



ENERGY STAR® Program Requirements

Product Specification for Central Air Conditioner and Heat Pump Equipment

Eligibility Criteria

Draft Version 6.2

1 Following is the Version 6.2 product specification for ENERGY STAR certified central air conditioner and heat pump
2 equipment. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

3 **1) Definitions:** Below are the definitions of the relevant terms in this document.

4 A. Central Air Conditioner (CAC) or Central Air Conditioning Heat Pump (HP)¹: A product, other than a
5 packaged terminal air conditioner or packaged terminal heat pump, which is powered by single phase electric
6 current, air cooled, rated below 65,000 Btu per hour, not contained within the same cabinet as a furnace, the
7 rated capacity of which is above 225,000 Btu per hour, and is a heat pump or a cooling unit only.

8 A central air conditioner or central air conditioning heat pump may consist of: A single-package unit; an
9 outdoor unit and one or more indoor units; an indoor unit only; or an outdoor unit with no match. In the case
10 of an indoor unit only or an outdoor unit with no match, the unit must be tested and rated as a system
11 (combination of both an indoor and an outdoor unit).

12 B. Single-package unit²: Any central air conditioner or heat pump that has all major assemblies enclosed in one
13 cabinet.

14 C. Split System²: Any air conditioner or heat pump that has at least two separate assemblies that are connected
15 with refrigerant piping when installed. One of these assemblies includes an indoor coil that exchanges heat
16 with the indoor air to provide heating or cooling, while one of the others includes an outdoor coil that
17 exchanges heat with the outdoor air. Split systems may be either blower coil systems or coil-only systems.

18 D. Multi-head mini-split system²: A split system that has one outdoor unit and that has two or more indoor units
19 connected with a single refrigeration circuit. The indoor units operate in unison in response to a single indoor
20 thermostat.

21 E. Multiple-split (or multi-split) system²: A split system that has one outdoor unit and two or more coil-only indoor
22 units and/or blower coil indoor units connected with a single refrigerant circuit. The indoor units operate
23 independently and can condition multiple zones in response to at least two indoor thermostats or temperature
24 sensors. The outdoor unit operates in response to independent operation of the indoor units based on control
25 input of multiple indoor thermostats or temperature sensors, and/or based on refrigeration circuit sensor input
26 (e.g., suction pressure).

27 F. Ducted System²: An air conditioner or heat pump that is designed to be permanently installed equipment and
28 delivers conditioned air to the indoor space through a duct(s). The air conditioner or heat pump may be either
29 a split-system or a single-package unit. A ducted system may be any one of the following configurations:

¹ 10 CFR part 430, Subpart A, § 430.2 Definitions

² 10 CFR part 430, Subpart B, Appendix M1

- 30 a. Ceiling-mount blower coil system²: A split system for which a) the outdoor unit has a certified cooling
 31 capacity less than or equal to 36,000 Btu/h; b) the indoor unit(s) is/are shipped with manufacturer-supplied
 32 installation instructions that specify to secure the indoor unit only to the ceiling, within a furred-down
 33 space, or above a dropped ceiling of the conditioned space, with return air directly to the bottom of the unit
 34 without ductwork, or through the furred-down space, or optional insulated return air plenum that is shipped
 35 with the indoor unit; c) the installed height of the indoor unit is no more than 12 inches (not including
 36 condensate drain lines) and the installed depth (in the direction of airflow) of the indoor unit is no more
 37 than 30 inches; and d) supply air is discharged horizontally.
- 38 b. Low-static blower coil system²: A ducted multi-split or multi-head mini-split system for which all indoor
 39 units produce greater than 0.01 in. wc. and a maximum of 0.35 in. wc. external static pressure when
 40 operated at the cooling full-load air volume rate not exceeding 400 cfm per rated ton of cooling.
- 41 c. Mid-static blower coil system²: A ducted multi-split or multi-head mini-split system for which all indoor units
 42 produce greater than 0.20 in. wc. and a maximum of 0.65 in. wc. when operated at the cooling full-load air
 43 volume rate not exceeding 400 cfm per rated ton of cooling.
- 44 d. Mobile home blower coil system²: A split system that contains an outdoor unit and an indoor unit that
 45 meet the following criteria:
- 46 i. Both the indoor and outdoor unit are shipped with manufacturer-supplied installation instructions that
 47 specify installation only in a mobile home with the home and equipment complying with HUD
 48 Manufactured Home Construction Safety Standard 24 CFR part 3280;
- 49 ii. The indoor unit cannot exceed 0.40 in. wc. when operated at the cooling full-load air volume rate not
 50 exceeding 400 cfm per rated ton of cooling; and
- 51 iii. The indoor and outdoor unit each must bear a label in at least 1/4 inch font that reads “For
 52 installation only in HUD manufactured home per Construction Safety Standard 24 CFR part 3280.”
- 53 e. Small-duct, high-velocity system²: A split system for which all indoor units are blower coil indoor units that
 54 produce at least 1.2 inches (of water column) of external static pressure when operated at the full-load air
 55 volume rate certified by the manufacturer of at least 220 scfm per rated ton of cooling.
- 56 f. Conventional ducted system²: All ducted central air conditioners and heat pumps not otherwise listed
 57 above³, tested at a minimum external static pressure of 0.50 in. wc.
- 58 G. Non-ducted Indoor Unit²: An indoor unit that is designed to be permanently installed, mounted on room walls
 59 and/or ceilings, and that directly heats or cools air within the conditioned space.
- 60 H. Gas/Electric Package Unit: A single package unit with gas heating and electric air conditioning that is often
 61 installed on a slab or roof.
- 62 I. Basic Model¹: All units of a given type of covered product (or class thereof) manufactured by one
 63 manufacturer and which have the same primary energy source and, which have essentially identical
 64 electrical, physical, or functional (or hydraulic) characteristics that affect energy consumption, energy
 65 efficiency, water consumption or water efficiency.

