Appliance Standards Awareness Project

January 9, 2024

Steve Leybourn and Abigail Daken
U.S. Environmental Protection Agency
William Jefferson Clinton Building
1200 Pennsylvania Avenue, NW
Washington, DC 20460

RE: ENERGY STAR® Draft 1 Test Method to Determine Room Air Conditioner Heating Mode Performance

Dear Mr. Leybourn and Ms. Daken,

This letter constitutes the comments of the Appliance Standards Awareness Project (ASAP) on the Draft 1 Test Method to Determine Room Air Conditioner Heating Mode Performance released on December 5, 2023. We appreciate the opportunity to comment.

We support the development of a test procedure for the heating operation of room heat pumps (RHPs) and would support future efforts to establish ENERGY STAR heating energy efficiency specifications (and Most Efficient levels) for RHPs. We also think that the identification and designation through the ENERGY STAR program of "cool" and "cold" climate RHPs would be a valuable tool for decarbonization, particularly for applications in existing multifamily buildings.

We understand that currently, most RHP models on the market are equipment intended to provide heating at mild ambient temperatures that are above conditions typical for frost formation.[1] To our knowledge, there are RHPs that operate at cold ambient temperatures that have been made available for specific programs, but that are not yet available for purchase by the general public.[2,3] We understand that these models will likely appear on the market soon, and we also expect further innovation and competition in this market segment that could drive heat pump adoption as a plug-and-play solution for

[1] Of the 8 RHP models in the ENERGY STAR database (as of 1/4/2024), ASAP was able to locate the product manuals for 4 models. Two Midea models specified heating operation at outdoor ambient temperatures greater than 39 °F and 2 Keystone models specified heating operation at outdoor ambient temperatures greater than 41°F.

[2] https://www.governor.ny.gov/news/governor-hochul-announces-installation-window-heat-pumps-new-york-city-public-housing

[3] Neither Gradient or Midea cold climate models installed by the NYC Housing Authority appear to be available for purchase. We understand that the CCHP10 all-weather model by Gradient would likely meet the proposed definition of cold climate per the manufacturer's published specifications. https://www.gradientcomfort.com/products/gradient-all-weather-120v-window-heat-pump .

building retrofits. An appropriate test procedure for all RHPs is important for communicating the performance of this equipment to consumers.

We encourage EPA to remove the climate designations from the test procedure. We agree that it makes sense for there to be different test procedure provisions for RHPs depending on their ability to provide reverse cycle heating operation at different outdoor temperatures. However, it seems that this could be accomplished through the reporting of compressor cut-in and cut-out only, and that the existence or type of defrost is not necessary to specify the test conditions for any particular unit. We also think that it would make sense for EPA to defer formalizing any definitions for cool and cold climate RHPs until the publication of an ENERGY STAR specification (however, we have offered some considerations on the proposed definitions in these comments).

If climate designations are removed, we suggest that the required (and optional) tests for equipment should be determined based on whether the system is single- or variable-speed and the compressor cut-in and cut-out temperature range. Table A incorporates all of the tests for single-speed equipment in Tables 3 through 6 of the draft test procedure in this proposed framework. In Section 4.3 Supplemental Test Instructions (STI) of the draft proposal, a manufacturer is required to submit compressor cut-in and cut-out temperatures. Due to the importance of the cut-in and cut-out temperatures, whether or not the temperature determination is performed using Section 6.3, or specified by the manufacturer, we think that these values should be subject to verification testing.

Table A: Heating Mode Test Conditions for Single-Speed Units

	Outdoor side temperature		**Product compressor cut-in and cut-out temperature**			
Test name	**dry-bulb**	**wet-bulb**	**≥42**	**[17,42)**	**[5,17)**	**<5**
$H_{0,full}$ Test	62	56.5	O			
$H_{1,full}$ Test	47	43	R	R	R	R
$H_{2,full}$ Test	35	33			O	O
$H_{3,full}$ Test	17	15			R	R
$H_{4,full}$ Test	5	4				R
$H_{L,full}$ Test	See note 1	See note 2		R		
$H_{x,full}$ Test	See note 1	See note 2				O

[0] Here R indicates a required test and O indicates an optional test. The open bracket indicates the range is exclusive of the temperature and the closed bracket indicates the range is inclusive of the temperature. For all tests, the indoor side temperature dry bulb and wet bulb shall be 70 and 60 (max), respectively.

[1] Test at the specified cut-in temperature or the cut-in temperature determined in section 6.3 if conducted.

[2] Use a wet-bulb temperature corresponding to a maximum 60% relative humidity level.

We note that for single-speed equipment, EPA specified tests for an "all-other" category for units that did not meet the mild, cool, or cold definitions. However, EPA has elected not to define test provisions for variable-speed units with this operating range, suggesting that "it is unlikely that manufacturers would choose to incur the expense of implementing active defrost for units that do not operate in cool or cold climates."[4] However, since it is not clear what engineering decisions manufacturers will ultimately select, we think that it would make sense for the same approach to be included for variable-speed equipment to ensure full coverage of the test procedure. Table B incorporates all of the tests for variable-speed equipment in Tables 7 through 9 of the draft test procedure. We think that EPA should specify tests for compressor cut-in and cut-out temperature greater than or equal to 17 °F and less than 42 °F (gray column).

