ENERGY STAR® Program Requirements for Residential Climate Controls

Partner Commitments

Following are the terms of the ENERGY STAR Partnership Agreement as it pertains to the manufacture and labeling of ENERGY STAR qualified products. The ENERGY STAR Partner must adhere to the following partner commitments:

Note: This Draft 3 Version 1.0 Residential Climate Controls Specification includes revisions based on stakeholder comments on the previous Draft 2 document. The majority of detailed comments were received on the following areas: Usability Metric; humidity sensor requirements; and technical requirements. In response to these comments, EPA is proposing revised requirements. Explanatory text associated with proposed specification changes is provided in note boxes found throughout the document.

Stakeholders are encouraged to also review the Draft 2 Version 1.0 Residential Climate Controls Comment Response document, which provides summaries of key stakeholder comments and EPA responses. This document also includes comments from stakeholders on the Usability Test and the Remote Interface Discussion document and can be found on the ENERGY STAR Web site at www.energystar.gov/newspecs**.** (Click on "Climate Controls").

Stakeholders are encouraged to provide feedback on this latest proposal by May 7, 2012. EPA will host a stakeholder webinar on April 17, 2012 from 1 to 3 pm EDT to discuss this Draft 3 Version 1.0 ENERGY STAR® Residential Climate Controls specification. If you would like to participate in this discussion, please RSVP to ClimateControls@energystar.gov by April 13, 2012. Conference call and log-in information will be provided to attendees prior to the meeting.

Qualifying Products

1. Comply with current ENERGY STAR Eligibility Criteria, which define performance requirements and test procedures for Climate Controls. A list of eligible products and their corresponding Eligibility Criteria can be found at www.energystar.gov/specifications.
2. **Prior to associating the ENERGY STAR name or mark with any product**, obtain written certification of ENERGY STAR qualification from a Certification Body recognized by EPA for Climate Controls. As part of this certification process, products must be tested in a laboratory recognized by EPA to perform testing for Climate Controls. A list of EPA-recognized laboratories and Certification Bodies can be found at www.energystar.gov/testingandverification.

Using the ENERGY STAR Name and Marks

3. Comply with current ENERGY STAR Identity Guidelines, which define how the ENERGY STAR name and marks may be used. Partner is responsible for adhering to these guidelines and ensuring that its authorized representatives, such as advertising agencies, dealers, and distributors, are also in compliance. The ENERGY STAR Identity Guidelines are available at www.energystar.gov/logouse.
4. Use the ENERGY STAR name and marks only in association with qualified products. Partner may not refer to itself as an ENERGY STAR Partner unless at least one product is qualified and offered for sale in the U.S. and/or ENERGY STAR partner countries.
5. Provide clear and consistent labeling of ENERGY STAR qualified Climate Controls.

5.1. Partner must use the ENERGY STAR mark via a permanent or temporary label on the top or front of the product. All temporary labeling must be affixed to the product with an adhesive or cling-type application.

5.2. Partner must use the ENERGY STAR mark in product literature (i.e., user manuals, spec sheets, etc.).

5.3. Partner must use the ENERGY STAR mark on product packaging for products sold at retail.

5.4. Partner must use the ENERGY STAR mark on the manufacturer's Internet site where information about ENERGY STAR qualified models is displayed.

If additional information about the ENERGY STAR program or other products is provided by the Partner on its website, Partner must comply with the ENERGY STAR Web Linking Policy, which can be found at www.energystar.gov/partners

Note: As with many other electronic products, manufacturers have been given the option of using a temporary ENERGY STAR label on the product.

Verifying Ongoing Product Qualification

6. Participate in third-party verification testing through a Certification Body recognized by EPA for Climate Controls, providing full cooperation and timely responses. EPA/DOE may also, at its discretion, conduct tests on products that are referred to as ENERGY STAR qualified. These products may be obtained on the open market, or voluntarily supplied by Partner at the government's request.

Providing Information to EPA

7. Provide unit shipment data or other market indicators to EPA annually to assist with creation of ENERGY STAR market penetration estimates, as follows:

7.1. Partner must submit the total number of ENERGY STAR qualified Climate Controls shipped in the calendar year or an equivalent measurement as agreed to in advance by EPA and Partner.

7.2. Partner shall exclude shipments to organizations that rebrand and resell the shipments (unaffiliated private labelers).

7.3. Partner must provide unit shipment data segmented by meaningful product characteristics (e.g., type, capacity, presence of additional functions) as prescribed by EPA.

7.4. Partner must submit unit shipment data for each calendar year to EPA or an EPA-authorized third party, preferably in electronic format, no later than March 1 of the following year.

Submitted unit shipment data will be used by EPA only for program evaluation purposes and will be closely controlled. If requested under the Freedom of Information Act (FOIA), EPA will argue that the data is exempt. Any information used will be masked by EPA so as to protect the confidentiality of the Partner.

8. Report to EPA any attempts by recognized laboratories or Certification Bodies (CBs) to influence testing or certification results or to engage in discriminatory practices.

9. Notify EPA of a change in the designated responsible party or contacts within 30 days using the My ENERGY STAR Account tool (MESA) available at www.energystar.gov/mesa.

Performance for Special Distinction

In order to receive additional recognition and/or support from EPA for its efforts within the Partnership, the ENERGY STAR Partner may consider the following voluntary measures, and should keep EPA informed on the progress of these efforts:

- Provide quarterly, written updates to EPA as to the efforts undertaken by Partner to increase availability of ENERGY STAR qualified products, and to promote awareness of ENERGY STAR and its message.
- Consider energy efficiency improvements in company facilities and pursue benchmarking buildings through the ENERGY STAR Buildings program.
- Purchase ENERGY STAR qualified products. Revise the company purchasing or procurement specifications to include ENERGY STAR. Provide procurement officials' contact information to EPA for periodic updates and coordination. Circulate general ENERGY STAR qualified product information to employees for use when purchasing products for their homes.
- Feature the ENERGY STAR mark(s) on Partner website and other promotional materials. If information concerning ENERGY STAR is provided on the Partner website as specified by the ENERGY STAR Web Linking Policy (available in the Partner Resources section of the ENERGY STAR website), EPA may provide links where appropriate to the Partner website.
- Ensure the power management feature is enabled on all ENERGY STAR qualified displays and computers in use in company facilities, particularly upon installation and after service is performed.
- Provide general information about the ENERGY STAR program to employees whose jobs are relevant to the development, marketing, sales, and service of current ENERGY STAR qualified products.
- Provide a simple plan to EPA outlining specific measures Partner plans to undertake beyond the program requirements listed above. By doing so, EPA may be able to coordinate, and communicate Partner's activities, provide an EPA representative, or include news about the event in the ENERGY STAR newsletter, on the ENERGY STAR website, etc. The plan may be as simple as providing a list of planned activities or milestones of which Partner would like EPA to be aware. For example, activities may include: (1) increasing the availability of ENERGY STAR qualified products by converting the entire product line within two years to meet ENERGY STAR guidelines; (2) demonstrating the economic and environmental benefits of energy efficiency through special in-store displays twice a year; (3) providing information to users (via the website and user's manual) about energy-saving features and operating characteristics of ENERGY STAR qualified products; and (4) building awareness of the ENERGY STAR Partnership and brand identity by collaborating with EPA on one print advertorial and one live press event.
- Join EPA's SmartWay Transport Partnership to improve the environmental performance of the company's shipping operations. The SmartWay Transport Partnership works with freight carriers, shippers, and other stakeholders in the goods movement industry to reduce fuel consumption, greenhouse gases, and air pollution. For more information on SmartWay, visit www.epa.gov/smartway.
- Join EPA's Green Power Partnership. EPA's Green Power Partnership encourages organizations to buy green power as a way to reduce the environmental impacts associated with traditional fossil fuel-based electricity use. The partnership includes a diverse set of organizations including Fortune 500 companies, small and medium businesses, government institutions as well as a growing number of colleges and universities. For more information on Green Power, visit www.epa.gov/greenpower.

ENERGY STAR® Program Requirements for Residential Climate Controls

Version 1.0
Eligibility Criteria
Draft 3

Following is the **Draft 3** Version 1.0 product specification for ENERGY STAR qualified Residential Climate Controls. A product must meet all of the identified criteria if it is to earn the ENERGY STAR.

