

CEE Residential Electric Water Heating Specifications

Effective January 1, 2023

Widespread promotion of the *CEESM Residential Water Heating Initiative* and common performance specifications provides a consistent definition of efficiency to all market actors and tiers that identify meaningful levels of energy savings.

Heat Pump Water Heater Specification

Scope: Integrated HPWHs

Level	UEF	Other Mandatory Requirements
CEE Tier 1*	≥ 3.30 UEF	ENERGY STAR Version 5.0 Compliance**
CEE Advanced Tier	≥ 3.75 UEF	ENERGY STAR Version 5.0 Compliance** CEE Connected Criteria

Split-System HPWH Specification

Scope: Split-System HPWHs

Level	UEF	Other Mandatory Requirements
CEE Tier 1*	≥ 2.20 UEF	ENERGY STAR Version 5.0 Compliance**

120 Volt, 15 Amp Heat Pump Water Heater Specification

Scope: 120V Integrated HPWHs

Level	UEF	Other Mandatory Requirements
CEE Tier 1*	≥ 2.20 UEF	ENERGY STAR Version 5.0 Compliance**

* Aligns with ENERGY STAR Version 5.0 specification
** ENERGY STAR Version 4.0 Compliance is acceptable through April 18, 2023.

Additional Requirements

Compressor Shutdown Notification

The unit shall provide notification to the consumer that the heat pump operation of the product has been disabled in any of the following situations.

Condition	Description	Notification
Normal, Temporary Event	The compressor is temporarily disabled due to specific operational controls (for example, low intake temperature or defrosting).	The unit shall display that the heat pump is not currently operating. The controls shall automatically restore compressor operation as soon as conditions return to allowable control parameters (for example, return to minimum intake temperature or completion of the defrost cycle).
User-Selected Override or Power Failure	The unit has a temporary, user-selectable heat pump override option.	The unit shall provide a default override period of up to 72 hours before returning to the previously selected operating mode (preferably to the as-shipped or better settings) except 100% electric resistance.
Product Failure Alarm	The unit's heat pump has a failure and requires service.	The unit shall provide to the consumer an audible and visible alarm on the interior unit. The unit shall provide a consumer acknowledgement feature which turns off the audible alarm. The visual alarm shall be visible without removal of panels or covers, with clear nomenclature and enunciation to notify the homeowner to take the needed action to solve the problem.

Default Settings

Minimal Use of Electric Resistance Element: In default operating mode, units shall make minimal or no use of electric resistance heating elements in order to maximize energy savings potential. During the first draw of the standard DOE First Hour Rating Test, the electric resistance heating element shall not be turned on until at least 66 percent of the tank's measured water volume has been withdrawn. Measured water volume is defined as the amount of water the unit actually stores under test, and not the nominal rated tank volume.

Shipment Mode: The unit shall be shipped in the default operational mode and settings used in demonstrating compliance to federal energy efficiency standards. Enhanced efficiency operational modes may be selected by the consumer during installation. Should a user initiate an override to a mode less energy efficient than the default condition, such selection will expire after a period of no more than 72 hours. Upon expiration, the appliance shall then automatically return to the mode previously selected by the user unless that mode was less efficient than the default, in which case it shall return to the default. The customer, technician, or installer shall have the ability to override the default setting. In the event of total power loss to the unit, it shall revert to the last setting selected, as long as this setting is not electric only.

Optional Connected Criteria

Units shall meet the following requirements and parameters in order to fulfill the optional CEE connected criteria.

Criteria Scope

Products must meet the scope and efficiency requirements set forth under “Heat Pump Water Heaters” in the Initiative’s Electric Qualification Criteria.

Connected Electric HPWH Definition and Key Aspects

To claim compliance with the CEE Connected Criteria, a connected heat pump water heater must include the device plus at least one communication interface at the device level that conforms with an open communication standard, to enable the product owner or an authorized third party to monitor and predictably execute load management functions as defined in Section D. Manufacturers may also choose to include an additional interface that may or may not use open communication standards to provide load management and other services. The product must continue to comply with the applicable product safety standards; the inclusion of the functionality described below shall not supersede existing safety protections and functions.

Connectivity

On-Premise, Open Standards Connectivity: CEE requires that a product must enable economical and direct, on-premise, open standards-based translation using the physical and data-link layers of an industry-accepted, modular communication interface such as ANSI/CTA-2045-B. The open standards interface must be combined with an open standards communication module. Manufacturers may also choose to include a secondary communication interface to facilitate load management or other services that may be proprietary to the manufacturer or a designated third party.

Open Access: Manufacturers must provide any documentation that is required for the product owner or any third party to develop technologies to connect to the device’s communication interface. This must include documentation for connecting to both proprietary and open standard based interfaces.