³ One-to-one “mini-split” systems are categorized as either a non-ducted system (when testing without ductwork at 0 ESP) or as a conventional ducted system (when tested with ductwork at 0.50 in. wc). No categorization exists allowing mini-split systems to be tested at reduced external static pressures in a ducted configuration.

- 66 J. Heating Seasonal Performance Factor 2 (HSPF2)⁴: HSPF2 is the total space heating required in region IV
67 during the space heating season, expressed in Btu, divided by the total electrical energy consumed by the
68 heat pump system during the same season, expressed in watt-hours. The represented value of HSPF
69 determined in accordance with Appendix M1 is HSPF2, and the represented value in accordance with
70 Appendix M is HSPF.
- 71 K. Seasonal Energy Efficiency Ratio 2 (SEER2)⁴: SEER2 is the total heat removed from the conditioned space
72 during the annual cooling season, expressed in Btu, divided by the total electrical energy consumed by the air
73 conditioner or heat pump during the same season, expressed in watt-hours. The represented value
74 determined in accordance with Appendix M1 is SEER2, and the represented value in accordance with
75 Appendix M is SEER.
- 76 L. Energy Efficiency Ratio 2 (EER2)⁴: EER2 is the ratio of the average rate of space cooling delivered to the
77 average rate of electrical energy consumed by the air conditioner or heat pump. This ratio is expressed in Btu
78 per Wh (Btu/Wh). The represented value determined in accordance with appendix M1 is EER2, and the
79 represented value determined in accordance with Appendix M is EER.
- 80 M. Coefficient of Performance (COP)²: COP means the ratio of the average rate of space heating delivered to
81 the average rate of electrical energy consumed by the heat pump. These rate quantities must be determined
82 from a single test or, if derived via interpolation, must be determined at a single set of operating conditions.
83 COP is a dimensionless quantity.
- 84 N. Percentage of Heating Capacity @ 5°F: The heating capacity of a given unit at 5°F, divided by the heating
85 capacity at 47°F, expressed as a percentage.
- 86 O. Independent Coil Manufacturer (ICM)²: A manufacturer that manufactures only the indoor unit (coil) in a
87 Central Air Conditioner or Air-Source Heat Pump Split System.
- 88 P. System Manufacturer (SM): A manufacturer that manufactures all the major assemblies in an Air- Source
89 Unitary Heat Pump and/or Unitary Air-Conditioner.

90 2) Scope:

- 91 A. Included Products: Single package, split system, and gas/electric package units that meet the definitions of a
92 central air conditioner or heat pump as specified herein are eligible for ENERGY STAR certification, with the
93 exception of products listed in Section 2.B. Units may be intended for installation into a duct system or may
94 be ductless.
- 95 B. Excluded Products: Three phase central air conditioners and heat pumps, and products rated at 65,000 Btu/h
96 or above are covered in the [ENERGY STAR Light Commercial HVAC specification](#). Ground Source Heat
97 Pumps are covered under the [ENERGY STAR Geothermal Heat Pump specification](#).

98 3) Certification Criteria:

- 99 A. Climates: ENERGY STAR heat pumps that are optimized for peak heating and part-load cooling performance
100 may use the Cold Climate certification mark if certified to meet the cold climate criteria. All other CACs and
101 HPs may use the standard ENERGY STAR certification mark.
- 102 B. Energy Efficiency Requirements:
- 103 a. Certification Metric Criteria

⁴ Based on definition in 10 CFR part 430, Subpart B, Appendix M and M1

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Table 1: Energy-Efficiency Criteria for Certified Residential Central Air Conditioners

| Product Type | SEER2 | EER2 |
|---|--------|--------|
| CAC Split Systems | ≥ 15.2 | ≥ 12.0 |
| CAC Single Package Equipment ¹ | ≥ 15.2 | ≥ 11.5 |

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¹ Including gas/electric package central AC units.

