

2.3 Residential Product Tiers

Tiers are incorporated into this specification to recognize variations in product performance and supported installation applications. Throughout the Residential chapter of this specification, different product categories, e.g., integrated units or split systems, may have different requirements as applicable to their design and operation. Table 1 and Table 2 summarize the tier requirements for integrated units and split systems, respectively. The requirements are further detailed throughout this Residential chapter.

Table 1. Integrated HPWH Product Tier Overview

	Minimum Cool Climate Efficiency (CCE)*	Minimum Features	Sound Levels**	Demand Response Enabled?
Tier 1.0	2.0	<ul style="list-style-type: none"> ENERGY STAR compliance Freeze protection 	dBA < 65	Optional
Tier 2.0	2.3	Tier 1 plus: <ul style="list-style-type: none"> Minimal use of resistance heating elements (see Section 2.5.1) Compressor shut-down/notification 10 year warranty Condensate management 	dBA < 60	Optional
Tier 3.0	2.6	Tier 2 plus: <ul style="list-style-type: none"> Simultaneous intake and exhaust ducting capabilities Air filter management Override and default mode behavior as per Section 2.6.1 	dBA < 55	Required
Tier 4.0	3.0	Tier 3 plus:	dBA < 50	Required

		<ul style="list-style-type: none"> Physical design or default controls that limit resistance element heating to less than upper 50% of tank 		
Tier 5.0	3.5	Tier 4 plus: <ul style="list-style-type: none"> No resistance element usage in default 	dBA < 50	Required

* See Appendix B.1.2 for details on Cool Climate Efficiency definition and calculation method. ** See Appendix D for details on Sound Level definition and calculation method.

Table 2. Split-System HPWH Product Tier Overview

	Minimum SCOP*	Minimum Features	Sound Levels	Demand Response Enabled?
Tier 1.0	2.1	<ul style="list-style-type: none"> ENERGY STAR compliance Freeze protection 	dBA < 65	Optional
Tier 2.0	2.4	Tier 1 plus: <ul style="list-style-type: none"> Minimal use of resistance heating elements (see Section 5.1) Compressor shut-down/notification 10 year warranty Condensate management 	dBA < 60	Optional
Tier 3.0	2.7	Tier 2 plus: <ul style="list-style-type: none"> Override and default mode behavior as per Section 6.1 	dBA < 50	Required
Tier 4.0	3.1	Tier 3 plus: <ul style="list-style-type: none"> Physical design or default controls that limit resistance element heating to less than upper 50% of tank 	dBA < 50	Required
Tier 5.0	3.6	Tier 4 plus: <ul style="list-style-type: none"> No resistance element usage in default mode unless outside ambient air temperature is below -5°F 	dBA < 50	Required

* SCOP (seasonal coefficient of performance) is a different variable from CCE. SCOP applies to split systems for which the heat pump is subject to outdoor air conditions (see Appendix B.4). The reference climate for the SCOP comprises a combination of the climates of five Pacific Northwest cities.
 ** See Appendix D for details on Sound Level definition and calculation method.

2.4 Requirements for All Residential Units (Tiers 1.0 and above)

2.4.1 Standards Approval

The unit shall be approved by Underwriters Laboratories (UL), Electrical Testing Laboratories (ETL), CSA International (CSA), or an equivalent third-party agency to the applicable standards and have the ability to be installed in the U.S. and/or Canada.

2.4.2 ENERGY STAR Compliance

The unit shall meet ENERGY STAR criteria effective at the time of manufacture.

2.4.3 Freeze Protection Test

Applicable only to units circulating water to system components outside the heated house envelope or buffer space (i.e., circulating water to a heat exchanger that is in a location subject to freezing temperatures). If applicable, the unit shall pass the 24-hour power-off freeze protection test as specified in Appendix C. The test is designed to help ensure water heaters do not freeze during power outages. Manufacturers should clearly state in installation manuals how to install units to prevent freezing (in cold temperatures without an energized unit).

2.4.4 Cool Climate Efficiency (CCE)

The unit shall meet minimum Cool Climate Efficiency values for cool climate installations, under default (out of the box configuration) operating mode settings, according to Table 1. See Appendix B.1.2 for the Cool Climate Efficiency Test Procedure and corresponding calculation method.

