ENERGY STAR® Program Requirements
Product Specification for Room Air Conditioners

Eligibility Criteria
Final Draft Version 4.0

Following is the **Final Draft Version 4.0** ENERGY STAR Product Specification for Room Air Conditioners. A product shall meet all of the identified criteria to earn the ENERGY STAR.

1) Definitions: Below are the definitions of the relevant terms in this document. Where noted below, definitions are identical to the definitions in the U.S Department of Energy (DOE) test procedure at 10 Code of Federal Regulations (CFR) 430, Subpart B, Appendix F or in 10 CFR 430.2. When in conflict, the definitions in the CFR take precedence.

A. Room Air Conditioner (RAC)[1]: A consumer product, other than a "packaged terminal air conditioner," which is powered by a single phase electric current and which is an encased assembly designed as a unit for mounting in a window or through the wall for the purpose of providing delivery of conditioned air to an enclosed space. It includes a prime source of refrigeration and may include a means for ventilating and heating.

1. Casement-only[1]: A RAC designed for mounting in a casement window with an encased assembly with a width of 14.8 inches or less and a height of 11.2 inches or less.
2. Casement-slider[1]: A RAC with an encased assembly designed for mounting in a sliding or casement window with a width of 15.5 inches or less.
3. Reverse Cycle[2]: A RAC that employs a means for reversing the function of the indoor and outdoor coils such that the indoor coil becomes the refrigerating system condenser, allowing for heating of the air in the conditioned space; similarly, the outdoor coil becomes the evaporator, utilizing outdoor air as a source of heat.
4. Through the Wall (TTW): A RAC without louvered sides. These units may also be referred to as "built-in" units.
5. Electromechanical: A RAC that measures room temperature with a thermostat that undergoes a physical change (dimensional, phase change, etc.) relative to temperature, and utilizes mechanical rotary, switch, or similar user controls for cooling output, fan speed, desired temperature, or other features.

B. Basic Model[1]: All units of a given type of covered product (or class thereof) manufactured by one manufacturer, having the same primary energy source, and which have essentially identical electrical, physical, and functional (or hydraulic) characteristics that affect energy consumption, energy efficiency, water consumption, or water efficiency.

C. Combined Energy Efficiency Ratio (CEER): The ratio of measured cooling output (in BTU per hour) to the sum of the measured average annual electrical energy input (in watts) and measured annual standby/off-mode power consumption (in watts). CEER is expressed in BTUs per watt-hour.

D. Ethylene Propylene Diene Monomer (EPDM): A closed-cell rubber that is used for outdoor gasketing and/or heating, ventilating, and air conditioning applications.

E. Louvered Sides: Exterior side vents on a RAC enclosure to facilitate airflow over the outdoor coil.

F. Packaged Terminal Air Conditioner (PTAC) [1]: A wall sleeve and a separate unencased combination of heating and cooling assemblies specified by the builder and intended for mounting through the wall. It includes a prime source of refrigeration, separable outdoor louvers, forced ventilation, and heating availability energy.

[1] 10 CFR 430.2

[2] Derived from ASHRAE 58 – Method of Testing for Rating Room Air Conditioner and Package Terminal Air Conditioner Heating Capacity

G. Portable Air Conditioner[3]: A single package air conditioner typically mounted on wheels for the purpose of moving the unit from place to place within a building or structure.

2) Scope:

A. Included Products: Products that meet the definition of a room air conditioner as specified herein are eligible for ENERGY STAR certification, with the exception of those products listed in Section 2.B.

B. Excluded Products: PTACs, portable air conditioners, and room air conditioner models with electric resistance heat as the primary heat source are not eligible for ENERGY STAR certification under this specification. Products that are covered under other ENERGY STAR product specifications, e.g., dehumidifiers, are not eligible for certification under this specification.

3) Certification Criteria:

A. Combined Energy Efficiency Ratio (CEER): CEER shall be greater than or equal to the Minimum CEER ($CEER_{MIN}$) as calculated per Equation 1.