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Table 2: Energy-Efficiency Criteria for Certified Residential Heat Pumps

| Product Type | SEER2 | EER2 | HSPF2 |
|--|--------|--------|-------|
| HP Split Systems | ≥ 15.2 | ≥ 11.0 | ≥ 7.8 |
| HP Single Package Equipment ¹ | ≥ 15.2 | ≥ 10.0 | ≥ 7.2 |

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¹ Including gas/electric package heat pumps, which are not eligible for the Cold Climate designation.

Note: The EPA is revising the EER2 minimum requirement for ENERGY STAR Residential Heat Pumps to 11.0 for split systems and 10.0 for single package equipment. This change accommodates variable speed heat pumps which have excellent seasonal efficiency and on average do not run at full capacity during peak cooling. It also allows for the ENERGY STAR Most Efficient 2025 criteria for Air Source Heat Pumps to better align with the Consortium for Energy Efficiency's (CEE) Inflation Reduction Act tax credit tiers, making it easier to identify tax-credit eligibility for consumers.

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i. For purposes of ENERGY STAR certification, a Heat Pump model may be designated as Cold Climate as per the associated requirements in Table 3.

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Table 3: Energy-Efficiency Criteria for Certified Residential Cold Climate Heat Pumps

| Product Type | SEER2 | HSPF2 |
|--|--------|-------|
| HP Split Systems (Non-Ducted) | ≥ 15.2 | ≥ 8.5 |
| HP Split Systems (Ducted) | ≥ 15.2 | ≥ 8.1 |
| HP Single Package Equipment ¹ | ≥ 15.2 | ≥ 8.1 |

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¹ Excludes gas/electric package heat pumps, which are not eligible for the Cold Climate designation.

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- 124 ii. Cold Climate Heat Pumps Low Ambient Performance: To earn the Cold Climate designation, heat
 125 pumps must demonstrate low ambient performance by meeting the following:
- 126 • COP at 5° F \geq 1.75, measured in accordance with Appendix M1⁵ H4₂ test.
- 127 • Percent of Heating Capacity at 5°F \geq 70% of that at 47°F, with the 5°F capacity measured per
 128 Appendix M1 H4₂ test and the 47°F capacity measured as the nominal heating capacity per
 129 Appendix M1 (*i.e.*, from the Appendix M1 H1_N test for units having a variable-speed compressor
 130 where the compressor speed shall be the maximum speed that the system controls would operate
 131 at 47°F, otherwise from the Appendix M1 H1₂ test).
- 132 • Perform a controls verification procedure (CVP) to confirm that the above performance metrics
 133 measured at the Appendix M1 low ambient test point at 5°F are achieved by the native controls
 134 operating as they would in a customer’s home. Either the [ENERGY STAR Cold Climate Heat](#)
 135 [Pump CVP](#) or a CVP adopted into the Code of Federal Regulations by the DOE is acceptable.

136 **Note:** The EPA is adding clarification that partners may use either the ENERGY STAR CVP test or one adopted by
 137 DOE for regulatory purposes, as has been proposed (89 FR 24206, April 5, 2024).

- 138 C. Installation Capabilities: This section presents installation capabilities criteria for ENERGY STAR certified
 139 Central Air Conditioners and Heat Pumps. Compliance with Section 3.C criteria is optional and those products
 140 that comply will be identified on the ENERGY STAR website.
- 141 Centrally ducted CAC/HPs shall be capable of providing at least three of the following capabilities to aid in
 142 quality installation. Mini-splits and multi-splits shall have at least two of the capabilities. For purposes of this
 143 section, a thermostat or controller (for example, but not limited to devices such as smartphone or tablet with a
 144 manufacturer app to control the unit) can be considered part of the system. Items a, b, and c are understood to
 145 be measured at an appropriate fan speed and capacity.
- 146 a. Refrigerant charge – System can self-verify that the refrigerant charge is within manufacturer
 147 recommended tolerances at a range of conditions including outdoor temperatures at least as low as 65°F
 148 or can estimate and report refrigerant charge level. An alert that only initiates when the charge is critically
 149 low does not satisfy this requirement.
- 150 b. Airflow measurement or external static pressure – System shall have some capability to self- estimate and
 151 report airflow and/or confirm that it is within the OEM recommended settings, or to self-measure and
 152 display external static pressure and the fan speed setting. For split systems, this capability may be
 153 contingent on the recognized product being paired with a specific furnace or air handler. (Capability not
 154 applicable to ductless units.)
- 155 c. Blower fan power draw – System shall have the capability to self-measure and report the watt draw of the
 156 blower fan. For split systems, this capability may be contingent on the recognized product being paired
 157 with a specific furnace or air handler. (Capability not applicable to ductless units.)
- 158 d. Test mode for manual measurements – The system provides an easily accessible test mode that locks the
 159 system into an appropriate fan speed and compressor capacity setting for testing refrigerant change,
 160 airflow/external static pressure, and blower fan power draw available in that installation.
- 161 e. Automatic system discovery – System is capable of automatically recognizing compatible communicating
 162 indoor/outdoor units, furnaces. Automatic discovery of humidifiers and dehumidifiers is encouraged.
- 163 f. Preprogrammed system tests – System shall automatically prompt the installer to run preconfigured
 164 system tests following the initial setup. These tests should verify, at a minimum, fan blower, cooling-mode,

