

ENERGY STAR® Program Requirements Product Specification for Water Coolers

Test Method – DRAFT

1 OVERVIEW

The following test method shall be used for determining product compliance with requirements in the ENERGY STAR Eligibility Criteria for Water Coolers.

2 APPLICABILITY

This test protocol is applicable for the evaluation of energy capacity, active power, and standby power consumed by bottled and bottle-less water coolers.

3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions in the ENERGY STAR Product Specification for Water Coolers.

A) General:

Water Cooler: A water cooler is a factory assembled, free standing device that consumes energy to cool and/or heat water for human consumption.

B) Water Cooler Types:

- 1) Cold Only: Units which dispense cold water only, utilizing a refrigeration cycle.
- 2) Hot and Cold: Units which dispense both hot and cold water, some having a third room-temperature tap. These units utilize an electric resistance heater and a refrigeration cycle.
- 3) Cook and Cold: Units which dispense both cold and room-temperature water, utilizing a refrigeration cycle.
- 4) Bottle: Units employ a bottle or reservoir for storing the supply of water to be cooled or heated.
- 5) Point of Use (POU): Units draw water from a pressurized water source and typically filter before cooling or heating the water.
- 6) Air Source: Units draw water from the surrounding air by condensing water vapor into liquid, similar to a dehumidifier. The water is then filtered and purified before cooling or heating.

- 7) Internal Storage: Units store the hot and cold water in tanks internal to the unit. They can then provide hot or cold water instantaneously as the water is maintained at set temperatures in the tanks. 
- 8) On Demand: Units do not store significant amounts of water internally, but rather heat or cool the water when requested. This process can take one minute or more but can potentially save large amounts of energy while waiting for water to be requested.
- 9) Compartment-Type: Bottled water coolers which, in addition to the primary function of cooler and dispenser of potable water, include a refrigerated compartment with or without provisions for making ice.
- 10) Standby Energy Consumption: Standby energy consumption, $P_{standby}$, is the required energy to maintain cold and/or hot water at appropriate dispensing temperatures with no water being drawn for 24 hours.

11) UUT: The UUT is the Unit Under Test.

12) Symbols and Abbreviations

$P_{standby}$ - Standby energy consumption

$T_{disphot}$ - Dispensed hot water temperature

$T_{dispcold}$ - Dispensed cold water temperature

T_o - Temperature of the internal reservoir before drawing water

T_f - Temperature of the internal reservoir after drawing water

C_{hot} - Capacity of the hot water reservoir

C_{cold} - Capacity of the cold water reservoir

RH - Relative Humidity

BTU - British Thermal Units

V - Volume in gallons

C) Technical Definitions:

- 1) Capacity: The amount of energy imparted on the delivered water in specified amount of time (BTU).

Capacity is calculated as:

Where:

V = Volume of water removed in 5 minute period

T_f = Temperature of the removed water

T_o = Original temperature of the hot or cold reservoir

8.35 = Weight in pounds of one (1) gallon of water

4 TEST SETUP

- A) Input Power: Products intended to be powered from AC mains shall be connected to a voltage source that shall be maintained at $115 \pm 1\%$ VAC and 60 ± 0.2 Hz
- B) Ambient Temperature: Ambient temperature shall be maintained at $75.0 \pm 2^\circ\text{F}$.
- C) Relative Humidity: Relative humidity shall be from 40% to 60%.
- D) Air Circulation: Airflow around the unit under test (UUT) shall not exceed 1.8 m/s.
- E) Power Meter: The power meter shall have a minimum resolution of 0.01 Watt and a precision of $\pm 1\%$
- F) Dispensed Water Temperature: Cold water dispensed shall not exceed a temperature of 50°F and hot water shall be at least 165°F . The default temperature settings for the UUT shall be used and confirmed to meet the temperature requirements. These temperatures shall be reached during capacity testing and shall be maintained through standby testing. The water temperature setting shall not be adjusted at any time during the test.
- G) UUT Setup: The UUT shall be placed a maximum of six (6) inches from a test wall. The test wall shall be at least seven (7) feet high and extend a minimum of two (2) feet to each side of the unit.
- H) Bottle Unit Setup: Install the five (5) gallon bottle in accordance with the consumer instructions.
- I) Point of Use (POU) Unit Setup: Connect the POU water cooler to a tap of hose to ensure a constant source of water to the unit.

5 ENERGY MEASUREMENT TESTS

5.1 Thermal Equilibrium

- 1) With the power supply connected to the UUT and with any on/off switch in the off position, allow the UUT to stabilize at least 12 hours in the test room at the correct ambient with the specified water supply connected.

5.2 Determine Dispensed Water Temperature

- 1) For each water cooler, ensure the UUT is on for at least one (1) hour with a provided water source, and storage reservoirs filled where applicable.
- 2) After one (1) hour, dispense hot water.
- 3) Measure the test time and temperature of the dispensed water until the water temperature is stabilized to within 3°F for one (1) minute.
- 4) Record the dispensed water temperature as $T_{disphot}$.
- 5) Record the time, volts, amps, watts, watt-hours, and temperature for the period to stabilize dispensed water supply at a frequency of 1 second or less.

- 6) Repeat steps 7.2.3 to 7.2.4 with cold water dispensed. Record the dispensed cold water temperature as $T_{disp\ cold}$.



5.3 Standby Test

- 1) Operate the UUT for 24 hours with the prescribed water source without drawing water.
- 2) Measure and record time, volts, amps, watts, and watt-hours during the 24 hour standby test at a measurement frequency of 15 seconds or less.
- 3) For water coolers with water reservoirs, record the temperature of the water reservoir at a measurement frequency of 15 seconds or less.
- 4) Determine the average standby energy power consumption, $P_{standby}$, for the UUT.



