would invalidate a test. However, due to the small percentage of total water use that would be affected, supply water temperatures that are slightly out of tolerance for the first one or two data points would have a negligible effect on the overall test result.⁸ This issue is less evident during the FHR test, which specifies an initial temperature measurement 15 seconds after

⁸ For example, the first two temperature readings would reflect 8 seconds of water flow, in comparison to total water draw durations ranging from 1 minute to over 8 minutes, according to the water draw patterns defined in Tables III.1, III.2, III.3, and III.4 of Appendix E.

the start of the water draw. This is not an issue during the max GPM test due to the system being in steady-state during the entire test.

Issue B.18: DOE requests feedback on whether one or two supply water temperature data points outside of the test tolerance at the beginning of a draw would have a measurable effect on the results of the test.

Issue B.19: DOE requests feedback on whether DOE should consider relaxing the requirement for supply water temperature tolerances at the start of a draw, and if so, which methods are most appropriate for doing so while maintaining accuracy and repeatability.

Section 2.2 of Appendix E specifies maintaining ambient air temperature between 65.0 °F and 70.0 °F (18.3 °C and 21.1 °C) on a continuous basis for all types of consumer water heaters (and residential-duty commercial water heaters) other than heat pump water heaters. For heat pump water heaters, ambient air temperature must be maintained between 67.5 °F $\pm$ 1 °F (19.7 °C $\pm$ 0.6 °C) , and the relative humidity must be maintained at 50% $\pm$ 2% throughout the test. For all water heaters, section 2.7.1 of Appendix E specifies maintaining the electrical supply voltage within $\pm$ 1% of the center of the voltage range specified by the manufacturer. Similar to the supply water temperature discussed above, a brief measurement of air temperature, relative humidity, or electrical supply voltage that is slightly outside of the test tolerance would invalidate a test, but likely has a negligible effect on the results of the test.

Issue B.20: DOE requests feedback on whether the tolerances for ambient air temperature, relative humidity, and electrical supply voltage are difficult to maintain at

the start of a draw, and if so, whether DOE should consider relaxing these requirements at the start of a draw. If DOE should consider relaxing these requirements, what should the tolerances be?

DOE has conducted exploratory testing to investigate the effect of relative humidity (RH) on the measured UEF values of consumer gas-fired instantaneous water heaters. Two models, one non-condensing and the other condensing, were each tested twice at an RH of 50 percent and an RH of 80 percent (*i.e.*, each model was tested four times, with two tests at an RH of 50 percent and two tests at an RH of 80 percent). The increase in relative humidity from 50 percent to 80 percent resulted in a maximum change in UEF for the non-condensing and condensing models of 0.011 and 0.015, respectively.

Issue B.21: DOE requests feedback on whether test conditions for relative humidity should extend to other consumer water heater types besides heat pump water heaters.

For gas-fired water heaters, sections 2.7.2 and 2.7.3 of Appendix E require maintaining the gas supply pressure in accordance with the manufacturer's specifications; or, if the supply pressure is not specified, a supply pressure of 7-10 inches of water column (1.7-2.5 kPa) for natural gas and 11-13 inches of water column (2.7-3.2 kPa) for propane gas must be maintained. In addition, for gas-fired water heaters with a pressure regulator, sections 2.7.2 and 2.7.3 require the regulator outlet pressure to be within ± 10 percent of the manufacturer's specified manifold pressure. From a review of product

literature, DOE has found that many gas-fired water heaters with variable input burners have a factory preset manifold pressure that is computer-controlled and cannot be adjusted directly. Further, the manufacturer-specified manifold pressure typically refers to when the water heater is operating at the maximum firing rate.

Issue B.22: DOE requests comment on whether sections 2.7.2 and 2.7.3 should be amended to account for models where the manifold pressure cannot be adjusted directly and whether the $\pm 10\%$ tolerance should apply only when firing to the manufacturer specified firing rate.