⁵ 10 CFR part 430, Subpart B, Appendix M1 – Section 3.6 Heating mode tests for Different Types of Heat Pumps, Including Heating-Only Heat Pumps

165 heat pump only heating, and auxiliary heating tests as applicable to the product and season of installation.
166 The system shall store all faults recognized during these tests until the installer corrects the related issues.

167 D. Multiple Assemblies: For split system central air conditioners and heat pumps, ENERGY STAR certification
168 shall be determined by the rated performance of the particular combination of indoor and outdoor units as
169 tested in accordance with the appropriate regional test procedure, regardless of the fact that the components
170 may be used in other combinations.

171 E. Gas/Electric Package Units: To certify as ENERGY STAR, gas/electric package units shall meet the cooling
172 portion of the single package specification requirements in Table 1 for CACs, or in Table 2 for HPs, above.
173 Gas/electric packaged heat pumps may not achieve the Cold Climate heat pump label.

174 F. ICM coil combinations: To certify as ENERGY STAR, ICM coil combinations shall meet the Central Air
175 Conditioner and Heat Pump Split System specification requirements in Tables 1, 2 and 3 above and include a
176 condensing (outdoor) unit listed in the ENERGY STAR program by a system manufacturer.

177 G. The HSPF2 and SEER2 ratings for split systems shall be identical to the levels reported to DOE and
178 appropriately reflected on the current Federal Trade Commission (FTC) Energy guide label. For packaged
179 units, the HSPF2 and SEER2 ratings shall be identical to the levels reported on the Federal Trade Commission
180 (FTC) Energy guide label and to those reported to DOE. For all units where EER2 (or EER) is reported to
181 DOE, the EER2 reported to EPA shall be identical.

182 H. Additional Reporting Requirements:

183 a. Report the type of refrigerant used in the air conditioner or heat pump, e.g. HFC-32 or R-454B.

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185 b. For all models, report whether a CVP was performed and identify which one, e.g. ENERGY STAR or the
186 DOE.

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188 c. For heat pumps, report the heating capacity and COP at 5F, per the H4₂ test point in Appendix M1.

189 I. Significant Digits and Rounding:

190 a. All calculations shall be carried out with actual measured or observed values. Only the final result of a
191 calculation shall be rounded. Unless otherwise directed below, calculated results shall be rounded to
192 the nearest significant digit as expressed in the corresponding specification limit.

193 b. Unless otherwise specified, compliance with specification limit shall be evaluated using exact values
194 without any benefit from rounding.

195 c. As specified in 10 CFR, 430.23(m)(3), SEER2, and HSPF2 shall be rounded off to the nearest 0.025
196 Btu/W.h. Similarly, EER2 should also be rounded off to the nearest 0.025 Btu/W.h.

197 d. As specified in 10 CFR, 430.23(m)(3), capacity shall be expressed in accordance with Table 4, below:

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Table 4: Rounding Requirements for Capacity

| Capacity Ratings, Btu/h | Multiples, Btu/h |
|-------------------------|------------------|
| < 20,000 | 50 |
| ≥ 20,000 and < 38,000 | 100 |
| ≥ 38,000 and < 65,000 | 250 |

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4) Connected Product Criteria:

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This section presents connected criteria for ENERGY STAR certified Central Air Conditioners and Heat Pumps. Compliance with Section 4 criteria is optional. ENERGY STAR certified products that comply with all Section 4 criteria will be identified on the ENERGY STAR website as having 'Connected' functionality.

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A. Definitions

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a. Connected CAC/HP System (CCS): Includes the ENERGY STAR certified Central Air Conditioner or Heat Pump product, integrated or separate communications hardware, and additional hardware and software required to enable connected functionality, including controllers/thermostats. In the case of a CCS that implements Open ADR 2.0 with a virtual end node (VEN) in the cloud, that VEN is part of the CCS for purposes of this specification. For products implementing CTA-2045A, the module is not considered part of the CCS for purposes of this specification. A product implementing both using a communication module in a CTA-2045 port could be tested both ways and identified as implementing both standards for the purposes of the ENERGY STAR product finder.