2.4.5 Sound Levels

The unit shall not exceed maximum sound levels according to Table 1. for interior units. Exterior units must comply with local codes regarding noise. See Appendix D for Sound Pressure Measurement Test Method.

2.4.6 High Volume Draw Test

Units that allow electric resistance element operation in the default operating mode, under standard operating conditions, shall complete the high-volume draw test. Standard operating conditions are defined as the normal temperature operating range of the heat pump system. Products that qualify for Tier 5 do not need to undergo this testing nor do products that do not use resistance elements in the default operating mode under standard operating conditions. This test has no minimum or performance requirements. It is required as informational only and the results are to be submitted on the Product Assessment Datasheet (see Appendix N for an example).

2.4.7 OPTIONAL: Warm Climate Efficiency Test

This is a test to demonstrate performance in warm climates. Test results may be useful in demonstrating product applicability and expanding market reach in warm climates. See Appendix B.1.3 for the measurement details of this *optional* test. In lieu of a measurement, energy use may be extrapolated from lower temperature test results per the method suggested in Appendix B.1.3.

2.4.8 Installation Guidance

Installation guidance shall be provided so the unit is installed with adequate clearance for all airflow to and from the evaporator. The manual shall provide several possible configurations and/or installation scenarios to assist the installer.

2.5 Additional Requirements for Residential Tiers 2.0 and Above

2.5.1 Minimal Use of Electric Resistance Heating Elements

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 U.S. Department of Energy (DOE) first-hour rating test,¹ the electric resistance heating element shall not be turned on until at least 66% of the tank's measured water volume has been withdrawn. Measured volume is defined as the actual storage volume of the unit under test, not the nominal rated tank volume.

2.5.2 Compressor Shut-Down, Notification

The unit shall provide notification to the consumer, at the unit itself through an indicator light, display, or similar, that the heat pump operation of the product has been disabled due to normal events, user-selected override, or product failure.

2.5.2.1 Normal, Temporary Event

The unit shall display that the heat pump is not currently operating if the compressor is temporarily disabled due to specific operational controls (e.g., low intake temperature or defrosting). The controls shall automatically restore compressor operation as soon as conditions return to allowable control parameters (e.g., return to minimum intake temperature or completion of the defrost cycle).

2.5.2.2 User-Selected Override and/or Power Failure

If 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 for 100% electric resistance. Upon power failure, the unit must return to the last mode the user had selected or in which the user was operating, unless new commands come in through the demand response port or the customer API.

2.5.2.3 Product Failure Alarm

The unit shall provide the following alarms to the consumer that the unit has a failure and requires service:

¹http://www.ecfr.gov/cgi-bin/text-idx?SID=80dfa785ea350ebeee184bb0ae03e7f0&mc=true&node=ap10.3.430_127.e&rgn=div9

- Visual alarm—shall be visible without removal of panels and/or covers and have clear direction to the homeowner to take needed action to solve the problem.
- Audible alarm and/or electronic notification to homeowner via email, text message, phone app, or similar. If an audible alarm is used, the unit shall provide a homeowner acknowledgement feature that turns off the audible alarm. An audible alarm shall be at least 50 dBA at the location specified in Appendix D for measuring noise level on the HPWH.

The unit shall have a visual alarm and one or both of the following: audible or e-notification alarms.

2.5.3 Warranty and Service

The unit shall carry a warranty of a minimum of 10 years for all system parts as well as a minimum of one year for labor from date of installation.

2.5.3.1 Contact Information

The unit shall include clear information on how to obtain warranty service, replacement filters or other maintenance items, and technical support via a toll-free phone number clearly marked on the exterior of the unit regardless of the channel through which the product is sold.

2.5.4 Condensate Management

Condensate shall be drained away according to local plumbing codes and industry best practices.

2.5.4.1 Acceptable Condensate Piping

The unit shall include a minimum standard piping connection for condensate drainage of proper size to function for the life of the product under normal use (field installation materials to be provided by the installer for the connection). The manufacturer shall supply appropriate condensate piping specifications including piping diameter, length, allowable turns, slope, and acceptable termination for gravity drains and for condensate pumping in locations, such as basements, where gravity drainage is not possible. Instructions for the installer shall highlight the importance of correct condensate line installation practices and adherence to local plumbing code.