1) Definitions

A. Climate Control: A device that controls heating, ventilation, and air-conditioning (HVAC) equipment to regulate the temperature and humidity of the room or space in which it is installed. A Climate Control enables the customer to schedule comfort and energy-saving periods; for when the occupant is home, away or asleep, respectively. An energy-saving setpoint is automatically initiated during energy-saving periods and a comfort setpoint during occupied periods. Climate Controls may be capable of controlling one or more zones of a conditioned space. Climate Controls include the following:

1 Communicating Climate Control: A Climate Control with the ability to communicate with sources external to the HVAC system for purposes of energy management and remote control. External sources include but are not limited to: (1) customer signals from home computer or mobile device, (2) utility price signals and display messages, and, (3) home energy management device signals. Examples of capabilities provided by such systems include: Internet-enabled scheduling, remote Heating, Ventilating, and Air Conditioning (HVAC) control; messaging and energy rate alert display. The communication link may be wired or wireless.

2 Residential (Communicating) Climate Control: A Climate Control intended for installation in homes and dwellings. This device includes fan modes and a default program schedule suitable for typical residential usage.

3 Line Voltage (Communicating) Climate Control: A device that controls HVAC equipment to regulate the temperature of the room or space in which it is installed by controlling the line-voltage HVAC electrical load directly or indirectly through a line-voltage operating circuit.

4 Low Voltage (Communicating) Climate Control: A device that controls HVAC equipment to regulate the temperature of the room or space in which it is installed by controlling the applied energy in a National Electrical Code (NEC) Class 2 circuit.

B. Setpoint: The temperature setting in degrees Fahrenheit or degrees Celsius for any given time period.

C. Recovery, Adaptive: A Climate Control algorithm that initiates recovery in advance of the programmed time to result in the room temperature reaching the comfort setpoint at or near the programmed time.

D. Recovery, Heat Pump with Auxiliary Heat: A Climate Control algorithm that that minimizes the use of auxiliary heat to maximize energy savings.

E. Short Term Hold: This mode temporarily overrides the program setpoint. Short Term Hold shall be active only until the next scheduled program event.

F. Long Term Hold: This mode suspends the Climate Control program schedule until the long term hold mode is cancelled by the user.

G. Remote Interface (RI): A user interface for the Residential Climate Control that is independent from the traditional on-product user interface. Remote Interfaces, include, but are not limited to, mobile device and PC web interfaces and apps capable of remotely managing the Climate Control.

Note: As signaled in the Remote Interfaces discussion, EPA has included a definition for Remote Interface (RI). Definitions that are no longer needed have been removed for simplicity and clarity.

H. Heating Ventilation and Air Conditioning (HVAC) System Definitions

1 Heat Pump: A Heat Pump is a mechanical apparatus that normally consists of one or more factory-made assemblies that include an indoor conditioning coil(s), compressor(s) and a reversing mechanism to transfer heat to the premises from the outside air, ground or water in heating mode and from the premises to the outside air, ground or water in cooling mode.

2 Non-Heat Pump HVAC: For the purpose of this specification, non-heat pump HVAC encompasses all other HVAC equipment including, but not limited to fossil-fuel heat, central air conditioning, electric resistance heating and evaporative coolers.

3 Dual Fuel Heat Pump: For the purpose of this specification, a Dual Fuel Heat Pump integrates a heat pump with a fossil fuel furnace. To maximize efficiency of the system, the furnace is utilized for cold outdoor temperatures and the heat pump for milder temperatures. The Climate Control monitors outdoor temperature and selectively utilizes the two heat sources to optimize energy efficiency.

4 Auxiliary Heat: Electric resistance heat used to supplement the heat pump during periods of low temperature or rapid recovery.

2) Qualifying Products

ENERGY STAR qualified Residential Climate Controls must either be (1) a Communicating Climate Control, as defined in Section 1.A above, or be (2) field upgradeable to a Communicating Climate Control by installation of a communication module. Simultaneous availability of compatible communication modules is not required. Manufacturers are free to offer communications modules at a later date, for example when warranted by market conditions.

Note: Qualifying product criteria for scheduling that is duplicative of Technical Criteria has been removed. Similarly, packaging criteria to indicate HVAC compatibility has been moved to Other Criteria.

3) Energy Efficiency Criteria

Only those products referenced in Section 2, above, that meet the criteria below may qualify as ENERGY STAR.

A. Technical Criteria

1. Schedule periods - The product must enable 7-day program scheduling with a minimum of four possible schedule periods each day.

2. Default schedule - The product must provide a default, pre-programmed schedule with comfort periods and energy savings periods for when occupants are gone or asleep. This default schedule is intended to drive significant energy savings and shall be fully customizable in order to fit varying lifestyles and schedules. Detailed requirements for this schedule are provided in Tables 2 and 3, below.

Note The default pre-programmed schedule, specified in Section 3 does not include differing weekday and weekend settings. EPA has revised the above language for consistency with the Section 3 criteria.

In response to stakeholder feedback, EPA has removed a prescriptive reference to specific schedule period nomenclature. Stakeholders may elect to use event or activity based nomenclature or other identification/naming conventions that they deem appropriate.

In response to stakeholder feedback, EPA has removed the product packaging requirement to identify the product as for Residential use, only. Note that removal of this prescriptive requirement, while providing additional flexibility for manufacturers, does not alter the residential scope for this ENERGY STAR specification.

3. Temperature Stability – The product shall be capable of maintaining room temperature within ± 1°F of the setpoint temperature in accordance with NEMA DC 3-2008 section 4.5.2 Differential Tests. This may be a configurable setting.

4. Outdoor Temperature – Products that support dual fuel heat pump installations shall have access to and shall use outdoor temperature data to provide automatic cutover to/from the backup heat source based on installer configurable cutover temperatures.

Note: The requirement for outdoor temperature data has been relaxed such that it applies only to products that support dual fuel heat pump installations. There are various acceptable options for this data, including, for example, remote temperature sensor data and temperature data sourced from local weather forecasts.

The requirement to monitor and display humidity levels may pose a financial burden for climate control manufacturers and only facilitates seasonal energy savings in certain regions. Therefore, EPA will not require the climate control to display relative humidity. EPA notes that there is significant individual savings potential associated with Residential Climate Controls that includes the ability to control HVAC equipment based on temperature and humidity in certain use cases, e.g. unoccupied homes in hot humid regions. Thus, EPA proposes to encourage manufacturers to include this feature set in certain models, and will consider a humidity sensor field on the Qualified Product List.

5. Selectable Recovery Algorithms – The product shall be equipped with installer selectable recovery algorithms. When configured for non Heat Pump HVAC installations, the default recovery algorithm shall comply with the definition for Recovery, Adaptive (Section 1C). When configured for Heat Pump installations, that use electric resistance auxiliary heat, the default recovery algorithm shall comply with the definitions for Recovery, Adaptive **and** Recovery, Heat Pump with Auxiliary Heat (Section 1D).

   Exception – When a Communicating Climate Control is interconnected with a system capable of remotely managing recovery, it is permissible for recovery to be controlled by the remote system.

Note: Stakeholders have advised EPA that advanced energy management systems are capable of reducing energy consumption through remote management of the Residential Climate Control. These systems may dynamically vary recovery rates, recovery periods and setback setpoints to minimize energy usage for homes on an individual basis. Thus, EPA has included an exception that allows control systems to manage recovery in Connected Climate Controls.

6. Power Consumption

   a. Connected Climate Controls shall consume no more than 2.0 watts of average power, evaluated in accordance with Table 1.

   b. Climate Controls that do not include connected capability shall consume no more than

1.0 watt of average power, evaluated in accordance with Table 1.

c. Climate Controls that are powered solely by batteries are exempt from power consumption limits.

Table 1: Residential Climate Control – Power Consumption Measurement		
Product	**Average Power (W)**	**Measurement Parameters**
Climate Control	1.0	• 5-minute measurement period • Away mode cycled 1x
Connected Climate Control	2.0	• 5-minute measurement period • Away mode cycled 1x • Connection to device external to HVAC system, at least 1x

Note: It is EPA's intention to encourage certification of Climate Controls with modular communication options that allow users to install or upgrade communications at a later date. (See section 3.B.2) However, this presents a challenge in the context of the power consumption limit for communicating units. How can a unit demonstrate that it meets this power consumption requirement with a communications module that does not yet exist? EPA seeks stakeholder input on this point.