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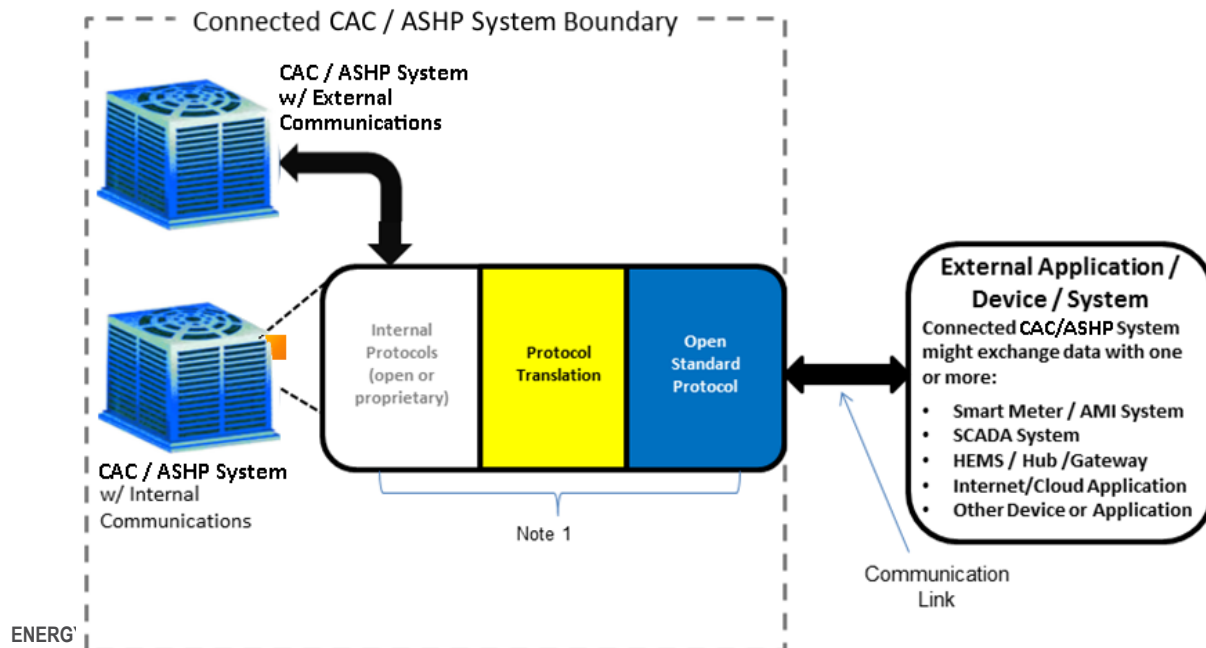
b. Consumer Authorized Third Party: Any entity for which the consumer has provided explicit permission to access the CCS connected functionality, in whole or in part, via a communication link.

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c. Communication Link: As shown in Figure 1, the mechanism for bi-directional data transfers between the connected CAC/HP system and one or more external applications, devices or systems.

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Figure 1. Connected CAC/HP System (CCS)

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Note 1: Communication device(s), link(s) and/or processing that enables Open Standards-based communication between the CCS and external application / device / system(s). These elements, either individually or together, could be within the product/controller, and/or an external communication module, a hub/gateway, or in the Internet/cloud.

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d. Demand Response (DR)⁶: Changes in electric usage by demand-side resources from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized.

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e. Demand Response Management System (DRMS): The system operated by a program administrator, such as the utility or third party, which dispatches signals with DR requests and/or price signals to the CCS products and receives messages from the CCS product.

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f. Interface Specification: A document or collection of documents that contains detailed technical information to facilitate access to relevant data and product capabilities over a communications interface.

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g. Load Management Entity: DRMS, home energy management system, and the like.

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h. Open Standards: Communication with entities outside the CCS that use, for all communication layers, standards:

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- included in the Smart Electric Power Alliance (SEPA) Catalog of Standards⁷, and/or

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- included in the NIST Smart Grid Framework Tables 4.1 and 4.2⁸, and/or

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- adopted by the American National Standards Institute (ANSI) or another well-established international standards organization such as the International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), International Telecommunication Union (ITU), Institute of Electrical and Electronics Engineers (IEEE) or Internet Engineering Task Force (IETF).^{6F8F}⁹

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i. On-Premises: Refers to a function that relies only on equipment present at the physical installed location of the ENERGY STAR certified device/equipment.

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j. Consumer Override (of DR events): Choosing to opt out of a scheduled and/or active DR event the product would otherwise respond to, without cancelling program enrollment.

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B. Communications

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a. The CCS Communication Link, in Figure 1, shall use Open Standards for all communication layers to enable functions listed in Section 4D).

