



Overview of Federal Energy Conservation Standards and Test Procedures for Water Heaters

Ashley Armstrong

Department of Energy
Building Technologies Office

February 22, 2016

Appliance Standards Program Overview

- 1** Appliance Standards Program Overview
- 2** Water Heater Standards Background
- 3** Recent Updates
- 4** Ongoing Activities

STANDARDS SAVE *BIG*: PRODUCT PROFILE

Over **65** covered products

Consumer



Commercial and Industrial



Lighting



Plumbing



90% of residential energy use covered

60% of commercial energy use covered

30% of industrial energy use covered

STANDARDS SAVE *BIG*: MONEY AND ENERGY

\$63 Billion

The annual utility bill savings to **consumers** from standards promulgated to date in 2015. This amounts to nearly \$320 per household per year in energy bill savings.

\$2 Trillion

The cumulative utility bill savings to **consumers** from standards are estimated to be over \$1 trillion through 2020, growing to nearly \$2 trillion through 2030.

132 quadrillion Btu

The cumulative energy savings of standards promulgated to date will be about 70 quadrillion British thermal units (quads) of energy through 2020, and will amount to nearly 132 quads through 2030 – 30 % more than 1 year’s worth of US energy use.

Consumer Water Heaters Standards Impacts

- Water heating accounts for approximately **18%** of residential U.S. household energy use.
- Consumer water heaters have undergone several standards revisions over the past 25 years.
 - Most recent standards mandatory in 2015; for products shipped from 2015-2044:
 - save approximately 3.3 quads of energy;
 - result in approximately \$63 billion in energy bill savings.
 - avoid about 172.5 million metric tons of carbon dioxide emissions, equivalent to the annual greenhouse gas emissions of about 33.8 million automobiles.
 - Previous standards mandatory in 2004; for products shipped from 2004-2033:
 - save approximately 6 quads of energy
 - result in approximately \$70.6 billion in energy bill savings
 - avoid about 316.8 million metric tons of carbon dioxide emissions, equivalent to the annual greenhouse gas emissions of about 62.1 million automobiles.
 - Initial standards mandatory in 1990; for products shipped from 1990-2019:
 - save approximately 3.2 quads of energy
 - result in approximately \$34.8 billion in energy bill savings
 - avoid about 180 million metric tons of carbon dioxide emissions, equivalent to the annual greenhouse gas emissions of about 35.3 million automobiles.

Commercial Water Heaters Standards Impacts

- Water heating accounts for approximately **8%** of U.S. commercial building energy use.
- Commercial water heaters have had multiple standards revisions.
 - Initial standards mandatory in 1994; for equipment shipped from 1994-2013:
 - save approximately .07 quads of energy
 - result in approximately \$730 million in energy bill savings
 - avoid about 4 million metric tons of carbon dioxide emissions, equivalent to the annual greenhouse gas emissions of about 784,000 automobiles.
 - More recent standards were mandatory in 2003 and save approximately 0.07 quads of energy for commercial water heating equipment shipped 2004-2030.
 - The most recent revision to standards, for oil-fired storage commercial water heaters only, was mandatory in 2015 and will save approximately 0.002 quads of energy for equipment shipped from 2015-2044.

Water Heater Standards Background

- 1 Appliance Standards Program Overview
- 2 Water Heater Standards Background**
- 3 Recent Updates
- 4 Ongoing Activities

Water Heater Standards Background

- Energy Policy and Conservation Act (EPCA) of 1975 (Pub. L. 94-163):
 - Established the Energy Conservation Program for Consumer Products other than Automobiles, which includes consumer water heaters
 - Established the Energy Conservation Program for Certain Industrial Equipment, which includes commercial water-heating equipment
- National Appliance Energy Conservation Act of 1987 (NAECA) (Pub. L. 100-12)
 - Established energy conservation standards for consumer water heaters
 - Required DOE to conduct 2 rounds of rulemaking to evaluate amended standards
- Energy Policy Act of 1992 (EPACT) (42 U.S.C. 6313(a)(5))
 - Added the initial Federal energy conservation standards and test procedures for commercial water heating equipment

Consumer Water Heater Standards Coverage

Consumer Water Heater Product Classes

Residential Water Heater	Rated Storage Volume	Nominal Input
Gas-fired Storage	≥ 20 to ≤ 100 gallons	$\leq 75,000$ Btu/h
Oil-fired Storage	≤ 50 gallons	$\leq 105,000$ Btu/h
Electric Storage	≥ 20 to ≤ 120 gallons	≤ 12 kW (40,956 Btu/h)
Tabletop*	≥ 20 to ≤ 100 gallons	≤ 12 kW (40,956 Btu/h)
Gas-fired Instantaneous	≤ 2 gallons	$> 50,000$ to $\leq 200,000$ Btu/h
Electric Instantaneous*	≤ 2 gallons	≤ 12 kW (40,956 Btu/h)

*Energy Conservation Standards will not change as a result of April 2010 final rule.