5.4 Reservoir Capacity Test

- 1) Weigh water cooler without any water added.
- 2) Add water to the cold water reservoir, where applicable, and measure and record the water cooler weight.
- 3) Add water to the hot water reservoir, where applicable, and measure and record the water cooler weight.
- 4) Determine the capacity of the cold water storage reservoir as C_{cold} , where applicable, in gallons.
- 5) Determine the capacity of the hot water reservoir as C_{hot} , where applicable, in gallons.



5.5 Energy Test - Internal Water Reservoir

- 1) Conduct the following steps in section 5.5 for hot water delivery followed by a separate test series for cold water delivery.
- 2) Stabilize the UUT as defined above in section 5.1
- 3) Energize the UUT for the time required to reach the internal regulated water temperature from full ambient thermal equilibrium.
- 4) Measure the temperature of the water in the designated internal water reservoir, T_o .
- 5) Measure and record time, volts, amps, watts, watt-hours and temperature at a frequency of one (1) second or less.
- 6) After the water in the internal water storage reservoir has reached the internal regulated water temperature, draw water continuously for five (5) minutes and collect in a single reservoir.



- 7) After the water draw, immediately measure the temperature of the withdrawn water in the reservoir, T_f , and the volume of water drawn, V , in gallons.
- 8) Allow the UUT to return to standby mode by not drawing water.
- 9) Record the time needed and energy consumed to return the internal water reservoir to the internal regulated water temperatures at a frequency of one (1) second or less.

5.6 Energy Test - No Internal Water Reservoir

- 1) Conduct the following steps in section 5.6 for hot water delivery followed by a separate test series for cold water delivery.
- 2) Allow the unit to stabilize as defined above in section 5.1.
- 3) Measure the water temperature as close as possible to the point of water cooling/heating at a frequency of one (1) second or less.
- 4) Draw water continuously for five (5) minutes and collect in a single reservoir. The five (5) minute test period starts when the hot water is first requested.
- 5) After the draw, immediately measure the temperature of the withdrawn water in the reservoir, T_f , and the volume of water drawn, V , in gallons.

5.7 Active Mode Test - Heat/Cool, Storage Units

- 1) Allow the UUT to stabilize as defined above in section 5.1.
- 2) Disable the unit from adding additional water into the hot reservoir for the following test.
- 3) Fill the test internal water reservoir with one (1) gallon of room temperature water and completely fill the opposite water reservoir with water meeting the required water operation temperature 
- 4) Energize the UUT and operate until the water in the test reservoir has reached the regulated temperature. 
- 5) Record the time, volts, amps, watts, watt-hours consumed to heat one (1) gallon of water to the regulated water temperature at a frequency of one (1) second or less.
- 6) Repeat the above steps in section 5.7 with one (1) gallon of room temperature water in the opposite water reservoir and a completely filled water reservoir with water meeting the regulated water temperature.

5.8 Active Mode Test - Heat/Cool, On Demand Units

- 1) Conduct the following steps in section 5.8 for hot water delivery followed by a separate test series for cold water delivery.

- 2) Stabilize the UUT as described above in section 5.1.
- 3) Energize the UUT until all startup and initialization operations have ceased.
- 4) Request hot water.
- 5) Record the temperature of the delivered water, time needed, and energy consumed to heat up and deliver one (1) gallon of water at the required hot water temperature at a frequency of one (1) second or less.

5.9 Active Mode Test - Replenish and Heat/Cool, Storage Units

- 1) Conduct the following steps in section 5.9 for hot water delivery followed by a separate test series for cold water reservoir.
- 2) Stabilize the UUT as described in step 5.1.
- 3) Energize the UUT and operate until the water temperatures in both hot and cold reservoirs have reached the regulated temperature.
- 4) Withdraw one (1) gallon of hot water from the reservoir and confirm that the drawn water is of the minimum temperature.
- 5) Allow the UUT to automatically refill the hot reservoir and return to the regulated temperature.
- 6) Record the time needed and energy consumed from the point water is no longer drawn to when the internal hot water reservoir has reached the required temperature at a frequency of one (1) second or less.

5.10 Active Mode Test - Replenish and Cool, On Demand Units

- 1) Stabilize the UUT as described in step 5.1.
- 2) Energize the UUT and operate until the water temperature in the cold reservoir has reached the regulated temperature.
- 3) Withdraw one (1) gallon of cold water from the reservoir and confirm that the drawn water is equal to or below the maximum temperature.
- 4) Allow the UUT to automatically refill the cold reservoir and return to the maximum required temperature.
- 5) Record the time needed and energy consumed from the point water is no longer drawn to when the internal cold water reservoir has reached the regulated temperature at a frequency of one (1) second or less.

6 TEST RECORDS

6.1 Test Report

A) The test report shall include the following information

- 1) Place and date of test.
- 2) Manufacturer's name, water cooler model number, serial number, and year of manufacture.
- 3) Water source, water temperature delivered, and water storage method.
- 4) Outer dimensions (rectangular).
- 5) Power rating (W) and required power source.
- 6) Ambient conditions: Temperature (°F) and Humidity (%RH).
- 7) The following shall be recorded for each measurement instrument in use
 - i) Instrument type
 - ii) Manufacturer and model
 - iii) Ranges used
 - iv) Serial number and year of manufacture
 - v) Last calibration date and next due calibration date