⁶ Federal Energy Regulatory Commission, <https://www.ferc.gov/electric/industry-activity/demand-response/national-assessment-and-action-plan-demand-response>. This definition does not cover all aspects of how load flexibility is being used by utilities. For instance, it does not cover behavioral DR, dispatch to prevent spilling wind resources, or reducing peak demand for natural gas. EPA intends to address any and all of these use cases in our criteria in addition to the more traditional DR in the FERC definition.

⁷ <https://sepapower.org/knowledge/catalog-of-standards/>

⁸ <https://www.nist.gov/system/files/documents/smartgrid/NIST-SP-1108r3.pdf>

⁹ <http://www.gridstandardsmap.com/>

253 b. An Interface Control Document (ICD), Application Programming Interface (API), or other documentation
254 shall be made available to interested parties that, at minimum, allows access to the functions listed in
255 Section 4D) and is recommended for Section 4C).

256 C. Consumer Feedback

257 a. **User Alerts**

258 The CCS shall be capable of providing at least two types of messages relevant to optimizing its
259 energy consumption, communicating to residents either:

260 i. On the product (if intended to be installed in conditioned space) or its consumer control
261 interface, and/or

262 ii. Transmitted to consumers and consumer authorized third parties via a communication
263 link. This link can include open standards protocols used for Demand Response or could
264 use a secondary communication link.

265 For example, messages relevant to energy consumption for CAC/HPs might address a fault
266 condition, a reminder to replace a filter, heat pump refrigerant charge, or a report of energy
267 consumption that is outside the product's normal range.

268 **Note:** Products meeting ENERGY STAR Most Efficient criteria for system status and messaging
269 are compliant with this requirement.

270 b. **Energy Reporting**

271 The product shall be capable of transmitting measured or estimated instantaneous power draw in
272 current conditions via a communication link to energy management systems and other consumer
273 authorized devices, services, or applications. Provision of this information through the
274 communication link and protocol used for demand response shall meet this requirement. *Example:*
275 *A CCS uses CTA-2045A to comply with section 4D) and implements CommodityRead functionality.*

276 D. Demand Response (DR)

277 a. **DR Communications Protocols**

278 The CCS shall meet the communication and equipment performance standards for CTA-2045-A or
279 OpenADR 2.0b, or both.

280 b. **Consumer Override**

281 The CCS shall provide an easily accessible means for consumers to override demand response
282 events during the event or ahead of time for a scheduled event. When the event is overridden, the
283 CCS shall return to its previous operating mode.

284 Temporary overrides shall be limited to a duration up to 72 hours without additional user input;
285 after this time, the CCS will return to its previous operating mode.

286 **Note:** Long term (persistent) overrides are not restricted, as some users may opt to use this
287 functionality. EPA recommends encouraging the use of temporary overrides to consumers when
288 appropriate.

289 c. **DR Information and Messaging**

290 The CCS shall support the following upstream messaging from the device as supported by
 291 application layer protocol(s) and may support the additional (optional) messaging capabilities.
 292 Support for these messaging signals is implemented via the open standards protocol used in the
 293 product. Implementation details are described in Appendix A.

294 Required DR Messaging I/O:

| Messaging I/O Operation | Messaging Operation Description |
|-------------------------|---|
| Verifying Connectivity | Ensures target CCS is connected to DRMS and prepared to accept DR signals. |
| System Capabilities | Requests basic CCS level information on target device, including equipment type response capability. |
| Operational State(s) | Requests information on CCS running state, DR conditions operating on product, opt in/out state, and current fault conditions. Note: Operational State data structure and layout may vary by application layer protocol, containing the following device state information: |

295 Operational State Codes:

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| Operational State Code | Operational State Definition |
|------------------------|--|
| Idle Normal | Indicates that no DR event is in effect and the CCS has no/insignificant energy consumption. |
| Running Normal | Indicates that no DR event is in effect and the CCS is running normal under local control. |
| Running Curtailed | Indicates that a curtailment type DR event is in effect and CCS is running in General Curtailment mode |
| Running Heightened | Indicates that a heightened-operation type of DR event is in effect and CCS is running in Critical Curtailment mode. |
| Idle Curtailed | Indicates that a curtailment type DR event is in effect and the CCS is in off mode. |
| CCS Error Condition | Indicates that the CCS is not operating or is in some way disabled (for example, no response to the grid). |
| Idle Heightened | Indicates that a heightened-operation type of DR event is in effect and the CCS is in off mode. |
| Idle Opted Out | Indicates that the HVAC system is presently opted out of any DR events and the system is in off mode. |

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| Running, Opted Out | Indicates that the SGD is presently opted out of any DR events and the SGD is operating normal under local control. |
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d. **DR Requests and Responses**

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The CCS shall also support the required DR operational modes listed below and may support additional open standard defined DR signals.