- The April 2010 final rule did not change the applicability of the standards.
- The UEF test procedure expanded the applicability of the test method, but did not change the coverage of energy conservation standards.

Commercial Water Heater Standards Coverage

Commercial Water Heating Equipment Classes

Equipment	Nominal Input
Electric storage water heaters	> 75,000 Btu/h
Gas-fired storage water heaters	> 105,000 Btu/h
Oil-fired storage water heaters	> 12 kW (40,956 Btu/h)
Gas-fired instantaneous water heaters and hot water supply boilers	> 200,000 Btu/h
Oil-fired instantaneous water heaters and hot water supply boilers	> 210,000 Btu/h

*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- and oil-fired storage water heaters, they have a fire damper or a fan assisted combustion.

**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."

Recent Updates

- 1 Appliance Standards Program Overview
- 2 Water Heater Standards Background
- 3 Recent Updates**
- 4 Ongoing Activities

Recent Updates to Standards and Test Procedures

- Consumer Water Heaters
 - DOE published the most recent amended standards for consumer water heaters on April 16, 2010. 75 FR 20112.
 - DOE published the Uniform Energy Factor test procedure (UEF TP) for residential water heaters on July 11, 2014. 79 FR 40541.
- Commercial Water Heating Equipment
 - DOE published a final rule on July 17, 2015, which adopted an amended standard for oil-fired storage water heaters. 80 FR 42614.
 - DOE published the most recent test procedure for commercial water heating equipment on May 16, 2012. 77 FR 28928.

Key Points – Consumer Standards April 2015 Levels

- For gas-fired and electric storage water heaters:
 - Standards equation slope and intercept changed
 - More stringent standards are required for water heaters above 55 gallons rated storage volume
- For gas-fired instantaneous and oil-fired storage water heaters:
 - Standards equation slope did *not* change
 - Standards equation intercept did change
- For electric instantaneous and tabletop water heaters:
 - Standards equations were not amended
- Amended standards required compliance on **April 16, 2015**.
- Grid-enabled water heaters have different standards

Key Points – Consumer Test Procedure

- UEF TP is conceptually similar to EF TP.
 - A maximum Gallons Per Minute test (Max GPM) or First-Hour Rating (FHR) test for determining delivery capacity
 - A 24-hour simulated use test (SUT) for determining UEF
- Thermostat is set based on delivery temp. Must be 125 +/- 5 °F.
- To determine UEF, water heater is tested to one of four possible draw patterns.
 - Draw patterns vary in length, flow rate, number of draws.
 - Result of the Max GPM or FHR test is used to determine the appropriate draw pattern for the UEF test.
- Coverage was expanded to include all consumer water heaters and certain commercial water heaters (i.e., “Residential-Duty Water Heater”).
- DOE is required to develop mathematical conversion from EF to UEF metric.

Key Points – Commercial Standard and Test Procedure

- Commercial Energy Conservation Standards
 - ASHRAE 90.1-2013 increased the thermal efficiency level for commercial oil-fired storage water heaters from 78% to 80%. DOE adopted the level in ASHRAE 90.1-2013 as a Federal energy conservation standard.
 - Compliance is required on **October 9, 2015.**
- Commercial Test Procedure
 - Incorporated by reference ANSI Z21.10.3-2011 (the most recent version of ANSI Z21.10.3 available at the time).
 - Effective on **May 13, 2013.**

Ongoing Activities

- 1 Appliance Standards Program Overview
- 2 Water Heater Standards Background
- 3 Recent Updates
- 4 Ongoing Activities

Ongoing Activities

- Uniform Efficiency Descriptor Mathematical Conversion
 - NOPR published on April 14, 2015 (80 FR 20116)
 - Public meeting held on May 28, 2015
 - SNOPR under development; expected publication Spring 2016. The SNOPR will incorporate new data submitted by AHRI
 - Final rule publication expected Summer 2016
- Commercial Water Heater Test Procedure
 - Request for Information published February 27, 2014 (79 FR 10999)
 - NOPR expected on February 2016.
- Commercial Water Heater Energy Conservation Standard
 - Request for Information (RFI) published October 21, 2014 (79 FR 62899)
 - NOPR at OIRA for review; publication expected spring 2016

Ongoing Activities Cont.

- Commercial Packaged Boilers Test Procedure
 - NOPR expected on February 2016.
- Commercial Packaged Boilers Energy Conservation Standard
 - NOPR at OIRA for review; publication expected February 2016
- Solar WH Definition Rule – expected Spring 2016
- AHRI Volume Petition – under consideration
- Consumer Water Heater Energy Conservation Standards (6 year look back)
 - Ongoing