Equation 1. Calculation of Minimum CEER

$$CEER_{MIN} = CEER_{BASE} - CEER_{Adder\_Connected}$$

where,

$CEER_{BASE}$ is the value provided in Table 1, 2 or 3 below, depending on product type

$CEER_{Adder\_Connected}$ is the CEER connected allowance derived using the calculation provided in Table 4, below

Table 1: Units Without Reverse Cycle

Capacity (BTU/hour)	$CEER_{BASE}$ (units with louvered sides)	$CEER_{BASE}$ (units without louvered sides)
< 6,000	12.1	11.0
6,000 to 7,999		
8,000 to 10,999	12.0	10.6
11,000 to 13,999		10.5
14,000 to 19,999	11.8	10.2
20,000 to 27,999	10.3	10.3
≥ 28,000	9.9	

[3] CSA C370-09 – Cooling Performance of Portable Air Conditioners

Table 2: Units With Reverse Cycle

Capacity (BTU/hour)	$CEER_{BASE}$ (units with louvered sides)	$CEER_{BASE}$ (units without louvered sides)
< 14,000		10.2
≥ 14,000		9.6
< 20,000	10.8	
≥ 20,000	10.2	

Table 3: Casement Units

Casement Type	$CEER_{BASE}$
Casement-Only	10.5
Casement-Slider	11.4

Table 4: Connected Allowance

Product Type	$CEER_{Adder\_Connected}$ [2]
All RAC types covered in Tables 1, 2 and 3[1]	0.05 x $CEER_{BASE}$

[1] Product must be certified using the final ENERGY STAR Test Method for Room Air Conditioners to Validate Demand Response (TBD) to use the allowance.
[2] Calculated allowance shall be rounded down to the nearest tenth before being applied in Equation 1.

Note:

Efficiency Criteria
In the Final Draft Version 4.0 specification, EPA continues to propose that to certify as ENERGY STAR, RACs must be at least 10% more efficient than the 2014 minimum federal efficiency standard. Two commenters indicated support for this proposal, noting that it would enable differentiation in the marketplace, as well as cost-effective rebate programs. A few others were hesitant about the limited number of models currently able to meet the proposed criteria. In light of these Draft 1 comments, EPA conducted additional outreach with numerous manufacturers, and believes incremental efficiency gains are well within reach with well understood components and technologies. Furthermore, EPA anticipates that as manufacturers revise RAC designs in order to meet the amended federal standard, there will be opportunity to reduce the incremental cost to achieve ENERGY STAR, by leveraging existing technologies and design options for use in RAC products, such as enhanced heat exchangers, more efficient motors, and the use of alternative refrigerants.

In response to the Draft 1 document, two commenters continued to note safety and technical feasibility concerns associated with the adoption of non-ozone-depleting, low global warming potential (GWP) alternative refrigerants that are flammable. EPA's Significant New Alternatives Policy (SNAP) program evaluates alternatives to ensure that they pose lower overall risk to health and the environment, and creates a menu of acceptable refrigerant options. The July 2014 SNAP proposed rule included alternative refrigerants for room air conditioners, with requirements for safe use. EPA anticipates the broader availability of alternative refrigerants for use in room air conditioners, and supports their use in ENERGY STAR products. Alternative refrigerants represent just one of a suite of technology advances available to manufacturers seeking to meet the proposed 10% efficiency bump.

B. Energy Saver Mode:

1. Product shall have an "Energy Saver Mode," which may be consumer override-able. In this mode, fan operation shall occur only in conjunction with compressor operation, with the following exceptions:

   a. The fan may continue to run for a period not exceeding 5 minutes after the compressor is switched off.

   b. After the above period, when the compressor is off, the fan may be cycled on for up to 17% of the total compressor off cycle time to facilitate accurate control of room temperature. For example, the fan may run for 1 minute then cycle off for at least 5 minutes or the fan may run for 2 minutes then cycle off for at least 10 minutes. Manufacturers may use other fan run durations, but fan run time shall not exceed 17% of total cycle time

   c. Through the Wall RACs, as defined in Section 1 may include an installer accessible setting that disables Energy Saver Mode functionality. The setting may be accessible from the product's controls or may use a physical switch, jumper or the like. Appropriate measures shall be taken to ensure that the setting is implemented as an installer setting not intended to be consumer accessible. For example, physical switches or jumpers shall require the use of tool(s), removal of a panel, or the like; settings accessible in the product's controls shall require a unique sequence of button presses, shall be in a hidden menu, shall require an installer password, or the like.

2. Products, excepting electromechanical RACs as defined in Section 1, shall ship with Energy Saver Mode enabled as the default setting.

3. Products, excepting electromechanical RACs as defined in Section 1, shall default to Energy Saver Mode each time the unit is switched on. However, products are not required to default to Energy Saver Mode upon restoration of power after an electrical power outage that results in a loss of power to the unit.

C. Filter Reminder:

1. Products, excepting electromechanical RACs as defined in Section 1, shall have a filter reminder that provides visual notification recommending the filter be checked, cleaned or replaced, as applicable. The filter reminder may be based on operating hours, sensing technology, or other means.