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i. Required Operational Mode Functionality:

| Operational Mode Function | Operational Mode Description |
|--------------------------------|--|
| Maximum Indoor Temp. Rise | Specifies the maximum indoor temperature rise that the equipment must use when processing curtailment and/or price responsive modes. |
| General Curtailment | Directs equipment to reduce power consumption to a maximum of 70% of rated load power. Applicable to both staged and variable capacity equipment. |
| Critical Curtailment | Directs equipment to reduce power consumption to a maximum of 40% of rated load power. Staged equipment is not anticipated to respond to this message type; DRMS may substitute a General Curtailment message for this equipment type. Both staged and variable capacity equipment in heating mode shall not use resistance heating while indoor ambient temperature is equal to or above 62° F. |
| Off Mode | Directs equipment to turn to off mode, while maintaining compressor crankcase heater power and system controls power. Applicable to both staged and variable capacity equipment. |
| End Active Events | Notifies equipment that current or upcoming DR event(s) are cancelled. |
| Advanced Notification | Notifies equipment of an upcoming DR event. Equipment may perform preheating / precooling as appropriate. Note: Protocol dependent, may be attached to DR signals in some application layers. |
| Utility Peak Load Price Signal | Notifies equipment that a peak price period is in effect and contains relative pricing info on this event. Equipment manufacturer may provide user with the means to configure system to automatically respond to peak load price signals. |
| Customer Override | Notifies DRMS that a consumer has overridden a current / scheduled DR event. |

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ii. Operational Requirements:

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Variable capacity equipment must ramp up/down changes in power over a minimum of 5 seconds, to decrease transients generated by operation.

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E. Additional Information for Consumers

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- a. If additional modules, devices, services, particular controllers/thermostats, and/or supporting infrastructure are required in order to activate the CCS's communications capabilities, installation instructions and a list of these requirements shall be prominently displayed in the product literature and cut sheets. These instructions shall provide specific information on what must be done to activate these capabilities (e.g. the brochure might include, "This product can participate in utility demand response programs if paired with model XD1124 thermostat, which has Wi-Fi capability

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313 and would also require Internet connectivity and a wireless router for this functionality.”)

314 **5) Test Requirements:**

315 A. One of the following sampling plans shall be used for purposes of testing for ENERGY STAR
316 certification:

317 a. A single unit is selected, obtained, and tested. The measured performance of this unit and of each
318 subsequent unit manufactured must be equal to or better than the ENERGY STAR specification
319 requirements. Results of the tested unit may be used to certify additional individual model variations
320 within a Basic Model as long as the definition for Basic Model provided in Section 1, above, is met; or

321 b. Ratings are determined pursuant to the sampling requirements defined in 10 CFR Part 429, Subpart B
322 § 429.16 either by selecting units for testing or by the application of an alternative rating method
323 (ARM) as defined in 10 CFR Part 429.70. The certified rating must be equal to or better than the
324 ENERGY STAR specification requirements. Results of the tested or simulated unit may be used to
325 certify additional model variations within a Basic Model as long as the definition provided above and in
326 10 CFR Part 430.2 is met. Further, all individual models within a Basic Model must have the same
327 certified rating per DOE’s regulations in Part 429 and this rating must be used for all manufacturer
328 literature, the certified product list, and certification of compliance to DOE energy conservation
329 standards.

330 B. When testing central air conditioners and heat pumps, the following test method shall be used to
331 determine ENERGY STAR certification:

332 **Table 5: Test Method for ENERGY STAR Certification**

| ENERGY STAR Requirement | Required For | Test Method Reference |
|---|--------------------------------|---|
| SEER2, EER2, HSPF2 | All CAC/HP | 10 CFR part 430 Subpart B Appendix M1, including the optional H4 very low temperature condition |
| COP @ 5° F, Percentage of Heating Capacity @ 5° F | HP Only | 10 CFR part 430 Subpart B Appendix M1, including the optional H4 very low temperature condition |
| Controls Verification Procedure | HP Only | CVP for Residential Heat Pump Low Ambient Performance or a CVP adopted into the CFR by DOE |
| Installation Capabilities | All CAC/HPs | Determined by examination of the product, its control system, and its documentation |
| Connected Products: Demand Response | Optional Connected designation | Evaluation of Demand Response in CAC/HP (in development) or certification to AHRI 1380* and examination of product documentation and interfaces |

333 * Until a test method is established, products may certify as Connected through examination of the product, its
334 control system, and its documentation. Recognition as meeting ENERGY STAR connected criteria is optional.

6) Effective Date: This ENERGY STAR Central Air-Conditioners and Heat Pump Specification shall take effect on January 1, 2023. To certify for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on the date of manufacture. The date of manufacture is specific to each unit and is the date (e.g., month and year) on which a unit is considered to be completely assembled.

7) Future Specification Revisions: EPA reserves the right to change the specification should technological and/or market changes affect its usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to the specification are arrived at through industry discussions. In the event of a specification revision, please note that the ENERGY STAR certification is not automatically granted for the life of a product model.