7. Default HVAC Schedule – Residential Climate Controls shall be shipped from the factory with an active, default program schedule, as defined in Tables 2 and 3, below. A minimum of four possible schedule periods is required. Default day and night (setback) periods must be at least 8 hours in duration.

Note: Stakeholders have requested that EPA allow manufacturers to determine how best to describe or name Climate Control schedule periods. In this draft, EPA has retained the default HVAC requirement, but has removed the prescriptive requirement to use specific schedule period nomenclature.

Table 2: Residential Climate Control Setpoints		
Setting	**Setpoint (Heat)**	**Setpoint (Cool)**
Morning	≤ 70°F	≥ 78°F
Day	Set-back at least 8°F	Set-up at least 7°F
Evening	≤ 70°F	≥ 78°F
Night	Set-back at least 8°F	≥ 78°F

Table 3: Residential Climate Control – Acceptable Schedule Periods and Setpoints			
Setting	**Time**	**Setpoint (Heat)**	**Setpoint (Cool)**
Morning	6 a.m.	70°F	78°F
Day	8 a.m.	62°F	85°F
Evening	6 p.m.	70°F	78°F
Night	10 p.m.	62°F	78°F

B. Communication Criteria

1. Open Access – Suitable documentation such as an application programming interface (API) or Interface Specification shall be available to 3rd party developers to enable access to the product's data reporting and remote management capabilities, as defined below in Sections 3.B.3 and 3.B.4.

2. Connectivity Standards – The following types of standards are recommended for connection outside of the HVAC system, using both built-in connectivity and/or modular connectivity:
    - Standards included in the Smart Grid Interoperability Panel (SGIP) Catalogue of Standards, and/or
    - Standards being considered for inclusion in the SGIP Catalogue of Standards, and/or
    - Standards adopted by the American National Standards Institute (ANSI) or a well established international standards organization, such as:
        - International Organization for Standardization (ISO)
        - International Electrotechnical Commission (IEC)
        - International Telecommunication Union (ITU)
        - Internet Engineering Task Force (IETF)

    More robust criteria may be considered in a future revision as relevant standardization efforts mature.

Note: Stakeholders have informed EPA that they are interested in protecting the user experience from poorly designed 3rd party apps or interfaces. EPA supports a market solution to this concern, and considers current examples of app qualification programs for smart phones such as the Android Market and iPhone App store to be acceptable models for manufacturer control of Residential Climate Control RIs. EPA has also clarified that the API or similar documentation may be limited to exposing only Data Reporting and Remote Management functionality as defined below.

In order to drive both open access and interoperability, EPA encourages the use of appropriate open communication standards, and strives to include consistent criteria across different ENERGY STAR product categories. As such, in this draft, EPA has added a recommendation for the use of standards included within or being considered for inclusion within the SGIP Catalogue of Standards and/or adopted by a well established Standards Developing Organization (SDO).

A previous proposal to phase in requirements to comply with NIST SGIP recommendations have been removed from this draft, based on the uncertainty of the development timeline for such standards, American National Standards, and those developed by a recognized international standards body such as IEC or ISO, which EPA encourages the use of. EPA will continue to monitor the NIST Smart Grid Interoperability Standards Project's work and may consider criteria associated will this body of work in future revisions, to encourage standardization, interoperability, communications security and open access.

3. Security – The product shall facilitate secure communications, including:

    a. **Basic authentication and authorization** so that only authorized devices or software applications can access the product, and

    b. **Security measures** to protect against unauthorized access.

4. Data Reporting – The product shall be capable of collecting and transmitting the following thermostat settings and data points on a periodic basis to connected devices external to the HVAC system. The product must be capable of recording data at least once every 60 seconds and transmitting data at least once every 5 minutes.

    - Unique Thermostat ID

- Room Temperature in °F or °C (0.1 °F resolution)
- Active Cool and Heat setpoints in °F or °C
- HVAC mode setting (off, Heat, Cool, auto)
- Active HVAC mode (off, Heat, Cool)
- Fan mode setting (off, on, auto)
- Active Fan mode (off, on)
- Current Hold mode type and state (e.g. Long Term – on)
- Current Away mode status (on, off)
- All Programmable settings, including program schedules & setpoints, hold modes, fan modes, HVAC modes and installer settings.
- Current Humidity reading and control mode

4. Remote Management – The product shall respond to the following remote control commands from authorized devices or software applications within 5 seconds. This criterion assumes receipt of the signal within 1 second of its transmission.

- Time synchronization
- Active Cool and Heat setpoints in °F or °C
- HVAC mode (off, Heat, Cool, auto)
- Current Humidity reading and control mode
- Fan mode (off, on, auto)
- Select hold mode type and status (e.g. Long Term – on)
- Select away mode status (on, off)
- All program schedule settings including times and setpoints for active and inactive schedules
- Select active program schedule

Note: To ensure the product is capable of responding to remote requests in near real-time, EPA has retained the 5 second response time criteria, but has revised the language to indicate that it is assumed that network latency is such that the requesting signal is received no later than 1 second after its transmission.

C. Ease of Installation Criteria

1. **Installation instructions** must utilize graphics and text, as appropriate, to guide the installer through both installation and configuration of the Residential Climate Control. These instructions shall include necessary installation steps and connection diagrams for all supported HVAC systems, both heat pump and non heat pump.

2. **Availability of Documentation** – Installer documentation must be posted on the manufacturer's Web site in electronic format and must be available for at least 10 years after cessation of product manufacture.

3. **HVAC Wiring Terminal Designations** shall be clearly labeled. It is recommended that Low Voltage Climate Controls use labels that comply with Table 5-1 in NEMA DC 3-2008. EPA notes that Low Voltage Climate Controls that use wired or wireless digital data interfaces between the Climate Control and the controlled HVAC equipment do not follow NEMA DC 3-2008. Line Voltage Climate Controls shall be marked to identify the Line, Load and Earth terminals.

Note: In response to stakeholder concerns that wiring terminal criteria were overly prescriptive and would drive up product cost, the HVAC wiring terminal criteria have been made less strenuous. Labels that comply with Table 5-1 in NEMA DC 3-2008 are recommended, but no longer mandatory.

4. **Batteries** – The product shall use commonly available batteries free of special handling and/or hazardous waste disposal requirements. This requirement is only applicable to products that use non-rechargeable batteries.

5. **Battery Life** – The product shall be designed for a typical battery life of a minimum of 12 months. This requirement is only applicable to products that use non-rechargeable batteries.

Note: In response to stakeholder concerns, battery requirements have been revised to clarify applicability only to products that use non-rechargeable batteries.

D. Residential Climate Control Ease of Use Criteria:

As illustrated in Figure 1, there are three approaches to demonstrate acceptable ease of use for Residential Climate Controls:

- Path 1 – Prescriptive Ease of Use – Compliance with both core prescriptive ease of use criteria **and** additional prescriptive ease of use criteria.

- Path 2 – Performance -Based Ease of Use – Compliance with both core prescriptive ease of use criteria **and** performance-based ease of use criteria.

- Path 3 – Performance -Based Ease of Use with Remote Interface:

    - Compliance with both core prescriptive ease of use criteria and a limited set of performance-based ease of use criteria without the use of the RI, and

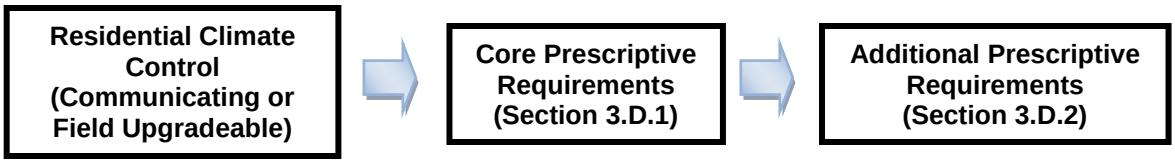
    - Compliance with the entire performance-based ease of use criteria, with users interacting with the product only with an associated RI.

Note EPA is proposing modified criteria that allow for streamlined qualification testing of *Connected* Residential Climate Controls associated with at least one RI. EPA believes that these changes will enable qualification of lower cost Climate Controls and increase consumer choice by encouraging more complex and interactive tasks to be performed from RIs on devices such as PCs, smartphones & tablets that are likely to foster a favorable user experience.