2. TTW RACs, as defined in Section 1, may include an installer accessible setting that disables Filter Reminder functionality. The setting may be accessible from the product's controls or may use a physical switch, jumper or the like. Appropriate measures shall be taken to ensure that the setting is implemented as an installer setting not intended to be consumer accessible. For example, physical switches or jumpers shall require the use of tool(s), removal of a panel, or the like; settings accessible in the product's controls shall require a unique sequence of button presses, shall be in a hidden menu, shall require an installer password, or the like.

D. Installation Requirements:

1. *Installation Materials (window units only)*: Room air conditioners intended for window installations shall be shipped with weather stripping and/or gasket materials appropriate for all intended applications, including the window size(s) the unit is typically used for, when installed according to provided instructions. The materials shall minimize air leaks (seal) between the room air conditioner and the window opening, including the area between the room air conditioner and the window sash, and the area between the room air conditioner and the window sill (if bottom-mounted) or the window head (if top-mounted). The materials shall also seal gaps between fixed and movable window sashes. Acceptable weather

stripping or gasket material includes, but is not limited to, vinyl clad foam, EPDM cellular rubber, silicone rubber, or comparable alternatives that resist air and water infiltration as well as degradation due to ultraviolet (UV) radiation exposure. Room air conditioner side curtains must be tight fitting to minimize air leaks and contain insulation in the panel with a minimum insulation value of R1 as determined by the Federal Trade Commission's (FTC) Labeling and Advertising of Home Insulation regulations, 16 CFR part 460.

2. *Installation Instructions*: Products shall ship with detailed installation documentation that includes text and, where applicable, diagrams intended to facilitate installation that minimizes air leakage and thermal losses. Instructions shall include recommendations on the proper locations to install weather stripping or gaskets and, optionally, the use of temporary tape or removable caulk to seal the unit in place. If the product is a TTW unit, instructions shall also include a recommendation that the consumer install an appropriately sized cover, to include recommended specifications that facilitate satisfactory fit, when the RAC is not in use to provide additional insulation and air sealing.

Note:

Installation

EPA continues to believe there is an opportunity to provide greater energy savings and performance/comfort for consumers through improved installation of ENERGY STAR RACs. Minimizing air infiltration and thermal losses enables energy savings during the cooling season for all RACs, and enables year-round energy savings for RACs that remain in-place during the heating season. Therefore, EPA is proposing to finalize installation criteria for ENERGY STAR room air conditioners.

The majority of commenters supported the inclusion of installation materials. A few sought more detail on the requirements for window units. In this Final Draft, EPA is clarifying what is meant by an adequate seal, by specifying the properties that installation materials must possess (i.e., resist air and water infiltration, as well as UV degradation). EPA is also clarifying which areas between the unit and the window opening are expected to be sealed using the provided materials. Through additional comments, stakeholder outreach, and research, EPA understands that a majority of manufacturers provide some supplemental installation materials. With these requirements for ENERGY STAR room air conditioners, EPA aims to improve the quality of provided materials and instructions.

EPA did receive concern regarding the cost and demonstrated savings associated with insulating cover requirement for through-the-wall (TTW) units. In response to these concerns, the Agency has removed this requirement for TTW units. EPA maintains that covers help minimize additional energy consumption during the heating season and also improve consumer comfort. Therefore, EPA is requiring that installation instructions for TTW units encourage consumers to install an appropriately sized cover to help insulate and seal and include recommended specifications that facilitate satisfactory fit. The Agency will continue to review resources on the associated energy and dollar savings, and the qualities of available cover designs, in order to assess the potential need for the inclusion of covers in the TTW product box in a future ENERGY STAR revision. In the meantime, through ENERGY STAR outreach efforts, EPA will also encourage consumers to purchase covers, and welcomes partners to do the same.

Sound Performance

Stakeholders provided varied feedback on the Draft 1 sound performance criteria. While some stakeholders supported the inclusion of sound performance requirements as a means of ensuring continued consumer satisfaction with the ENERGY STAR brand, several stakeholders cited challenges with meeting the proposed criteria. EPA is removing the sound performance criteria from the Final Draft specification, but will continue to monitor product trends to assess if there is a need to consider sound performance in a future specification.

