



# ENERGY STAR® Residential Climate Controls Draft Specification Framework – Performance-Based Usability Requirements November 30, 2011

Please send comments to [ClimateControls@energystar.gov](mailto:ClimateControls@energystar.gov) by January 30, 2011

## Overview

This framework document details proposed usability requirements for ENERGY STAR Residential Climate Controls, including revised language for prescriptive usability requirements and new performance-based usability test requirements. EPA presents the performance based requirements in the context of prescriptive requirements to promote better understanding. This framework document is based on the Section 3 usability requirements from the Draft 2 Version 1.0 ENERGY STAR Residential Climate Controls Eligibility Criteria. To facilitate comparison to that document, all changes from it are noted in **red font**.

The purpose of this framework document is to provide stakeholders with an opportunity to review, and provide feedback on, EPA's proposed approach for addressing usability prior to inclusion in the next Draft specification. EPA intends to incorporate these requirements, taking into consideration stakeholder comments received by January 30, 2011, into the Draft 3 specification, scheduled to be released in February 2011, and will provide a subsequent comment period.

## Usability Requirements:

There are two **paths to demonstrating** an acceptable level of usability for Climate Controls:

- Path 1) Performance-Based Path:** Compliance with **both the** core prescriptive usability requirements (**Section A**) **and** demonstration of an acceptable level of usability when evaluated against a performance-based usability test (**Section B**); **or**
- Path 2) Prescriptive Path:** Compliance with both the core prescriptive usability requirements (**Section A**) **and** additional prescriptive usability requirements (**Section C**).

### A. Core Prescriptive Usability Requirements:

**A product shall meet core usability requirements A.1 thru A.4 to qualify for ENERGY STAR. Note that these core requirements apply to all products:**

- A.1 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.
- A.2 Date & Time –** The product shall be capable of maintaining the correct date & time without user input, including automatic adjustment for U.S. 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  $\pm 0.5s$  per 24-hour period. When integrated into an EMS/ESI that includes date & time synchronization with external sources; EMS/ESI date & time synchronization shall take precedence.

- A.3 Energy Saving Mode** – The product shall include an easily accessible setback mode. Default Heat and Cool setpoints for this mode shall be 62°F and 85°F, respectively. The **Heat setback** setpoint may be user configurable, but not to a value greater than 65°F. 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 usability test requirements or by compliance with requirement C.2 (page *tbd*) for the prescriptive path.**
- A.4 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.

**B. Performance-Based Usability Testing:**

- B.1 Usability Testing Overview** – Performance-based usability testing involves usability panel testing of specific tasks and is further detailed in the Draft 1 Version 1.0 *Residential Climate Controls Test Method – Usability*, including panel selection criteria, task descriptions, test setup and test administration.

**B.2 Performance-Based Usability Test Metric**

Task completion success and time to complete each usability task shall be recorded and entered into the following metric to generate a score:

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

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 or not completed within allotted time

$s = 1$  if task is completed correctly, within allotted time

Notes:

- 1) Score range is 0 to 100, higher score is better
- 2)  $k_i$  is different for each task; values have been selected such that  $M_i = 70$  when the task is completed in a subjectively chosen *target time to complete*.

**Note:** Lawrence Berkley National Labs (LBNL) has completed a usability study on a number of currently available programmable thermostats. A total of four usability metrics were used, and the LBNL study indicated that each metric produced similar and consistent results. The above metric has been selected by EPA for qualification of ENERGY STAR Residential Climate Controls because it is the easiest to measure; it has been modified to produce a range of scores from 0 to 100.

**B.3 Compliance Criteria**

A product shall comply with both Criterion A and B to qualify for ENERGY STAR.

**Criterion A:** For each task, the average usability score  $M_i(avg)$  shall be  $\geq 40$ . As an example, Task 1 average usability score shall be calculated as follows:

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

where

$n = \text{panel size}$

**Criterion B:** The total composite usability score  $M_c$  shall be  $\geq 70$ .  $M_c$  shall be calculated as follows:

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

where

$x = \text{number of tasks}$

**Note:** Criterion A sets a lower usability limit for individual tasks. The lower limit was selected in order to permit task to task variance while maintaining a minimum score for each task. The more stringent Criterion B limit ensures that aggregate product usability is at an acceptable level.

#### C. Additional Prescriptive Usability Requirements:

Usability requirements C.1 through C.8, below, are required for products that have **not** been evaluated to the performance-based usability requirements, above.

- C.1 Schedule Period Nomenclature** – Products that use four schedule periods shall use the descriptive names: “Morning,” “Day,” “Evening,” and “Night.” Products with more than four schedule periods may use alternate schedule period nomenclature.

**Note:** In response to a stakeholder comments, schedule period naming requirements have been moved here from the technical requirements section to allow stakeholders that follow the Performance-Based Path to define schedule periods names. Also, stakeholders following the Prescriptive Path that use more than four schedule periods per day are now permitted to use alternate schedule period names, also in response to a stakeholder comment.

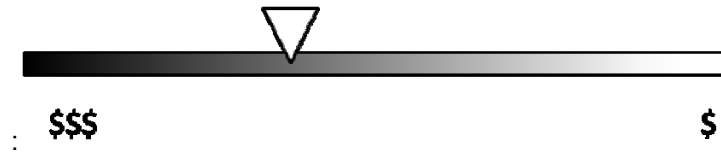
- C.2 Access to Energy Saving Mode** – The product shall include an energy saving operational mode that is activated and cancelled by single user operations. This energy saving mode shall simultaneously activate the energy saving setpoint as described in Requirement A.3 and place the product in Long Term Hold. The energy saving mode shall be given a descriptive label (EPA recommends use of the term “Away”)
- C.3 Current Status Display** – The product shall include visual indication that controlled HVAC heating or cooling elements are active. Products capable of controlling Heat Pump systems that use electric resistance auxiliary heat shall additionally 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**



- C.4 Setpoint Adjustability** – The product shall provide the user with 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 or Temporary Hold indicator that informs the user that the change will be overridden by the schedule at the next scheduled change.
- C.5 Temperature Resolution** – The product shall operate in Fahrenheit and shall provide 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.
- C.6 Current Mode Display** – The product shall provide indication of current operating mode, as follows:
- a) Following program schedule, Away, Long-Term Hold, Short Term Hold
  - b) HVAC mode (Heat, Cool, Auto, Off)
  - c) Fan mode (Auto, On)
  - d) Program (configuration/setup) mode
- C.7 Character Size** – The product display shall have primary and secondary characters (i.e., numbers) that are at least 16 mm and 4.75 mm in height, respectively. In the default display mode or screen, primary characters shall indicate current room temperature.
- C.8 Electricity Price Tier Indication** – The product shall incorporate green, yellow and red LEDs (or an equivalent implementation using the same colors) to indicate current energy price tier, as follows:

**Example 1** – Three tier implementation

Green – Off Peak  
Yellow – Mid Peak  
Red – On Peak

**Example 2** – Four tier implementation

Green – Off Peak  
Yellow – Mid Peak  
Red – On Peak  
Flashing Red – Critical Peak

The color coded implementation shall ensure that each mode is discernable to individuals with color vision deficiency (e.g., via use of different physical locations for each indicator).