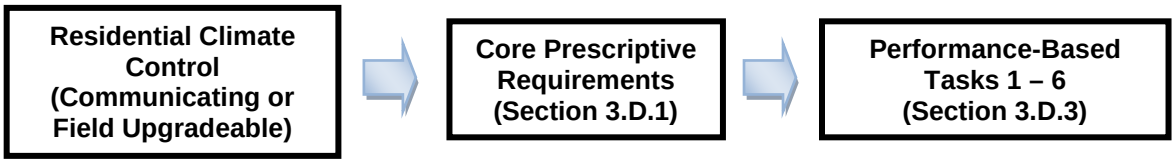
Connected Residential Climate Controls that may be managed by *Remote Interfaces* (RIs) have come to market in greater number over the last few years. EPA believes this emerging shift to remote energy management presents significant opportunities for energy savings. Recognizing this market shift, EPA is proposing allowing Residential Climate Controls with remote interfaces to earn the ENERGY STAR.

Figure 1 – Ease of Use: Paths to Demonstration of Compliance

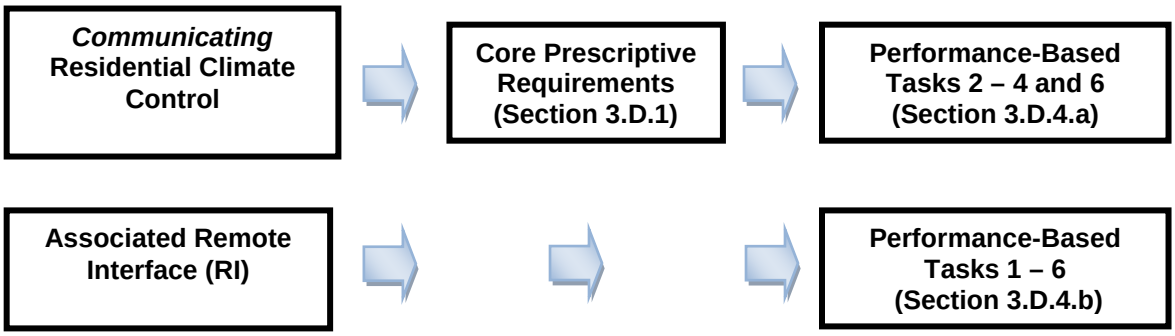
Path 1 – Prescriptive Ease of Use



Path 2 – Performance-Based Ease of Use



Path 3 – Alternate Performance-Based Ease of Use



1 Core Prescriptive Ease of Use Criteria: A Climate Control shall meet the following criteria to earn the ENERGY STAR. Note that these criteria apply to **all** Residential Climate Controls.

a. **Programmed Settings –** The product shall store all programmed settings for the equipment it is designed to control in non-volatile memory in case of an external power outage or battery failure.

b. **Date & Time –** The product shall be capable of maintaining the correct date & time without user input, including automatic adjustment for US Daylight Savings Time (DST) that is enabled by default. The product shall permit automatic daylight savings time adjustment to be disabled. Correct date & time shall be maintained through power outages of 7 days or less duration. Minimum timekeeping accuracy shall be ±0.5s per 24-hour period. When connected with an external app, device, or system that includes date & time synchronization, this synchronization shall take precedence.

c. **Energy Saving Mode –** This easily accessible mode shall use Default Heat and Cool setpoints of 62°F and 85°F, respectively. The Heat setback setpoint may be user configurable but not to a value greater than 65°F. Similarly, the Cool setback setpoint may be user configurable but not to a value less than 80°F. Ease of access to this mode shall be verified either by compliance with performance-based ease of use criteria or by compliance with requirement 3.D.2.a for the prescriptive path.

d. **Low-Battery Indicator –** The product shall include a low-battery indicator that activates at least 2 months prior to critical battery depletion. This requirement is only applicable to products that use non-rechargeable batteries.

Note: In response to a stakeholder comment, EPA has clarified that the low battery indicator is not applicable to products that use rechargeable batteries, because they are continually recharged by the climate control.

2 Additional Prescriptive Ease of Use Criteria – Residential Climate Controls that are evaluated for ease of use by the Path 1 – Prescriptive Path shall meet requirements a through g to earn the ENERGY STAR.

a. **Access to Energy Saving Mode –** The energy saving mode, requirement 3.B.3, shall be activated and cancelled by single user operations. This mode shall simultaneously activate the setback setpoint and place the Residential Climate Control in Long Term Hold. The mode shall be given a descriptive label; EPA recommends use of the term "Away."

b. **Setpoint Adjustability** – The product shall provide the user the ability to raise or lower the setpoint with a single user action. Setpoint changes made while the product is following a program schedule shall activate a Short Term Hold indicator that informs the user that the change will be overridden at the start of the next schedule period.

c. **Operating Mode** – The product shall provide indication of current operating mode, as follows:

- Following program schedule, Away, Long-Term Hold, Short Term Hold.
- HVAC mode (Heat, Cool, Auto, Off)
- Fan mode (Auto, On)
- Program (configuration/setup) mode

d. **Current Status** – Climate Controls shall include visual indication that controlled HVAC equipment is actively providing heating or cooling.

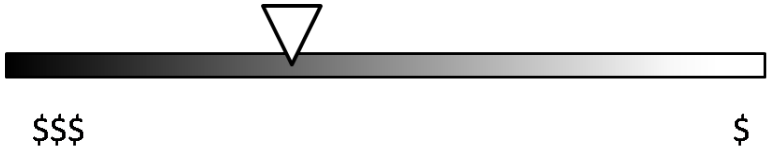
e. **Relative Cost Indication** – When configured to control Heat Pump systems with electric resistance auxiliary heat, Climate Controls shall convey high relative cost when auxiliary heat is energized. The following examples are given for reference but stakeholders are encouraged to use other effective methods for communicating this information.

Example 1:

Heat Pump Systems with electric resistance auxiliary heat

$	Stage 1 Heat or Cool Active
$$	Stage 2 Heat or Cool Active
$$$$	Electric Resistance Auxiliary Heat Active

Example 2:



f. **Character Size** – The product display shall have primary and secondary characters (i.e., numbers) that are at least 16mm and 4.75mm in height, respectively. In the default display mode or screen, primary characters shall indicate current room temperature.

g. **Temperature Resolution** – The product shall operate in Fahrenheit with a minimum resolution for indoor temperature display and setpoint of 1°F. If Celsius operation is included, the product shall provide a minimum resolution for indoor temperature display and setpoint of 0.5°C.

Note: EPA received feedback from stakeholders indicating that energy rate tiers may not be widely available for a considerable amount of time, thus reducing this requirement's applicability and usefulness. In addition, EPA received no clear indication from utilities that this feature would be helpful. Given that, EPA has removed the proposal to require energy rate tier indication in the additional prescriptive ease of use criteria.

3 Performance-Based Ease of Use Criteria – In addition to compliance with section 3.D.1 core prescriptive ease of use criteria, Residential Climate Controls that are evaluated for ease of use by the Path 2 – Performance-Based Ease of Use shall be evaluated against tasks 1 – 6, as defined in Appendix A – Residential Climate Controls Performance-Based Ease of Use Metric.

4 Performance-Based Ease of Use Criteria with Remote Interface – In addition to compliance with section 3.D.1 core prescriptive ease of use criteria, Residential Climate Controls that ship with at least one RI may be evaluated for ease of use by Path 3 – Performance-Based Ease of Use with Remote Interface, as follows:

a. The Residential Climate Control without the RI, shall rate acceptably when evaluated against ease of use tasks 2 – 4 and 6, as defined in Appendix A – Residential Climate Controls Performance-Based Ease of Use Metric, and

b. The Residential Communicating Climate Control, with users interacting with the product only through the associated RI, shall rate acceptably when evaluated against tasks 1-6, as defined in Appendix A – Residential Climate Controls Performance-Based Ease of Use Metric.

4) Other Criteria

A. Indicate supported HVAC equipment - Product packaging and installation instructions shall clearly indicate the types of HVAC systems supported. For Low-voltage Climate Controls, this information shall include the number of controlled heating and cooling stages.

B. Climate Controls shall contain restricted levels of the following materials, where the maximum concentration values tolerated by weight in homogeneous materials are: lead (0.1%), mercury (0.1%), cadmium (0.01%), hexavalent chromium (0.1%), polybrominated biphenyls (PBB) (0.1%), or polybrominated diphenyl ethers (PBDE) (0.1%). Batteries are exempt. The following exemptions are granted for components in Climate Controls:

1. Copper alloy containing up to 4% lead by weight.

2. Electrical or electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezoelectronic devices, or in a glass or ceramic matrix.