Stakeholders identified the lack of availability of test chambers and the burden of both building capacity for testing and sound power testing as barriers to the inclusion of sound performance in an ENERGY STAR specification. EPA understands that there are test facilities available internationally, but at this time, test chambers meeting the EN12102 standards are not available domestically. Additionally, the existing international test chambers are designed for mini-splits and PTACs, and would need to be modified to accommodate room air conditioners.

(Cont.) EPA anticipates that as the European Union's (EU) EcoDesign regulation gains longevity, there will be additional test facilities developed to support the need for sound performance testing of air conditioning products. EPA plans to continue to engage manufacturers to understand their evolving capabilities for sound performance testing.

Secondly, stakeholders indicated the sound performance criteria proposed in Draft 1 may be overly stringent for products available in the U.S. market. EPA understands that the EcoDesign regulations were informed by test data available for products prevalent in the European market (e.g., mini-splits and PTACs), coupled with information on existing sound regulations in place in the EU. Continued stakeholder engagement informs that some products currently available in the U.S. market perform at sound power levels above the Draft 1 proposed 60 dB(A). One stakeholder supported tiered sound power criteria levels based on capacity, and specific to the U.S. market. However, at this time EPA lacks a data set sufficient to inform appropriate levels and/or tiers.

Manufacturers have indicated that increasing fan speeds continues to be a low-cost option for increasing efficiency, and that there is a relationship between higher fan speeds and noise levels. The compressor also contributes to the sound performance of the RAC unit. While EPA has removed the sound performance criteria in this Final Draft, EPA strongly encourages manufacturers to consider impacts to sound performance as they seek to meet the ENERGY STAR efficiency levels, and to avoid significantly increasing fan speeds. EPA instead promoted employing air flow optimization adjustments in conjunction with other energy efficient technology options. EPA plans to work with manufacturers, retailers and consumer advocacy groups to monitor consumers' experience with ENERGY STAR certified RACs, in order to determine if there is the need for sound performance criteria as a part of a future specification. As needed, EPA will in a next revision set requirements to guard against noise such as limits on attributes that contribute to noise (e.g., fan speed) or limits on sound levels.

E. Significant Digits and Rounding: All calculations shall be carried out as specified in Appendix F to Subpart B of Part 430 and 10 CFR Part 430.23(f).

F. Model Numbers: Model numbers used for ENERGY STAR certified product submissions shall be consistent with FTC and DOE submissions.

4) Connected Product Criteria:

The following optional connected criteria are applicable to Included Products, Section 2.A,

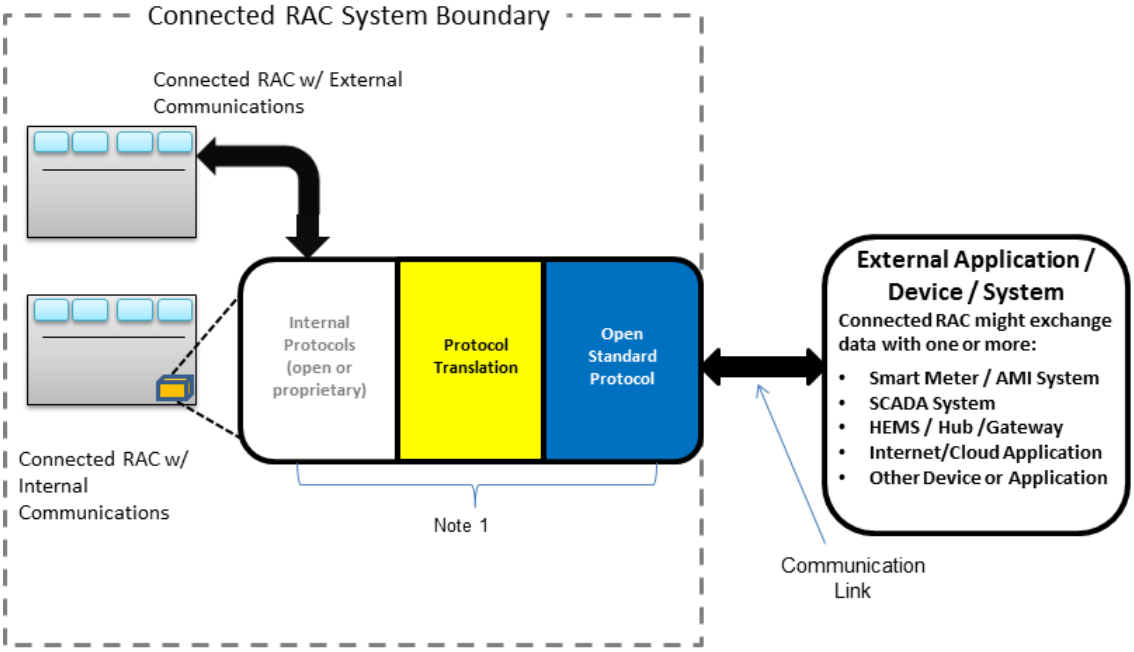
A. Connected Room Air Conditioner System