In 2019 and 2020, EPA's ENERGY STAR Emerging Technologies program recognized highly efficient air to water heat pumps that have acceptable cold climate performance. As this technology gains a foothold in the US, EPA anticipates it will eventually make sense to include this type of product in the scope of the CAC/HP specification.

Appendix A: Demand Response Messaging:

Table 6: Normative DR Message Mapping

| Category | Sub-type | Demand Response Messaging | Response Result | CTA (2045-A) | OpenADR (2.0b) |
|--------------------------------|-------------------------|---------------------------------------|---|---|--|
| Basic Signals | Curtailment | General Curtailment | Reduce load (moderate) | Shed9F9F ¹⁰ | oadrDistributeEvent: SIMPLE level 1.10F10F ¹¹ |
| | | Emergency Curtailment | Reduce load (major) | Critical Peak Event ¹⁰ | oadrDistributeEvent: SIMPLE level 2. ¹¹ |
| | | Off Mode | Turn off (if possible) | Grid Emergency ¹⁰ | oadrDistributeEvent: SIMPLE level 3. ¹¹ |
| | Operational State | Return to Normal Operation | Return to defaults | End Shed / Run Normal ¹⁰ | oadrDistributeEvent: CANCELLED.11F11F ¹² |
| | | Advance Notice | No requirement (flexible) | Pending Event Time / Type ¹⁰ | oadrDistributeEvent: NEAR / FAR / ACTIVE ¹² |
| Advanced Signals | Device State (in event) | Maximum Indoor Temp. Offset | Adjust setpoint for use in curtailment / price response | Get / Set Temperature Offset12F12F ¹³ | oadrDistributeEvent: LOAD_CONTROL, x-loadControlSetpoint ¹¹ |
| | Device Logic | Utility Peak Load Price Signal | Use / do not use energy when appropriate | Present Relative Price ¹⁰ | oadrDistributeEvent: ELECTRICITY_PRICE ¹¹ |
| Device Properties & Enrollment | Opt Out | Consumer Override | Skip response to event within opt out time window | Customer Override. Sent each time device is queried while opt out is active ¹⁰ | oadrCreateOpt, oadrCancelOpt13F13F ¹⁴ |
| | Dev. Info | Device Information | Indicates product type | Info Request ¹³ | ei:eiTargetType (endDeviceAsset)14F14F ¹⁵ |
| | Status | State Reporting Requirements | Provide state information to requestor | Query / State Query Response ¹³ | EiReport. oadrPayloadResource-Status (see Table 7 and 8) ¹² |

¹⁰ CTA-2045-A: Table 8-2

¹¹ OpenADR 2.0b, Section 8.2.2

¹² OpenADR 2.0b, Section 11.2

¹³ CTA-2045-A: Table 9-2

¹⁴ OpenADR 2.0b, Section 8.5

¹⁵ OpenADR 2.0b, Annex A

| | | | | | |
|---------------|----------|-----------------------|------------------------------|---|--------------------------------------|
| | Hardware | Hardware Requirements | Design of product & comms. | AC or DC Form Factor physical interface | - |
| Device Energy | Energy | Power (Instantaneous) | Demand of product (W) | Get CommodityRead, code 015F15F ¹⁶ | oadrReport: energyReal ¹² |
| | | Energy (Cumulative) | Energy used by product (kWh) | Get CommodityRead, code 0 ¹⁶ | oadrReport: energyReal ¹² |

Table 7: Operational State Codes

| Op State Code | Name |
|---------------|-------------------------|
| 0 | Idle Normal |
| 1 | Running Normal |
| 2 | Running Curtailed Grid |
| 3 | Running Heightened Grid |
| 4 | Idle Grid |
| 5 | Water Heater Error |
| 6 | Idle Heightened |
| 11 | Idle, Opted Out |
| 12 | Running, Opted Out |

Table 8: OpenADR 2.0b Operational State Reporting¹⁷

| <i>OpenADR 2.0b EiReport Service</i> | | | |
|--------------------------------------|------------------|----------------------------------|--------------|
| REQ | Report Name | x-CTA2045_Status | |
| M1.1 | Report Structure | Status | Interval |
| | rID | OperationalState | 1-min |
| | Report Type | Reading | |
| | Reading Type | Direct Read | |
| Units | customUnit | | |
| <i>ANSI/CTA-2045-A Message</i> | | | |
| Message | | Operational State Query Response | |
| Element Mapped to rID | | Opcode 2 of Basic 0x13 | |

¹⁶ CTA-2045-A, Section 9.3.1

¹⁷ Electric Power Research Institute, Communication Protocol Mapping Guide 1.0, OpenADR 2.0 to ANSI/CTA-2045-A, Table 2-3 Measurement and Reporting Mapping Requirements