3. Lead in dielectric ceramic in capacitors for a rated voltage of 125V AC or 250 V DC or higher.

For purposes of third-party certification, hazardous materials requirements shall not be reviewed when products are initially qualified or during subsequent verification testing. Instead, consistent with the RoHS Directive, manufacturers shall maintain documentation on file that products meet these requirements. EPA reserves the right to request this documentation at any time.

These requirements apply to models qualified for sale in the U.S. as ENERGY STAR.

Note: In response to stakeholder comments on other specifications related to third party certification, EPA has clarified that these requirements are exempt from the ENERGY STAR third-party certification process. Further, also in response to stakeholder comment, EPA added language making clear that the non-energy requirements proposed here are not intended for international adoption.

In developing these requirements, EPA seeks to avoid associating the ENERGY STAR label with poor quality or otherwise undesirable products. EPA drew from existing standards for hazardous materials. EPA looked to the RoHS Directive for a hazardous materials limit because electronics manufacturers have extensive experience with designing products free from certain hazardous materials in compliance with RoHS. Most global manufacturers have been in compliance with RoHS since 2006, when the directive first took effect.

EPA intends to harmonize with the RoHS Directive by adding language in Section 4.B allowing the same exemptions as those outlined in the current RoHS Directive. The exemptions proposed in this section are harmonized with exemptions for consumer electronics, 6(c), 7(c)-I. and 7(c)-II in the revised RoHS Directive. EPA seeks stakeholder assistance in identifying whether these exemptions apply to climate controls, and whether other exemptions should be included. EPA does not intend to require documentation of the need for exemption beyond what is needed by the Partner to demonstrate compliance with the RoHS Directive.

5) Test Criteria

Note: Climate Controls must be evaluated by EPA-recognized labs, with test reports approved by an EPA-recognized Certification Body. More information is available on the following ENERGY STAR webpage: http://www.energystar.gov/testingandverification**.**

A. A representative unit, based on the definition for Basic Model provided in Section 1, shall be selected to test energy performance for qualification to ENERGY STAR.
B. Except as noted in Table 3 below, compliance with Section 3 Energy Efficiency Criteria shall be determined through the examination of the product, product packaging, and/or product documentation.

Table 3: Test Method for Temperature Stability

ENERGY STAR Requirement	Test Method Reference
Temperature Stability	NEMA DC 3-2008 section 4.5.2
Performance Based Ease of Use	Test Method – Performance Based Ease of Use (Appendix B)
Power Consumption	Test Method – Power Consumption – Climate Controls (Appendix C)

6) Effective Date

The date that products must meet the requirements specified under the Version 1.0 Residential Climate Controls specification will be defined as the *effective date* of the agreement. The ENERGY STAR Version 1.0 specification for Residential Climate Controls shall go into effect immediately upon final release.

Note: Since this is a new specification, EPA will make it effective immediately upon completion – inviting manufacturers to qualify products as ENERGY STAR and providing consumers with differentiation immediately. A specific date will be added when we approach finalization.

Products Qualified Under Previous Specifications: When ENERGY STAR specifications are revised, EPA does not automatically grant continued qualification to products submitted under previous specification versions. Any product sold, marketed, or identified by the manufacturing Partner as

ENERGY STAR must meet the specification in effect on the date of manufacture of the product.

7) Future Specification Revisions

ENERGY STAR reserves the right to change the specification should technological and/or market changes affect its usefulness to consumers or industry or its impact on the environment. In keeping with current policy, revisions to the specification will be discussed with stakeholders. In the event of a specification revision, please note that ENERGY STAR qualification is not automatically granted for the life of a product model. To qualify as ENERGY STAR, a product model must meet the ENERGY STAR specification in effect on the model's date of manufacture.

Appendix A

Performance-Based Ease of Use Criteria

1) Overview

This document details Performance-Based Ease of Use criteria for ENERGY STAR Residential Climate Controls seeking to earn the ENERGY STAR by demonstrating ease of use through a performance based path. This criteria is based on groundbreaking research, testing and analysis performed by a team led by Alan Meier, a senior scientist in the Energy Analysis Department, Lawrence Berkley National Laboratory.

Criteria in this document leverage the LBNL body of work into:

A. a set of six typical tasks designed to evaluate Climate Controls through ease of use testing, and

B. an ease of use metric used to calculate numerical ease of use scores, and

C. performance-based ease of use criteria to asses products' individual task and cumulative ease of use compliance, and

D. test administrator requirements and script to standardize the interaction between administrators and the individuals who will be performing ease of use tasks on Climate Control test samples.

Note: This document relies heavily on the work of the following researchers:

• Alan Meier – Senior Scientist, Lawrence Berkeley National Laboratory – Energy Analysis Department
• Cecilia Aragon – Staff Scientist, Lawrence Berkeley National Laboratory – Advanced Computing for Science, Computational Research Division
• Therese Peffer – Research Coordinator, Enabling Technologies, California Institute for Energy and Environment
• Daniel Perry – Master's Student, UC Berkley
• Marco Pritoni – Ph.D. Student, UC Davis

Details of the performance based ease of use criteria were moved into this appendix in order to make this requirements document easier to use and understand. The criteria units must meet are essentially defined by the tasks users will perform during the test, and thus the tasks are included here as part of the specification. The test administrator script is based directly on the required tasks, and therefore is also included in the specification. Some details of the test method, (such as the selection of the user group), are included in the test method itself, and located in the following appendix. This document builds on the performance-based usability requirements released on November 20, 2010 as part of the usability framework.

The Performance-Based Ease of Use Test Method, located in the following Appendix, shall be used for evaluating product compliance with the performance-based ease of use criteria in this Appendix.

2) Ease of Use Tasks

The following tasks are referenced by the ENERGY STAR Residential Climate Controls specification – Eligibility Criteria, sections 3D2 and 3D3 for Residential Climate Control ease of use testing:

A. **Task 1:** Set Date & Time – The UUT shall be provided in HVAC Heat mode with the default program schedule active and the default or home screen displayed. Date & time shall be set to 12:00 AM, January 1, 1999. The individual user shall be provided with the current date in the Month, Day, Year format and a digital clock displaying current time. The user shall be instructed to set the current date and time in the UUT.

Certain Climate Control models automatically set and maintain the date and time. If the UUT automatically sets and maintains the date and time, user group testing shall be waived for Task 1 and the UUT shall be assigned a score of 100, the maximum available, for Task 1.

B. **Task 2:** Identify Room Temperature – The UUT shall be provided in HVAC Heat mode with the default or home screen displayed – the individual user shall be instructed to identify and read aloud the current room temperature.

C. **Task 3:** Identify Setpoint – The UUT shall be provided in HVAC Heat mode with the default or home screen displayed – the individual user shall be instructed to identify and read aloud the active setpoint (target temperature).

Note: After preliminary testing performed in 2011, EPA discovered that certain users found the compound sentence structure of task 2 to be confusing. Given that, EPA has separated Task 2 into Tasks 2 and 3.

D. **Task 4:** Turn on Heat – The UUT shall be provided in HVAC Off mode with the default or home screen displayed – the individual user shall be instructed to set the UUT to HVAC Heat mode at an active setpoint of 68°F.

E. **Task 5:** Modify Program Schedule – The UUT shall be provided in HVAC Heat mode with the program schedule defined in Table A-1 below active and the default or home screen displayed – the individual user shall be instructed to configure and save the following day and time changes (Table A-2) to the default Climate Control schedule as well as set the UUT to follow the modified schedule in HVAC Heat mode:

Table A-1: Residential Climate Control - Schedule Periods and Setpoints

Setting	Time	Setpoint (Heat)	Setpoint (Cool)
Morning	6 a.m.	70°F	78°F
Day	8 a.m.	62°F	85°F
Evening	6 p.m.	70°F	78°F
Night	10 p.m.	62°F	78°F

Table A-2: Residential Climate Control – Program Modifications

Time	Setpoint (Heat)
9:00 a.m. (Saturday) to 11:00 p.m. (Saturday)	68°F
11:00 p.m. (Saturday) to 6 a.m. (Sunday)	65°F

Tables A-3 and A-4 below specify acceptable programmed ranges for programmed times and setpoints, respectively. These ranges include a ±1°F tolerance for the programmed temperatures, a ±10 min tolerance for programmed times, and shall be used in assessing successful completion of Task 5.