To be recognized as connected and to be eligible for the connected allowance, a Connected RAC System, as shown in Figure 1) shall include the appliance plus all elements (hardware, software) required to enable communication in response to consumer-authorized energy related commands *(not including third-party remote management which may be made available solely at the discretion of the manufacturer)*. These elements may be resident inside or outside of the appliance. This capability shall be supported through one or more means, as identified in section 4.B.2.

The specific design and implementation of the Connected RAC System is at the manufacturer's discretion provided it is interoperable with other devices via open communications protocol and enables economical consumer-authorized third party access to the functionalities provided for in sections 4.D, 4.F and 4.G. The capabilities shall be supported through one or more means, as identified in section 4.B.2. A product that enables economical and direct, on-premises, open-standards based interconnection is the preferred option for meeting this requirement, but alternative approaches, where open-standards connectivity is enabled only outside of the consumer premises, are also acceptable.

The product must continue to comply with the applicable product safety standards – the addition of the functionality described below shall not override existing safety protections and functions.

Figure 1. Connected Room Air Conditioner System Boundary – Illustrative Example



Note 1: Communication device(s), link(s) and/or processing that enables open standards-based communication between the Connected Room Air Conditioner System and Energy Management Device/Application(s). These elements could be within the appliance, and/or an external communication module, a hub/gateway, or in the Internet/cloud.

B. Communications

1. Open Standards – Communication with entities outside the Connected RAC System that enables connected functionality (sections 4.D, 4.F and 4.G) must use, for all communication layers, standards:

   - Included in the Smart Grid Interoperability Panel (SGIP) Catalog of Standards,[4] and/or
   - Included in the NIST Smart Grid framework Tables 4.1 and 4.2, and/or
   - 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).

2. Communications Hardware Architecture – Communication with entities outside the Connected RAC System that enables connected functionality (sections 4.D through 4.G) shall be enabled by any of the following means, according to the manufacturer's preference:

   a. Built-in communication technology
   b. Manufacturer-specific external communication module(s) and/or device(s)
   c. Open standards-based communication port on the appliance combined with open standards-based communications module
   d. Open standards-based communication port(s) on the appliance in addition to a, b or c, above

   If option b or c is used, the communication module/device(s) must be easy for a consumer to install and be shipped with the appliance, provided to the consumer at the time of sale, or provided to the consumer in a reasonable amount of time after the sale.

C. Open Access

To enable interconnection with the product, in addition to section 4B1 that requires open-standards, an interface specification, application programming interface (API) or similar

[4] http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/PMO#Catalog_of_Standards_Processes

documentation shall be made available to interested parties that at a minimum, allows transmission, reception and interpretation of the following information:

- Energy Consumption Reporting specified in section 4.D (must include accuracy, units and measurement interval);
- Operational Status, User Settings & Messages specified in section 4.F (if transmitted via a communication link);
- Demand Response specified in section 4.G.

D. Energy Consumption Reporting

In order to enable simple, actionable energy use feedback to consumers and consumer authorized energy use reporting to 3rd parties, the product shall be capable of transmitting energy consumption data via a communication link to energy management systems and other consumer authorized devices, services, or applications. This data shall be representative of the product's interval energy consumption. It is recommended that data be reported in watt-hours for intervals of 15 minutes or less, however, representative data may also be reported in alternate units and intervals as specified in the product manufacturer's interface specification or API detailed in section 4.C.

The product may also provide energy use feedback to the consumer on the product itself. On-product feedback, if provided, may be in units and format chosen by the manufacturer (e.g., $/month).

E. Remote Management

The product shall be capable of receiving and responding to consumer authorized remote requests *(not including third-party remote management which may be made available solely at the discretion of the manufacturer)*, via a communication link, similar to consumer controllable functions on the product. The product is not required to respond to remote requests that would compromise performance and/or product safety as determined by the product manufacturer.

F. Operational Status, User Settings & Messages

1. The product shall be capable of providing the following information to energy management systems and other consumer authorized devices, services or applications via a communication link:

    - Operational / Demand Response status (e.g., off/standby, energy saver mode, low cool, max cool, delay appliance load, temporary appliance load reduction).