In addition to the gas pressure requirements, section 5.2.3 requires maintaining an hourly Btu rating (*i.e.*, power input rate) that is within $\pm 2\%$ of the value specified by the manufacturer (*i.e.*, the nameplate value). DOE has observed during testing that for some gas-fired water heaters, a power input rate cannot be achieved that is within $\pm 2\%$ of the nameplate value while maintaining the gas supply pressure and manifold pressure within the required ranges. In such instances, it is common practice for the testing laboratory to modify the size of the orifice that is shipped with the water heater; for example, the testing laboratory may enlarge the orifice to allow enough gas flow to achieve the nameplate input rating within the specified tolerance, if the power input rate is too low with the orifice as supplied. For commercial water heating equipment, DOE addressed this issue by specifying in the product-specific enforcement provisions that, after adjusting the manifold and supply pressures to their specified limits, if the fuel input rate is still not within ± 2 percent of the rated input, DOE will attempt to modify the gas inlet orifice. 10 CFR 429.134(n)(ii).

Issue B.23: DOE requests comment regarding whether provisions should be added to the test procedure at Appendix E to address water heaters that cannot operate within ± 2 percent of the nameplate rated input as shipped from the factory. If so, DOE requests comment on how to address this issue, and whether it is appropriate to physically modify the orifice, similar to the direction for commercial water heaters.

b. Terminology

In sections 5.3.3.1 and 5.3.3.2 of Appendix E, which describe general requirements and draw initiation criteria, respectively, for the FHR test, the term “storage-type water heaters” is used. However, the FHR applies to all water heaters that are not flow-activated, which could include non-flow-activated instantaneous water heaters with storage volumes above 2 gallons.

Issue B.24: DOE requests feedback on whether to update the phrase “storage-type water heaters” in section 5.3.3 to “non-flow-activated water heaters.”

c. Test Set-up

DOE is considering whether it should update the test set-up requirement for the location of a flow meter (when used), and/or specifications regarding how to determine the water density for the purpose of calculating the water mass removed from the water heater when volume is measured using a flow meter. In sections 6.3.2 and 6.4.1 of Appendix E, both titled, “Recovery Efficiency,” the total mass of water removed (*i.e.*, mass of water that flows through the outlet) from the start of the 24-hour simulated-use test to the end of the first recovery period (M_1) is used to calculate recovery efficiency.

The test procedure accommodates determining the total mass either directly (*e.g.*, through the use of a weighing scale), or indirectly by multiplying the total volume removed (V_1) (*i.e.*, total volume of hot water flow through the outlet) by the density of water (ρ_1), which is required to be determined based on the water temperature at the point where the flow volume is measured.⁹ The test procedure does not specify where in the flow path the flow volume and density must be measured, which allows for laboratory test set-ups that measure the flow volume either on the cold inlet side of the water heater or on the hot outlet side. DOE is concerned that allowing the flow meter to be located on either the inlet or outlet side, and calculating the mass of the water that is heated during the test based on the density of the water where the flow meter is located, could result in differences in the mass of water that is calculated depending on whether the flow meter is in the inlet water line or the outlet water line. Because the inlet water is colder than at the outlet, it is also denser, meaning that the same volume of water has more mass at the inlet than the outlet. In addition, some of the mass of inlet water could, after being heated, expand out of the water heater into the expansion tank and be purged prior to a draw.¹⁰ Any “expanded” volume of water that is lost through the purge line could be included in a volume measurement taken at the inlet, but not be included in a volume measurement taken at the outlet. To alleviate the potential for a mismatch between the mass of water measured at the inlet and outlet, DOE is considering whether to specify the location of the flow meter when one is used to determine the amount of water removed.

Alternatively, if the volume of water going into the water heater will always be

⁹ Although the DOE test procedure does not specify how to measure and/or calculate density, it is typically calculated using either a regression equation or density tables based on a specific temperature and pressure.

¹⁰ The change in volume occurs because water expands and increases in volume as it is heated.

equivalent to the volume withdrawn, DOE could consider using the density at the hot outlet side for the purpose of calculating total mass of water removed in sections 6.3.2 and 6.4.1 of Appendix E, regardless of where flow volume is measured.

