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December 30, 2024

Holly Tapani
ENERGY STAR® HVAC Program
U.S. Environmental Protection Agency
Submitted via e-mail: HVAC@energystar.gov

RE: Draft 1 Version 6.0 and Version 7.0 ENERGY STAR Specifications for Room Air Conditioners

Dear Ms. Tapani:

Rheem Manufacturing Company ("Rheem") appreciates the opportunity to submit the following comments regarding the Draft 1 Version 6.0 and Version 7.0 specifications for room air conditioners.

Rheem is an industry leader for total heating, cooling and water heating solutions and operates facilities throughout the U.S. and around the world. Friedrich Air Conditioning, a division of Rheem, is the sole manufacturer of room air conditioners (RAC) in North America, and for over seventy years has offered premium room conditioning and other home environment solutions for residential, lodging, multifamily properties, and schools. Today, Friedrich remains one of the most recognized RAC brands, known for innovation, commercial-grade durability, and energy efficiency.

Rheem fully supports the establishing of RAC heating criteria by EPA and appreciates the dialogue with staff on this program. EPA has advanced the performance measurement of RAC with reverse cycle, also referred to as room heat pumps (RHP), and with this specification sets forth important thresholds based on the nascent test data currently available. It is with these considerations that we offer the following feedback:

- <u>The Type 1 heating criterion is not attainable and should be revised.</u>
  The proposed 5.1 HEER for Type 1 Heat Pumps is a level which is impossible to attain based on the calculation of HEER as defined in the ENERGY STAR Test Method. Justification is shown below using a sample HEER calculation for a "perfect or hypothetical" heat pump, i.e. one that can meet building load down to 42°F (T_{off} as defined in the test method for Type 1 heat pumps) without consuming any power during heat pump operation.

Equation 7.1.1 in the ENERGY STAR Test Method defines the HEER calculation. The equation can be refactored to remove the cooling capacity from the numerator by using equation 7.1.2 from the Test Method.

$$HEER = \frac{\sum_{j=1}^{14} n_j * BL(T_j)}{\sum_{j=1}^{14} e_h(T_j) + \sum_{j=1}^{14} RH(T_j)}$$

$$BL(Tj) = \sum_{j=1}^{14} Q_c * \frac{(63 - Tj)}{(T_j + 15)}$$

$$\therefore HEER = \frac{Q_c * \sum_{j=1}^{14} n_j * \frac{(63 - T_j)}{(T_j + 15)}}{\sum_{j=1}^{14} e_h(T_j) + \sum_{j=1}^{14} RH(T_j)}$$

Table 11 temperature bin information from the Test Method can be used to solve the summation portion of the numerator.

$$\sum_{j=1}^{14} n_j * \frac{(63 - T_j)}{(T_j + 15)} = .3344$$

$$\therefore HEER = \frac{Q_c * .3344}{\sum_{j=1}^{14} e_h(T_j) + \sum_{j=1}^{14} RH(T_j)}$$

A “perfect or a hypothetical” heat pump would have an e_h of 0 (we are assuming that this heat pump provides all the reverse cycle heat without consuming any power – technically this is impossible), so the HEER calculation can be further simplified by reducing the denominator to just the watts that would be consumed by resistance heat.

$$\therefore HEER = \frac{Q_c * .3344}{0 + \sum_{j=1}^{14} RH(T_j)}$$

The resistance heat power consumption is a function of building load and fraction of total temperature bin hours at temperatures below T_{off} (Bins 6-14 from Table 11)

$$\therefore HEER = \frac{Q_c * .3344}{Q_c * \frac{\sum_{j=6}^{14} n_j * \frac{(63 - T_j)}{(T_j + 15)}}{3.413}}$$

Table 11 temperature bin information can again be used to solve the summation portion of the denominator, as shown below, resulting in an HEER calculation of 4.69. This is the theoretical max limit of HEER for a Type 1 heat pump, and it would be impossible to have an HEER value equal to or greater than this.

$$\frac{\sum_{j=6}^{14} n_j * \frac{(63 - T_j)}{(T_j + 15)}}{3.413} = .0713$$

$$\therefore HEER = \frac{Q_c * .3344}{Q_c * .0713} = 4.69$$

The HEER level for a Type 1 heat pump should not be an impossible value. The justification listed for this value is that it would correspond to a seasonal heating performance 1.5 times more efficient that resistance heating. Since a Type 1 heat pump is only active for 45.5% of the heating bin hours then the 1.5 times more efficient should just be incorporated into the active bin hours of the calculation.

For example, an attainable HEER level would be 4.2, representing a heat pump 3.5 times more efficient than electric heat *in the active bin hours of heat pump operation*.

A sample calculation is shown below, starting with the refactored HEER calculation mentioned earlier.

$$HEER = \frac{Q_c * .3344}{\sum_{j=1}^{14} e_h(T_j) + \sum_{j=1}^{14} RH(T_j)}$$

The heat pump power consumption can be calculated using the heat pump bin hours 1-5 for a Type 1 heat pump and divided by a factor of 3.5 to incorporate an efficiency 3.5 times greater than electric heat.

$$HEER = \frac{Q_c * .3344}{Q_c * \frac{\sum_{j=1}^{5} n_j * \frac{(63 - T_j)}{(T_j + 15)}}{3.413 * \mathbf{3.5}} + Q_c * \frac{\sum_{j=6}^{14} n_j * \frac{(63 - T_j)}{(T_j + 15)}}{3.413}}$$

$$\therefore HEER = \frac{Q_c * .3344}{Q_c * (.0076 + .0713)} = 4.23$$

In summary, Rheem recommends that EPA use an HEER value of 4.2 as the heating criterion for Type 1 heat pumps.

- More time is needed to evaluate the 7.0 Draft Specification.
  Rheem is grateful to EPA for the advanced notice of the specification that will succeed 6.0. Having a view of long-term thresholds is critical to manufacturing product development and planning. With the short comment period occurring at the end of the calendar year, however, we are in need of additional time to provide meaningful feedback on a specification that will complement the DOE minimum efficiency change in 2026. We do agree with the decision to implement the criteria in a step-wise fashion that aligns with federal standard timing, as it would be premature to go directly to the higher thresholds earlier than 2026.

Given that the ENERGY STAR 6.0 specification carries the significance of being the qualifying requirement for High-Efficiency Electric Home Rebate Program in 2025 for RAC, as established by the Inflation Reduction Act of 2022, we encourage EPA to quickly revise and publish initial criteria for RHP so that they might qualify for the incentives. We appreciate the opportunity to provide these comments and look forward to continued collaboration.

Sincerely,

Allison J. Skidd
Director, Global Regulatory Affairs – Air
Rheem Manufacturing Company

CC: Karen Meyers, Lionel Lopez