Energy Consumption Reporting: Products must be capable of communicating measured or estimated data representative of interval energy consumption to consumers via the physical communication device to provide actionable behavioral opportunities for the customer to save energy where available. Products must be able to collect and transmit this data to consumer authorized third parties.

Energy consumption data must be reported in kWh for intervals of 15 minutes or less, unless otherwise stated. Products must also provide energy use feedback on the product itself in a format chosen by the manufacturer (i.e., \$/month).

Consumer Data Security: Where applicable, products should be certified to a relevant cybersecurity industry standard such as UL 2900, UL IoT Security Rating, CSA T-200, or equivalent.

Products must also allow for over the air updates of firmware associated with normal product operation.

Enabled Demand Response Capabilities

To ensure that connected products respond in a predictable manner and provide a standardized set of data, CEE requires that products support a common set of load control and monitoring messages. For more information about these messages, responses, and associated water heater control strategies, please see the ANSI/CTA-2045-B Standard and the EPRI Heat Pump Water Heater Specification.

Demand Response Messages	General Description and Use Cases
Application ACK (acknowledgement)	Confirmation of signal receipt.
Application NAK (negative acknowledgement)	An indication that a signal was not received or was corrupted during transmission.
Outside communication connection status	The water heater must monitor for this “heartbeat” signal. If the water heater is processing a curtailment request and the heartbeat is not received within 15 minutes, the water heater will return to normal operation.
End shed/run normal	Used to inform the water heater that no events are in effect and to run normally. If received during a curtailment event, the water heater shall immediately return to normal operation.
Shed	The water heater shall avoid operation. If the stored energy drops below the minimum consumer comfort level, only the heat pump unit should engage to heat water if the shed event is in effect. Heat pump should attempt to avoid using resistive elements while this command is in effect.
Critical peak event	The water heater shall avoid operation, allowing the stored thermal energy in the tank to drop. Since these events are typically infrequent, the water heater should more aggressively curtail demand. Heat pump should attempt to avoid using resistive elements while this command is in effect.
Grid emergency	During an emergency event, the water heater shall immediately shut down, not heating water until the event has ended. Note: Customer overrides shall be allowed, even for grid emergencies.
Present Relative Price	The Relative Price command is used in association with a range of price-based programs and lends itself strongly to consumer configurability of response (that is, no particular response is mandatory from a utility perspective). Manufacturers are encouraged to design a response method that considers the customer’s price thresholds.

Autonomous cycling and terminate cycling	This message passes the water heater a request for operation at a particular duty cycle. The water heater acts to carry out this duty cycle of operation to the extent possible, given total cycle-count limits and the need to remain within the bounds of upper and lower temperature limits and maximum and minimum stored energy. For the water heater, it is acceptable for the unit to self-impose a minimum delay between cycled starts to protect itself.
Load Up	Sent from the communication module to the water heater to request that the unit increase the stored energy to the maximum allowable level, as determined by user set point. The HPWH should attempt to avoid using resistive elements while this command is in effect.
Advanced Load Up	Sent from the communication module to the water heater to request that the unit increase the stored energy beyond user set point to the maximum allowable level within safety parameters, as determined by manufacturer. The HPWH should attempt to avoid using resistive elements while this command is in effect.
Get/set user preference level	The User Preference Level message provides values from low to high (0-10) that the manufacturer shall use to manage the level of customer comfort and grid services. The water heater can obtain the user preference level through the Get User Preference Level command.
Customer override	If an override occurs, the water heater must return to normal operation and ignore any new curtailment messages for the next 12 hours. The water heater must also provide a simple mechanism to proactively override any curtailment event requests for a duration of up to 24 hours.
Query and response: operational state	The communication module, at any time, can query the water heater for its operational state.
Query and response: device information request	At a minimum, water heater shall support all mandatory device information plus the model number and serial number optional fields associated with the information request.
Get/set commodity read request and get/set commodity read reply	Water heater shall support the following requests from a communication interface: electric power and cumulative lifetime energy consumed, total energy storage capacity, and present energy storage capacity. The accuracy of this estimation must be at most 25% of the full capacity.
Get present water temperature	The preferred value to report is the best estimate of the average temperature of the water in the tank.

Response to Loss of Connectivity to Utility: If there is a loss of connectivity between the product and utility during a load management event, defined as the product's lack of response to the utility load management system within the bounds of response time set by the utility, or vice versa, the product will:

- Complete the load management event dictated operation as planned if participating in an event with a messaged set duration
- Return to normal operations within 30 minutes of the start of the load management event dictated operation if no set time duration was messaged.

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