Issue B.25: DOE requests feedback on whether the consumer water heater test procedure should require measurement of flow in the outlet water line to ensure that the mass of water removed from the tank is accurate. Alternatively, DOE is interested in comment on whether requiring density, ρ_1 , to be determined based on the outlet temperature, rather than the temperature where the flow volume is measured, would alleviate this issue.

In sections 6.3.5 and 6.4.2 of Appendix E, the mass withdrawn from each draw (M_i) is used to calculate the daily energy consumption of the heated water at the measured average temperature rise across the water heater (Q_{HW}). However, neither section includes a description of how to calculate the mass withdrawn for tests in which the mass is indirectly determined using density and volume measurements (as described above).

Issue B.26: DOE requests feedback on whether to update the consumer water heater test procedure to include a description of how to calculate the mass withdrawn from each draw in cases where mass is indirectly determined using density and volume measurements.

In section 6.3.3 of Appendix E titled, “Hourly Standby Losses,” the descriptions for cumulative energy consumption ($Q_{su,0}$ and $Q_{su,f}$) and mean tank temperature ($\bar{T}_{su,0}$ and $\bar{T}_{su,f}$) at the start and end of the standby period, along with the elapsed time, average

storage tank and average ambient temperatures over the standby period ($\tau_{\text{stby},1}$, $\bar{T}_{\text{t,stby},1}$ and $\bar{T}_{\text{a,stby},1}$, respectively) specifically refer to the standby period that would occur after the first draw cluster, but do not explicitly address the case where the standby period occurs after the last draw of the test.

Issue B.27: DOE requests feedback on whether DOE should revise the descriptions of $Q_{\text{su},0}$, $Q_{\text{su},f}$, $\bar{T}_{\text{su},0}$, $\bar{T}_{\text{su},f}$, $\tau_{\text{stby},1}$, $\bar{T}_{\text{t,stby},1}$, and $\bar{T}_{\text{a,stby},1}$ to accommodate cases where the standby period occurs after the last draw of the test, in addition to cases where the standby period occurs after the first draw cluster.

d. Specific Considerations for Certain Consumer Water Heaters

DOE has found that several manufacturers produce consumer gas-fired instantaneous water heaters that are designed to be used with a volume of stored water (usually in a tank, but sometimes in a recirculating hot water system of sufficient volume, such as a hydronic space heating or designated hot water system) where the water heater does not directly provide hot water to fixtures, such as a faucet or shower head, but rather replenishes heat lost from the tank or system through hot water draws or standby losses by circulating water to and from the tank or other system. These recirculating consumer gas-fired instantaneous water heaters are typically activated by an aquastat¹¹ installed in a storage tank that is sold separately or by an inlet water temperature sensor. While the products identified by DOE are within the statutory and regulatory definition of a consumer “water heater” as a covered product, the design and application of recirculating

¹¹ An “aquastat” is a temperature measuring device typically used to control the water temperature in a separate hot water storage tank.

gas-fired instantaneous water heaters makes testing to the consumer water heater test procedure difficult, if not impossible, as these products are not capable of delivering water at the temperatures and flow rates specified in the UEF test method. Modifications to the consumer water heater test procedure may be required to be more representative of typical use for these products. These modifications could include changes to inlet and/or outlet water temperature requirements or draw patterns (flow rate and timing). In addition, use of a representative storage tank may be considered.

Issue B.28: DOE requests feedback on the typical application(s) in which recirculating gas-fired instantaneous water heaters are used.

Issue B.29: DOE requests feedback on what changes to the consumer water heater test procedure may be necessary to appropriately test recirculating gas-fired instantaneous water heaters.

Issue B.30: Additionally, DOE requests feedback on whether there is an industry standard that would allow for testing of recirculating gas-fired instantaneous water heaters that would provide results representative of the energy use of these products for an average use cycle or period of use.