Table B: Heating Mode Test Conditions for Variable-Speed Units

	Outdoor side temperature		**Product compressor cut-in and cut-out temperature**			
Test Name	**dry-bulb**	**wet-bulb**	**≥42**	**[17,42)**	**[5,17)**	**<5**
$H_{0,low}$ Test	62	56.5	R		R	R
$H_{1,full}$ Test[4]	47	43			O	O
$H_{1,nom}$ Test[3]	47	43	R		R	R
$H_{1,int}$ Test	47	43	O			
$H_{1,low}$ Test	47	43	R		R	R
$H_{2,int}$ Test	35	33			R	R
$H_{3,full}$ Test	17	15			R	R
$H_{4,full}$ Test	5	4				R
$H_{L,full}$ Test	See note 1	See note 2				
$H_{x,full}$ Test	See note 1	See note 2				R

[0] Here R indicates a required test and O indicates an optional test. The open bracket indicates the range is exclusive of the temperature and the closed bracket indicates the range is inclusive of the temperature. For all tests, the indoor side temperature dry bulb and wet bulb shall be 70 and 60 (max), respectively.

[1] Test at the specified cut-in temperature or the cut-in temperature determined in section 6.3 if conducted.

[2] Use a wet-bulb temperature corresponding to a maximum 60% relative humidity level

[4] https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Draft%201%20Test%20Method%20to%20Determine%20Room%20Air%20Conditioner%20Heating%20Mode%20Performance.pdf. p. 12.

[3] Maximum speed that the system controls would operate the compressor in normal operation in 47 F ambient temperature.
[4] Maximum speed that the system controls would operate the compressor in normal operation in 17 F ambient temperature.

We encourage EPA to consider alternative test designations. We believe that the nomenclature introduced in the test procedure notice of proposed rulemaking (NOPR) for commercial unitary air conditioners and heat pumps (CUACs/CUHPs) is clearer and easier to understand.[5] For instance, the $H_{1,full}$ test is referred to as H47H. We encourage EPA to align the test designations in this test procedure with those for CUACs/CUHPs.

We encourage EPA to use different nomenclature to indicate performance at a single ambient temperature. In the draft test procedure, EPA has introduced the calculations of $HEER_{17}$, $HEER_5$, and $HEER_X$. However, because HEER is a seasonal metric that represents heating over different temperatures (bins), we think that it would be more appropriate to refer to the existing coefficient of performance (COP) nomenclature or a uniquely named new metric to convey performance at a single ambient temperature.

We encourage EPA to consider energy use in standby mode in the heating metric. As EPA notes, the cooling metric for room air conditioners, CEER, incorporates inactive and off mode power.[6] We think that it is also important to capture standby energy consumption in the heating metric to enable heating efficiency comparisons that fully account for energy use during the heating season. We encourage EPA to consider whether there is a way to appropriately capture the standby power associated with heating mode.

Cool and cold climate definitions should be relocated to any upcoming ENERGY STAR specification. We think that it would be valuable to identify cool and cold climate RHPs. However, as described above, we think that the climate definitions do not necessarily need to be located in the test procedure since the test specifications can be based on a unit's operating temperature range. We think that instead it would make more sense for any climate definitions to be included in a future ENERGY STAR specification for RHPs, through which a cool or cold climate designation could be achieved.

In addition, we encourage EPA to only include capacity maintenance and cut-in and cut-out requirements within the definitions, which would align with the structure of the definition of "cold climate heat pump" in AHRI 210/240-2024 (and AHRI 1600-202X). We think that any efficiency performance requirements (e.g., $HEER_5$) would be more appropriate to include as part of an ENERGY STAR or other efficiency specifications.

[5] https://www.regulations.gov/document/EERE-2023-BT-TP-0014-0003; The NOPR references AHRI 1340 https://www.ahrinet.org/search-standards/ahri-1340-i-p-performance-rating-commercial-and-industrial-unitary-air-conditioning-and-heat-pump. Table 23. p. 46.
[6] https://www.govinfo.gov/content/pkg/FR-2021-03-29/pdf/2021-05415.pdf. p. 16478.

EPA should consider the impact of different defrost control strategies in a subsequent revision. In a future version of the test procedure, it may be desirable to differentiate defrost performance, since it is recognized that different defrost approaches for heat pumps have an energy impact. For instance, in the AHRI 1600-202X draft, a demand defrost credit, defrost heat debit, and defrost overrun debit are applied to the efficiency metric to adjust for different control strategies. This is a simple accounting for the general impact of different control strategies without directly quantifying the energy consumption (see Table 17 in AHRI 1600-202X). In support of this future development, we would encourage reporting through the STI for v1 of the test procedure a description of the defrost control strategy.

Thank you for considering these comments.

Sincerely,

Rachel Margolis
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Appliance Standards Awareness Project