2. The product shall be capable of providing the following information on the product and/or to energy management systems and other consumer authorized devices, services or applications via communication link:

    - At least two types of messages relevant to the energy consumption of the product. For example, messages for room air conditioners might address a performance issue, such as a clogged filter, or reporting energy consumption that is outside the product's normal range.

G. Demand Response

The product shall have the capability to receive, interpret and act upon consumer-authorized signals by automatically adjusting its operation depending on both the signal's contents and settings from consumers. At a minimum, the product shall be capable of providing the following for all cycle and setting combinations:

1. *Delay Appliance Load Capability:* The capability of the product to respond to a signal in accordance with consumer settings, except as permitted below; by increasing the set temperature by at least 4°F for at least 4 hours.

    a. Maximum Set Temperature – The increased set temperature shall not exceed 85°F.

    b. Consumer override – The consumer shall be able to override the product's Delay Appliance Load response without limitation.

c. The product shall be able to provide at least one Delay Appliance Load response in a rolling 24-hour period.

2. *Temporary Appliance Load Reduction Capability:* The capability of the product to respond to a signal in accordance with consumer settings, except as permitted below; by disabling compressor operation for at least 10 minutes.

a. Maximum Set Temperature – The product shall not respond if the set temperature is ≥ 85°F.

b. Consumer override – The consumer shall be able to override the product's Temporary Appliance Load Reduction response without limitation.

c. The product shall be able to provide at least three Temporary Appliance Load Reduction responses in a rolling 24-hour period. The product is not required to provide more than one Temporary Appliance Load Reduction response per 60-minute period.

H. Information to Consumers

If additional modules, devices, services and/or infrastructure are part of the configuration required to activate the product's communications capabilities, prominent labels or other forms of consumer notifications with instructions shall be displayed at the point of purchase and in the product literature. These shall provide specific information on what consumers must do to activate these capabilities (e.g. "*This product has Wi-Fi capability and requires Internet connectivity and a wireless router to enable interconnection with an Energy Management System, and/or with other external devices, systems or applications."*).

5) Test Requirements:

A. One of the following sampling plans shall be used to test energy performance for certification to ENERGY STAR:

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

2. Units are selected for testing and results calculated according to the sampling requirements defined in 10 CFR Part 429, Subpart B § 429.16. The certified rating must be equal to or better than the ENERGY STAR specification requirements. Results of the tested unit may be used to certify additional model variations within a Basic Model as long as the definition provided above and in 10 CFR Part 430.2 is met.

B. When testing room air conditioners, the following test method shall be used to determine ENERGY STAR certification:

Table 5: Test Methods for ENERGY STAR Certification

ENERGY STAR Requirement	Test Method Reference
CEER	10 CFR 430, Subpart B, Appendix F

C. Compliance with Energy Saver Mode, Filter Reminder, and Installation criteria shall be through examination of product and/or product documentation.

D. Compliance with connected functionality requirements, as specified in Section 4, shall be demonstrated through examination of product and/or product documentation. In addition, upon publication of a final test method, demand response functionality shall be tested using the ENERGY STAR Test Method for Room Air Conditioners to Validate Demand Response. After the publication of the final Test Method, it must be used to certify demand response functionality in order for a product to be listed as having connected functionality on the Qualified Product List, and to be eligible for any connected allowance.

Note: Consistent with proposed modifications to Section 3 of this specification, EPA removed references to sound performance testing *EN 12102: Air Conditioners, liquid chilling packages, heat pumps and dehumidifiers with electrically driven compressors for space heating and cooling – Measurement of airborne noise – Determination of sound power levels*, from Table 5 as testing is no longer applicable for the purposes of ENERGY STAR certification.

EPA has also provided additional clarity on the certification of products with connected functionality capabilities.

6) **Effective Date:** The ENERGY STAR Room Air Conditioner specification shall take effect on **TBD**. Any product model with a date of manufacture on or after this date shall meet this specification to earn the ENERGY STAR. The date of manufacture is specific to each unit and is the date on which a unit is considered completely assembled.

Note: EPA is aware that room air conditioners are a seasonal product with specific manufacturing cycles to support an April-August retail sales cycle. EPA intends to finalize this Version 4.0 specification in February 2015 and anticipates it would be effective 9 months later on October 26, 2015. As with other ENERGY STAR specifications, early certification will be available once the specification has been finalized.

7) **Future Specification Revisions:** EPA reserves the right to change the criteria should federal requirements, 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 ENERGY STAR certification is not automatically granted for the life of a product model.