2.5.4.2 Condensate Overflow Shut-off and Alarm

Units shall include a safety switch to shut off compressor operation in the event of a blockage of the condensate removal system for any units installed in interior applications. An alarm (See Section 2.5.2.3) shall be activated to signal the need for service in the event of a compressor shut-off due to condensate drain failure.

2.5.4.3 Condensate Collection Pan and Drain Service

The condensate collection pan and drain shall be designed to require no regular maintenance or interaction by the consumer for the life of the product. In the event of a blockage, the pan and drain shall be designed to allow the consumer to be able to clear the drain with normal household tools and restore normal operation of the condensate line. Collection pan equipment and installation shall meet local code.

2.6 Additional Requirements for Residential Tiers 3.0, 4.0, and 5.0

2.6.1 Default Settings

The unit shall be shipped in the default operational mode used in demonstrating compliance with 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 72-hour period. 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, and/or installer shall have the ability to override the default setting. In the event of total power loss to the unit, upon restart, it shall revert to the last settings selected as long as it is not electric resistance only.

2.6.2 Intake and Exhaust Ducting

The unit may have a manufacturer-supplied, optional ducting kit to provide for simultaneous intake and exhaust air ducting (“ducting kit”), available from the same distribution/retail channels as the unit. See manufacturer’s recommendations for ducting applications and solutions.

2.6.2.1 Ducting Hardware

The unit shall include all necessary flanges, collars, or other connections that are capable of directly connecting to common ducting products. Alternatively, manufacturer-supplied add-on ducting modifications may be used if they provide the same capabilities.

2.6.2.2 Minimum Flow Rate/Pressure Drop

The unit shall maintain necessary airflow to achieve the tested performance (CCE) when attached to the duct system. The manufacturer shall supply instructions for the ducting kit that show necessary installation requirements (e.g., maximum equivalent duct length at a given diameter) to maintain airflow.

2.6.2.3 Application Options

The unit shall be capable of operating with or without ducting installed. Manufacturers shall clearly identify which models are configured for which applications along with a

clear description (e.g., parts list and drawings) of the appropriate layout/configurations and accessory parts necessary to meet the requirements for specific applications.

2.6.3 Air Filters: Routine Maintenance and Homeowner Notification

If any air filters are present, they shall be either 1) permanent, washable media or 2) replaceable, standard filters in shapes and forms obtainable at a typical hardware store. The unit shall provide visible notification to the homeowner of appropriate need to change, or service, the filter in order to prevent compromise of performance of the heat pump from reduced airflow. Recommendations are to be defined by the manufacturer.

2.6.4 Demand Response Features

Units shall be configured and shipped with the capability to respond appropriately to demand response, grid emergency, and efficiency messages over a standard communication protocol and hardware interface. Units shall have a communication port that operates in compliance with CTA-2045² (or equivalent open source modular interface standard) with specific demand response signals such as shed, end shed, etc. The communication port shall be easily accessible and allow for the plug-in of non-proprietary communication modules. The product shall revert to the user's previously-selected mode (or factory settings) after a demand response event. All CTA-2045 or equivalent open source modular interface functionality, including hardware and software, must be contained on the unit. A module or adaptor separate from the unit does not meet the requirement; it must be affixed in such a way that the average homeowner cannot remove it without special tools and/or significant effort. See Appendix F for further definitions and requirements.

2.6.5 Refrigerants

The current version of this specification does not require specific refrigerants to be used for any product. Future versions of this specification, especially for products at higher tier levels, may require refrigerants that have a lower Global Warming Potential³ (GWP) than those typically used in current products (for example, future specifications may limit GWP to less than 100).

2.7 Additional Requirements for Residential Tier 4.0

2.7.1 Further Minimization of Electric Resistance Heating

The physical design, or default equipment controls, shall limit the electric resistance element heating to less than the upper 50% of the tank volume. This requirement applies

²CTA-2045 has been newly renamed EcoPort.

³<https://www.epa.gov/ghgemissions/understanding-global-warming-potentials>

only to operation within the standard operating range for the heat pump. If the temperature range is outside that at which the heat pump compressor can operate, use of resistance heat is permitted.

2.8 Additional Requirements for Residential Tier 5.0

2.8.1 No Resistance Element Usage in Default Mode

Integrated units shall not use electric resistance heat in the default operating mode. Split systems shall not use electric resistance heat in the default operating mode unless the outside air temperature is less than -5°F.