DOE has identified flow-activated water heaters that are designed to deliver water at a temperature below the set point temperature of $125\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$ ($51.7\text{ }^{\circ}\text{C} \pm 2.8\text{ }^{\circ}\text{C}$) that is required by section 2.5 of Appendix E. These water heating products are typically marketed as handwashing or point-of-use water heaters. These units typically have low heating rates, which requires the testing agency to reduce the flow rate in order to be able to achieve the outlet temperature within the set point temperature range. However, these

units have a minimum activation flow rate, below which the unit shuts off. Therefore, when the flow rate is too low, the unit will stop heating water, so there is no flow rate at which the unit will operate and deliver water at the required outlet temperature.

Issue B.31: DOE requests feedback on whether language should be added to section 5.2.2.1 of Appendix E, titled, “Flow-Activated Water Heaters, including certain instantaneous water heaters and certain storage-type water heaters,” to allow for water heaters not designed to deliver water at $125\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$ ($51.7\text{ }^{\circ}\text{C} \pm 2.8\text{ }^{\circ}\text{C}$) to be tested at a lower set point temperature, or whether other changes to the test method need to be made to accommodate these types of models (*e.g.*, an additional draw pattern, product definition).

DOE has identified water heating products with storage volumes less than 20 gallons and with input rates near or at the maximum input rate and considers them to be consumer water heaters. These products are sold in the consumer market and can be tested to the consumer water heater test procedure. Section 5.3.3 titled, “First-Hour Rating” of the consumer water heater test procedure at Appendix E requires that water heaters with storage volume less than 20 gallons be tested at $1.0 \pm 0.25\text{ gpm}$ ($3.8 \pm 0.95\text{ L/min}$), as opposed to $3.0 \pm 0.25\text{ gpm}$ ($11.4 \pm 0.95\text{ L/min}$) required for water heaters with rated storage volumes greater than or equal to 20 gallons. Water heaters with low volume and high input rates can potentially operate indefinitely at the $3.0 \pm 0.25\text{ gpm}$ ($11.4 \pm 0.95\text{ L/min}$) flow rate. When tested as currently required by Appendix E, such products would have a measured FHR around 60 gallons (227 L) and, therefore, would be required to use the medium draw pattern, although such models could be used in applications similar to other types of water heaters that fall into the high draw pattern (*e.g.*, flow-

activated instantaneous water heaters with high input rates and storage water heaters with greater than 20 gallons stored water and high input rates and/or volumes).

Issue B.32: DOE requests feedback on the consumer water heater test procedure with respect to testing the delivery capacity of non-flow-activated water heaters with low volume and high input rate. If amendments are warranted, DOE requests comment on what method(s) would be appropriate for determining the delivery capacity of such models and what attributes can be used to distinguish these water heaters from non-flow-activated water heaters more appropriately tested by the FHR test.

Section 4.5 of Appendix E requires water heaters with a rated storage volume at or above 2 gallons must have their internal storage tank temperature measured. Typically, a thermocouple tree is inserted into the storage tank of a water heater through either the anode rod hole, the outlet water line, or the temperature and pressure relief valve. DOE has identified consumer water heaters with physical attributes that make measuring mean tank temperature difficult, such as water heaters that have a built-in mixing valve and no anode rod, or have a large heat exchanger that does not allow a thermocouple tree to be inserted.

Issue B.33: DOE requests feedback on whether amendments to the water heater test procedure are needed to address water heaters that cannot have their internal storage tank temperatures measured as required by the test procedure. If so, DOE requests comment on what updates to the test procedure would be necessary that would still allow for accurate measurement of temperature.

C. Test Procedure Waivers

A person may seek a waiver from the test procedure requirements for a particular basic model of a type of covered product when the basic model for which the petition for waiver is submitted contains one or more design characteristics that: (1) prevent testing according to the prescribed test procedure, or (2) cause the prescribed test procedures to evaluate the basic model in a manner so unrepresentative of its true energy consumption characteristics as to provide materially inaccurate comparative data. 10 CFR 430.27(a)(1). If a waiver is granted, as soon as practicable, DOE will publish in the *Federal Register* a NOPR that proposes to amend its regulations so as to eliminate any need for the continuation of such waiver. As soon thereafter as practicable, DOE will publish in the *Federal Register* a final rule. 10 CFR 430.27(l). Currently, DOE has granted one finalized waiver from the current consumer water heater test procedure.