Table A-3: Residential Climate Control – Compliant Programmed Times

Time Tolerance	Compliant Programmed Time
±10 min	8:50 – 9:10 a.m.
	10:50 – 11:10 p.m.
	5:50 – 6:10 a.m.

Table A-4: Residential Climate Control – Compliant Programmed Setpoints

Temperature Tolerance	Compliant Programmed Setpoint
±1°F	67 – 69°F
	64 – 66°F

F. **Task 6:** Activate/Cancel Energy Saving Mode – The UUT shall be provided in HVAC Cool mode with the program schedule configured to maintain a temperature of 78°F during performance of this task and the default or home screen displayed. The individual user shall be instructed to configure the UUT to the Energy Saving Mode required by Section 3D1c of the ENERGY STAR Residential Climate Controls specification – Eligibility Criteria, then verbally announce, "Savings activated." After activation of this mode, the user shall be instructed to return the UUT to follow the default program schedule in HVAC Cool mode and verbally announce, "Savings cancelled."

Note: Given stakeholder concerns regarding use of the Climate Control to convey rate information, the associated ease of use task has been removed.

3) **Ease of Use Metric**

The ease of use metric shall be used to calculate ease of use test scores.

$$M_i = \frac{200s}{1 + e^{x_i}}$$

where

$i = task\ number$

$x_i = t_i / k_i$

$t_i = time\ to\ complete\ task\ i\ (seconds)$

$k_i = constant\ for\ task\ i$

$s = 0\ if\ task\ is\ completed\ erroneously$

$s = 1\ if\ task\ is\ completed\ correctly$

Notes:

- Score range is 0 to 100, higher score is better
- k_i is different for each task; the lower the k value, the more it matters to the score that the task be completed quickly.

Table 5: Residential Climate Control – Ease of Use Task Parameters

Task Number	Target Time to Complete (s)	k_i	Maximum Time to Attempt (s)
1 – Set Date & Time	120	$k_1 = 194$	600
2 – Identify Room Temperature	5	$k_2 = 8.0$	30
3 – Identify Setpoint	5	$k_2 = 8.0$	30
4 – Turn On Heat	10	$k_3 = 16$	120
5 – Modify Program Schedule	180	$k_4 = 291$	900
6 – Activate/Cancel Energy Saving Mode	15	$k_5 = 24$	120

Note: In this release**,** EPA has retained the ease of use metric as originally proposed, with the intent to reexamine it based on the results of the round robin testing. In light of this, the maximum time to attempt each task has been extended, in order to collect as much data as possible. EPA retains such a limit to ensure that the total time it may take a lab to complete the test is predictable. As long as a metric including k values is retained, there will be a point past which successful completion of a task will not result in a significantly better score than non-completion. In this case, it would make sense to retain maximum time to attempt each task.

Another possible strategy for making the total test time predictable is to impose a total test time rather than limits for each task. This has the advantage of eliminating users' experiences of being told they are out of time, which may affect their performance on subsequent tasks. If combined with a metric based on total time to complete all tasks, it also would allow users to familiarize themselves with the device during any individual task, without the score for that task being affected. However, any tasks not completed during the total time limit would have to be deemed unsuccessful. EPA invites stakeholder ideas on the best way to limit how long it takes to run the complete test on a unit.

While EPA has not adjusted the numeric value of the k_i parameters, the Agency may do so prior to release of the Draft Final specification based on stakeholder feedback and available test data. This adjustment is part of the specification, not the test method, and would not affect lab accreditation. It would also not effect whether data collected using v1.0 of the test method (included in this release) could eventually be used for qualification.

4) **Performance-based Ease of Use Criteria** – A product shall comply with both Criterion A and B to qualify for ENERGY STAR.

Criterion A: For each task, the average ease of use score $M_i(avg)$ shall be ≥ 40. As an example, Task 1 average ease of use score shall be calculated as follows:

$$M_1(avg) = \frac{M_1(user\ 1) + M_1(user\ 2) + \cdots + M_1(user\ n)}{n}$$

Where

$M_1(user\ 1)$ = task 1 ease of use score for user 1

$n = panel\ size$

Criterion B: The total composite ease of use score M_c shall be ≥ 70. M_c shall be calculated as follows:

$$M_c = (M_1(avg) + M_2(avg) + \cdots + M_x(avg))/x$$

Where

$x = number\ of\ tasks$

5) **Test Administrator Requirements**

A. Test administrators shall follow the test procedure in Appendix B and read from the script in Section 7 of this appendix.

B. Test administrators shall not influence the individual users in any way, including:

1. Verbal statements or cues beyond the scripts outlined below;
2. Body movements or hand gestures that could assist or dissuade an individual completing a task; or
3. Facial expressions or eye movements that would indicate what buttons to push or where to find specific information beyond what is read to the individual user.

C. Administrators shall either instruct individual users not to observe the product, or shall prevent them from doing so until the start of the first task.

D. Written instructions shall be provided to individual users immediately prior to the start of each task. In order to ensure test impartiality, individual users waiting to begin testing shall be prevented from hearing the verbal instructions given by the test administrator to the current individual user or from seeing the test setup.

E. The individual user shall turn his back to the product while reading the task instructions. He may turn to face the product when he or she indicates that he or she is ready to begin the task.

F. For the Test Administrator Script in Section 7 of this document:

1. text to be read aloud is in quotation marks and *italic* font;
2. for each task, the instructions that shall be provided as a printout are in quotation marks and *italic* font;
3. specific, individualized directions to be given by the test administrator are in parentheses and non-italic font (e.g., location of the clock in the room); and
4. specific commands to be used within the test (e.g., times up) are in ***italic bold*** font.

6) **Test Administrator Script**

A. Introduction Script

"*Good Morning/Afternoon I'd like to begin by thanking you, in advance, for your participation in this important test program. Your participation will help us ensure that ENERGY STAR Residential Climate Controls save energy and money with energy saving modes that are simple to use and configure. You will be helping us evaluate a Residential Climate Control for ease of use. These devices are often called Programmable Thermostats and are used to control heating, ventilation, and air conditioning equipment. I will ask you to perform six tasks that require interaction with the device. The Climate Control will be evaluated based on how easily and quickly users like you can complete these tasks. If most users can finish the tasks quickly, we will know that the unit is easy to use. To make sure we have time to test how easy a variety of product functions are to use, we may sometimes need to ask you to move to the next task before you have completed the task you are working on.*

*I cannot answer any questions or influence your actions in any way. If you do not understand the instructions for any task, please let me know and I will reread those instructions a second time. I will also provide the same instructions in writing for each task. After I read the instructions, please perform the task. Once you have completed a task, please say '**Task done**' and I will verify.*

*If you are having trouble completing a task or wish to stop working on a task for any reason, please say '**I'd like to move on**' and we will move to the next task until all are completed. If we need to move to the next task to make sure you have time to test all the functions, I will say '**We need to move to the next task.**'*

I may need to adjust the Climate Control between tasks, and ask you to please not observe my actions while I do so.

Let's begin."

B. **Task 1 Script:** Set Date & Time

Before providing instructions for this task, configure the UUT in HVAC Heat mode with the time & date set to 12:00 AM, January 1, 1999 and with the default or home screen displayed. If configuration of this incorrect date and time is not possible, for example with a UUT that automatically configures the date and time, document this, assign the product a score of 100, the maximum available, for Task 1 and skip to Task 2.

"The date and time are currently incorrect on the Climate Control. When I say 'Begin,' please enter this date and time into the Climate Control (indicate direction where clock and calendar is located)*. When finished, say 'Task done.' If you are having trouble completing a task or wish to stop working on a task for any reason, please say 'I'd like to move on'. **Begin**."*

Start the timer. When the individual user says "***Task done***" or "***I'd like to move on***", stop the timer, check task correctness and record results. If the user appears to have completed the task but does not say "***Task done***" or "***I'd like to move on***," the administrator shall say "**Are you done?**" Stop the timer when the user confirms that he/she is complete. If the individual user has not completed the task and the maximum time to attempt the task has been reached, the administrator shall say "**Please move on to the next task**", stop the timer, check task correctness and record results.

C. **Task 2 Script:** Identify Room Temperature

Before providing instructions for this task, configure the UUT to HVAC Heat mode, with the default or home screen displayed.