On January 31, 2020, DOE published a Notice of Decision and Order in the *Federal Register* granting Bradford White Corporation a waiver for a specified basic model that experiences the first cut-out of the 24-hour simulated use test during a draw. 85 FR 5648. The Decision and Order requires Bradford White Corporation to use an alternate test procedure that DOE has determined more accurately calculates the recovery efficiency when the first cut-out occurs during a draw.¹² *Id.*

¹² Docket number EERE-2019-BT-WAV-0020, see: <https://www.regulations.gov/docket?D=EERE-2019-BT-WAV-0020>.

DOE has determined that the alternate test procedure is representative of real-world use conditions for the basic model specified in the Decision and Order. DOE requests feedback on whether the test procedure waiver approach is generally appropriate for testing basic models with these features.

D. Other Test Procedure Topics

In addition to the issues identified earlier in this document, DOE welcomes comment on any other aspect of the existing test procedures for consumer water heaters and residential-duty commercial water heaters. As noted, DOE recently issued an RFI to seek more information on whether its test procedures are reasonably designed, as required by EPCA, to produce results that measure the energy use or efficiency of a product during a representative average use cycle or period of use. 84 FR 9721 (March 18, 2019). DOE seeks comment on this issue as it specifically pertains to the test procedures for consumer water heaters and residential-duty commercial water heaters that are the subject of this current RFI.

As noted previously, DOE also requests comments on whether potential amendments based on the issues discussed would result in a test procedure that is unduly burdensome to conduct, particularly in light of any new products on the market since the last test procedure update. If commenters believe that any such amendments would result in a procedure that is, in fact, unduly burdensome to conduct, DOE seeks information on whether an existing private sector-developed test procedure would be more appropriate or

other avenues for reducing the identified burdens while advancing improvements to the water heaters test procedure.

DOE also requests comment on the benefits and burdens of adopting any industry/voluntary consensus-based or other appropriate test procedure, without modification. DOE notes that ANSI/ASHRAE Standard 118.2-2006 (RA 2015), “Method of Testing for Rating Residential Water Heaters,” is effectively the same as the DOE test procedures formerly used to measure EF. Further, as discussed earlier in this document, ASHRAE 118.2-2006 (RA 2015) is currently under revision with major changes being considered to update that test method so as to be similar to the DOE UEF test procedure currently in Appendix E.

Additionally, DOE requests comment on whether the existing test procedures limit a manufacturer’s ability to provide additional features to purchasers of consumer water heaters. DOE particularly seeks information on how the test procedures could be amended to reduce the cost of new or additional features and make it more likely that such features are included on consumer water heaters, while still meeting the requirements of EPCA.

DOE also requests comments on any potential amendments to the existing test procedures that would address impacts on manufacturers, including small businesses.

Finally, DOE recently published an RFI on the emerging smart technology appliance and equipment market. 83 FR 46886 (Sept. 17, 2018). In that RFI, DOE

sought information to better understand market trends and issues in the emerging market for appliances and commercial equipment that incorporate smart technology. DOE's intent in issuing the RFI was to ensure that DOE did not inadvertently impede such innovation in fulfilling its statutory obligations in setting efficiency standards for covered products and equipment. DOE seeks comments, data, and information on the issues presented in the RFI as they may be applicable to the consumer water heaters and residential-duty commercial water heaters that are the subject of this RFI.