"*When I say 'Begin,' please read aloud the current room temperature. When finished, say 'Task done.' If you are having trouble completing a task or wish to stop working on a task for any reason, please say 'I'd like to move on'. **Begin**."*

Start the timer. When the individual user says "***Task done***" or "***I'd like to move on***", stop the timer, check task correctness and record results. If the user appears to have completed the task but does not say "***Task done***" or "***I'd like to move on,***" the administrator shall say "**Are you done?**" Stop the timer when the user confirms that he/she is complete. If the individual user has not completed the task and the maximum time to attempt the task has been reached, the administrator shall say "**Please move on to the next task**", stop the timer, check task correctness and record results.

D. **Task 3 Script:** Identify Setpoint

Before providing instructions for this task, configure the UUT to HVAC Heat mode, with the default or home screen displayed.

"*When I say 'Begin,' please read aloud the current set temperature, that is the desired room temperature. When finished, say 'Task done.' If you are having trouble completing a task or wish to stop working on a task for any reason, please say 'I'd like to move on'.* ***Begin****."*

Start the timer. When the individual user says "***Task done***" or "***I'd like to move on***", stop the timer, check task correctness and record results. If the user appears to have completed the task but does not say "***Task done***" or "***I'd like to move on,***" the administrator shall say "**Are you done?**" Stop the timer when the user confirms that he/she is complete. If the individual user has not completed the task and the maximum time to attempt the task has been reached, the administrator shall say "**Please move on to the next task**", stop the timer, check task correctness and record results.

E. **Task 4 Script:** Turn on Heat

Before providing instructions for this task, configure the UUT to a Heat setpoint of 72°F – then to HVAC Off mode, with the default or home screen displayed.

"*The Climate Control is currently turned off. When I say 'Begin,' please adjust the Climate Control to heat the room to 68°F." When finished, say 'Task done.' If you are having trouble completing a task or wish to stop working on a task for any reason, please say 'I'd like to move on'.* ***Begin****."*

Start the timer. When the individual user says "***Task done***" or "***I'd like to move on***", stop the timer, check task correctness and record results. If the user appears to have completed the task but does not say "***Task done***" or "***I'd like to move on,***" the administrator shall say "**Are you done?**" Stop the timer when the user confirms that he/she is complete. If the individual user has not completed the task and the maximum time to attempt the task has been reached, the administrator shall say "**Please move on to the next task**", stop the timer, check task correctness and record results.

F. **Task 5 Script:** Modify Program Schedule

Before providing instructions for this task, configure the UUT to HVAC Heat mode with the ENERGY STAR program schedule (defined in the table below) active and the default or home screen displayed.

Setting	Time	Setpoint (Heat)	Setpoint (Cool)
Morning	6 a.m.	70°F	78°F
Day	8 a.m.	62°F	85°F
Evening	6 p.m.	70°F	78°F
Night	10 p.m.	62°F	78°F

"*The Residential Climate Control unit is currently in Heat Mode. It is using a predefined schedule for heating. Please adjust the Residential Climate Control to include the following changes. This sheet has the information you will need."*

Hand the individual user a sheet of paper with the following (**bold** text):

> **Please configure the Climate Control so that the home is automatically heated to 68°F from 9:00 AM to 11:00 PM on Saturdays, then heated to 65°F during the overnight period starting at 11:00 PM on Saturday nights.**

"*Please review this page which lists information that you will be asked to enter into the Climate Control. Let me know when you are ready to proceed."*

Pause until the individual user indicates his/her readiness.

"When I say Begin, please modify and save the Climate Control program schedule. Then set the Climate Control to follow this heating schedule. Change only the times and temperatures as indicated on the page, with which I've provided you. Then, verbally announce 'Task done.' If you are having trouble completing a task or wish to stop working on a task for any reason, please say 'I'd like to move on'. ***Begin***"

Start the timer. When the individual user says "***Task done***" or "***I'd like to move on***", stop the timer, check task correctness and record results. If the user appears to have completed the task but does not say "***Task done***" or "***I'd like to move on,***" the administrator shall say "**Are you done?**" Stop the timer when the user confirms that he/she is complete. If the individual user has not completed the task and the maximum time to attempt the task has been reached, the administrator shall say "**Please move on to the next task**", stop the timer, check task correctness and record results.

G. **Task 6 Script:** Activate/Cancel Energy Saving Mode

Before providing instructions for this task, ensure that the UUT's Energy Saving Mode is configured with default Heat and Cool setpoints of 62°F and 85°F. Then, configure the UUT to follow a program schedule configured to maintain a temperature of 78°F during performance of this task. Configure the UUT to display the default or home screen.

"This Residential Climate Control has an easily accessible Energy Saving Mode that will remain on until cancelled. This mode is typically activated when leaving the home and cancelled after returning."

"When I say Begin, please activate the Energy Saving Mode. Once activated, verbally announce 'Savings activated.' Next, cancel the Energy Saving Mode, then, verbally announce 'Savings cancelled – Task done.'

If you are having trouble completing a task or wish to stop working on a task for any reason, please say 'I'd like to move on'. Would you like me to repeat the instructions one more time?"

If the answer is yes, repeat the above instructions; if no, say, *"**Begin**"*

Once you say Begin, start the timer. You will also need to verify proper setting of Away Mode as the individual user is instructed to cancel it immediately after it is activated. When the individual user says "***Away mode cancelled – Task done***" stop the timer, verify task correctness and record results. If the user appears to have completed the task but does not say "***Task done***" or "***I'd like to move on,***" the administrator shall say "**Are you done?**" Stop the timer when the user confirms that he or she is done. If the individual user has not completed the task and the maximum time to attempt the task has been reached, the administrator shall say "We need to move to the next task", stop the timer, check task correctness and record results.

H. **Exit Script**

"You have completed all tasks and this concludes our testing. Thank you. We appreciate your participation in this testing program. Please return to the (insert appropriate destination—example: front desk) *before you leave."*

Appendix B

Test Method – Performance-Based Ease of Use Version 1.0

1) Overview

The following test method shall be used to determine product compliance with the Performance-Based Ease of Use criteria in the ENERGY STAR Eligibility Criteria for Residential Climate Controls.

2) Applicability

This ENERGY STAR Test Method is applicable to Residential Climate Controls subject to Performance-Based Ease of Use Testing, as described in the ENERGY STAR Residential Climate Controls Specification.

3) Definitions

Unless otherwise specified, all terms used in this document are consistent with the definitions contained in the ENERGY STAR Eligibility Criteria for Residential Climate Controls.

A. User Group: A group of persons, recruited by the test laboratory in accordance with selection criteria included in this test method. Members of this group are responsible for individually performing ease of use tasks on the UUT in accordance with this test method

B. Individual User: A member of the User Group

C. Test Administrator: The individual(s) facilitating Residential Climate Control ease of use testing

D. UUT: Unit Under Test

4) User group selection

A. User Group size: 28

B. User Group Composition:

1 The User Group shall concurrently meet the following requirements:

a. Represented Age Group;

b. Gender; and

c. Level of Education.

2 The details for these requirements include:

a. Age Groups

- Age 21–34 – 28.6% of users
- Age 35–49 – 28.6% of users
- Age 50–64 – 28.6% of users
- Age 65–79 – 14.2% of users

b. Gender composition

- Male – 50% of users
- Female – 50% of users

c. Level of Education.

- Less than High-School Education – 14% of users
- High-School Graduate & Less than Bachelor's Degree – 57% of users
- Bachelor's Degree or Higher – 29% of users

3 The following limits are imposed on the user group selection:

a. In each age group, the male/female split shall be 50% each, plus or minus one user.

b. In each age group, at least one individual must have less than a high school education.

c. In age groups 20-34, 35-49, and 50-64, no more than 3 individuals of each gender may have graduated high school but not have a bachelor's degree.

d. In age group 65 to 79, no more than 2 individuals of each gender may have graduated high school but not have a bachelor's degree.