III. Submission of Comments

DOE invites all interested parties to submit in writing by **[INSERT DATE 45 DAYS AFTER DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**, comments and information on matters addressed in this document and on other matters relevant to DOE's consideration of amended test procedures for consumer water heaters and residential-duty commercial water heaters. These comments and information will aid in the development of a test procedure NOPR for consumer water heaters, if DOE determines that amended test procedures may be appropriate for these products. After the close of the comment period, DOE will review the public comments received and may begin collecting data and conducting the analyses discussed in this RFI.

Submitting comments via <http://www.regulations.gov>. The <http://www.regulations.gov> webpage requires you to provide your name and contact information. Your contact information will be viewable to DOE Building Technologies staff only. Your contact information will not be publicly viewable except for your first

and last names, organization name (if any), and submitter representative name (if any). If your comment is not processed properly because of technical difficulties, DOE will use this information to contact you. If DOE cannot read your comment due to technical difficulties and cannot contact you for clarification, DOE may not be able to consider your comment.

However, your contact information will be publicly viewable if you include it in the comment or in any documents attached to your comment. Any information that you do not want to be publicly viewable should not be included in your comment, nor in any document attached to your comment. Persons viewing comments will see only first and last names, organization names, correspondence containing comments, and any documents submitted with the comments.

Do not submit to <http://www.regulations.gov> information for which disclosure is restricted by statute, such as trade secrets and commercial or financial information (hereinafter referred to as Confidential Business Information (CBI)). Comments submitted through <http://www.regulations.gov> cannot be claimed as CBI. Comments received through the website will waive any CBI claims for the information submitted. For information on submitting CBI, see the Confidential Business Information section.

DOE processes submissions made through <http://www.regulations.gov> before posting. Normally, comments will be posted within a few days of being submitted. However, if large volumes of comments are being processed simultaneously, your comment may not be viewable for up to several weeks. Please keep the comment

tracking number that <http://www.regulations.gov> provides after you have successfully uploaded your comment.

Submitting comments via email, hand delivery/courier, or postal mail. Comments and documents submitted via email, hand delivery/courier, or postal mail also will be posted to <http://www.regulations.gov>. If you do not want your personal contact information to be publicly viewable, do not include it in your comment or any accompanying documents. Instead, provide your contact information in a cover letter. Include your first and last names, email address, telephone number, and optional mailing address. The cover letter will not be publicly viewable as long as it does not include any comments.

Include contact information each time you submit comments, data, documents, and other information to DOE. If you submit via postal mail or hand delivery/courier, please provide all items on a CD, if feasible, in which case it is not necessary to submit printed copies. No telefacsimiles (faxes) will be accepted.

Comments, data, and other information submitted to DOE electronically should be provided in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format. Provide documents that are not secured, written in English, and free of any defects or viruses. Documents should not contain special characters or any form of encryption and, if possible, they should carry the electronic signature of the author.

Campaign form letters. Please submit campaign form letters by the originating organization in batches of between 50 to 500 form letters per PDF or as one form letter with a list of supporters' names compiled into one or more PDFs. This reduces comment processing and posting time.

Confidential Business Information. Pursuant to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email, postal mail, or hand delivery/courier two well-marked copies: one copy of the document marked "confidential" including all the information believed to be confidential, and one copy of the document marked "non-confidential" with the information believed to be confidential deleted. Submit these documents via email or on a CD, if feasible. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

It is DOE's policy that all comments may be included in the public docket, without change and as received, including any personal information provided in the comments (except information deemed to be exempt from public disclosure).

DOE considers public participation to be a very important part of the process for developing test procedures and energy conservation standards. DOE actively encourages the participation and interaction of the public during the comment period in each stage of this process. Interactions with and between members of the public provide a balanced discussion of the issues and assist DOE in the process. Anyone who wishes to be added to the DOE mailing list to receive future notices and information about this process

should contact Appliance and Equipment Standards Program staff at (202) 287-1445 or via e-mail at *ApplianceStandardsQuestions@ee.doe.gov*.

Signed in Washington, D.C., on February 21, 2020.

Alexander N. Fitzsimmons
Deputy Assistant Secretary for Energy Efficiency
Energy Efficiency and Renewable Energy

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