Note: As part of the first round of Ease of Use testing, EPA and DOE received feedback in the User-Centered Design (UCD) report that variations in the demographics of the user are likely to be an avoidable source of lab to lab and test to test variation in scores. Therefore, EPA proposes some restrictions on how the user group demographic characteristics are correlated. These restrictions are based on the correlation of these demographic categories in the 2010 census. This proposal balances test reproducibility with the expense of recruiting a user group that meets all of the requirements. EPA has also removed the requirement for a color blind individual to be included in the test, based on UCD recommendations. The total size of the user group has been chosen to balance the expense of the test with its ability to differentiate similarly usable units. The UCD final report is posted on the ENERGY STAR Residential Climate Controls partner webpage: http://www.energystar.gov/index.cfm?c=new_specs.climate_controls

C. Individual User Criteria:

1. U.S. resident
2. No prior experience with the UUT or alternative user interface, if relevant
3. No association or prior involvement with the HVAC or related industries, including family members associated with the company providing the UUT
4. No financial interest associated with the UUT or its manufacture, including stocks, bonds or other investments
5. No other conflicts of interest that could unfairly influence test results

5) Performance-based Ease Of Use criteria

Ease of use criteria, to be used with this test method, are included in Section 3 of the ENERGY STAR Program Requirements for Residential Climate Controls – Eligibility Criteria. Performance-based ease of use criteria, including task descriptions, metric and ease of use criteria are detailed in Appendix A.

6) Test Procedures

E. Test Equipment

Table B-1: Test Equipment

Test Equipment	Measurement / Units	Measurement Accuracy (minimum)
Humidistat	Relative Humidity / %	± 5%
Thermometer	Ambient Temperature / °F	± 0.5°F
Sound Level Meter	Ambient Noise / dB SPL	± 2dB SPL
Stopwatch	Test Interval / s	± 0.5s

7) Test Administration

Ease of use testing shall be conducted by test administrator(s) who shall:

A. Configure UUT

B. Ensure test environment is orderly, quiet, and comfortable

C. Ensure the UUT cannot be seen by the individual user prior to initiating the first task

D. Provide verbal instructions to individual users in accordance with the Residential Climate Controls Test Administrator Script, included in Appendix A.

E. Observe task performance

F. Assess and record task success

G. Measure and record time to complete

Test administrators shall not offer additional guidance or assistance beyond the Residential Climate Controls Test Administrator Script.

Test administrators capturing task success and time to complete shall not be visible to the user. The test administrator capturing task success, for example, may either be behind a one-way mirror, in the test room but out of sight of the user, or in a separate room watching a video feed.

Note: EPA intends the test administrator that is not present in the room to keep track of the time to complete each task. Several stakeholders noted that the test administrator that reads the script should not also hold a stopwatch during the test to avoid pressuring the test participant.

8) UUT Configuration

The UUT(s) shall be configured for operation prior to the start of each day of ease of use testing. Multiple UUTs may be configured to make the test run faster and smoother. Correct configuration shall be verified prior to each task and test iteration. UUT configuration shall be accurately documented and shall include the following steps:

A. Ensure that UUT configuration is “as shipped”; reset configuration to “as shipped” if required.

B. Perform minimal configuration so that UUT functionality is representative of a typical installation.

9) Test Setup

A. Residential Climate Control

Setup shall be representative of typical home installations. The UUT shall be installed according to product installation instructions. If intended for wall mounting the UUT shall be affixed to a wall in its normal orientation, with the center of the device 5 feet above the floor. Use of alternate mounting heights are permitted in cases where a 5-foot height is problematic for an individual user. As an example, a mounting height of 3 ½ feet above the floor will better suit a user in a wheel chair.

B. Remote Interface

Setup shall be representative of typical home installations. The UUT shall be affixed to the wall as described above. A computer, smart phone, or other device that provides access to the remote interface shall be available and placed on a desk at which the user shall sit during testing. The manufacturer is responsible for providing the equipment to enable the remote interface (e.g. computer, smart phone), along with the UUT.

C. Date & Time

Current Date and Time shall be clearly posted. Date shall be MMM DD, YYYY format (e.g. "JAN 18, 2011"). Time shall be indicated with a digital clock and shall be in HH:MM 12-hour format (e.g., "12:30 PM").

D. Test Environment

The test environment shall be quiet and dedicated to ease of use testing. Examples of suitable spaces include a meeting room, vacant office, or similar work space. The following environmental parameters shall be maintained during ease of use testing:

1. Ambient Temperature (heating season): 70 ± 2°F
2. Ambient Temperature (cooling season): 78 ± 2°F
3. Relative Humidity: 20 – 60%
4. Ambient Noise: ≤ 45 dB SPL

Users shall not be permitted to access product documentation external to the physical product, before or during the test. User documentation that is included as part of the physical product or interface (i.e., instructions/directions included on a flip down door, help menu) or instructions or help menus, incorporated into alternate interfaces may be accessible to the user during testing.

Note: Feedback from a usability firm applying the first draft test method (see line 1183) included concerns that provision of a written user manual introduces unnecessary variability into the test results. The test administrators observed that some users immediately examined the manual, then began the first task, thus skewing their time to complete result. In addition, if a user manual is included, then the usability of the manual itself will affect the test results. Given these concerns, in addition to concerns that manuals are often lost, and that users should not need them, EPA has decided not to allow access to written user documentation during the test.

E. Data Collection

Ambient temperature, relative humidity, and ambient noise shall be measured and recorded prior to the start of each day of ease of use testing.

Ease of use test data shall be recorded for each of the test iterations for each task, as follows:

1. Test Date
2. Start Time

3. Task success

   - s = 0, task completed incorrectly or not completed (e.g., user chooses to abandon task or give up), or
   - s = 1, task completed correctly

4. Time to complete, if s = 1

The format and method for data collection and recording shall be determined by the test laboratory. Excel-based electronic versions of the data collection sheets shall be available on the ENERGY STAR website.

Appendix C

Test Method – Power Consumption – Climate Controls

1) OVERVIEW

Power consumption of the Unit Under Test (UUT) shall be measured and compared to the applicable limit specified herein.

2) APPLICABILITY

This ENERGY STAR Test Method is applicable to both Low-Voltage and Line-Voltage Climate Controls intended to be powered by:

A. Low-Voltage Climate Controls: 24 V, 60 Hz

B. Line-Voltage Climate Controls: 115 – 125V single-pole / 200 – 250V 2-pole, 60 Hz

3) DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions contained in the ENERGY STAR Eligibility Criteria for Residential Climate Controls.

4) APPLICABLE STANDARD

Test setup and instrumentation for all portions of this procedure shall be in accordance with the requirements of IEC 62301, Ed. 2.0, 2011-01, "Measurement of Household Appliance Standby Power," Section 4, "General Conditions for Measurements," unless otherwise noted in this document. In the event of conflicting requirements, the ENERGY STAR test method shall take precedence. The UUT shall be tested in a stand-alone configuration without any connection to controlled HVAC elements or other devices. Connection to the test voltage shall be in accordance with manufacturer provided installation instructions.

5. TEST CONDUCT

A. Supply voltage and frequency

   1. Low-Voltage UUT: 24V ± 1%, 60 Hz ± 1%
   2. Line-Voltage UUT:
      a. single-pole: 115V ± 1%, 60 Hz ± 1%
      b. 2-pole: 230 V ± 1%, 60 Hz ± 1%

B. UUT Configuration – The UUT shall be tested in its "as-shipped" configuration. For products that offer a choice of user-configurable options, all options shall be set to their default conditions.

C. Batteries – If batteries are used, they shall be fully charged before the start of testing. Products powered solely by batteries are outside the scope of this test method.

6. UUT INITIALIZATION PRIOR TO PERFORMING TEST

A. Supply power to the UUT in accordance with the product installation instructions. No other electrical connections shall be made with the exception of wired connections, if required to enable communications in accordance with section 7C.

B. If the UUT is a Communicating Climate Control, configure it to enable data communications between the UUT and a connected device external to the HVAC system.

7. TEST PROCEDURE

A. Measurement Procedure – power consumption shall be measured using the sampling method, section 5.3.2 of IEC 62301, Edition 2.0 2011-01. The total measurement period shall be at least 3 test periods of 5 minutes each. If, a longer measurement period is required in order to satisfy stability criteria as outlined in section 5.3.2 of IEC 62301, the total measurement period shall extended in 15 minute increments (i.e. 30m, 45m, 60m…).

B. Communicating Climate Controls – Ensure that data communication between the UUT and a connected device external to the HVAC system occurs at least 1x during each 5-minute test period.

C. Away Mode – Configure the UUT with Away mode disabled. Approximately halfway through each five minute test period, change Away mode setting. That is, at approximately 2 ½ minutes, enable Away mode; then at approximately 7½ minutes, disable Away mode, and so on for the duration of the test.

D. Measure and record average energy consumption for each five minute test period.