

Appliance Standards Awareness Project  
Natural Resources Defense Council  
American Council for an Energy-Efficient Economy

September 4, 2018

Catherine Rivest  
U.S. Department of Energy  
Office of Energy Efficiency and Renewable Energy  
Building Technologies Office, EE-5B  
1000 Independence Avenue SW  
Washington, DC 20585

**RE: Docket Number EERE–2017–BT–TP–0020: Request for Information for Test Procedures for Single Package Vertical Air Conditioners and Single Package Vertical Heat Pumps**

Dear Ms. Rivest:

This letter constitutes the comments of the Appliance Standards Awareness Project (ASAP), Natural Resources Defense Council (NRDC), and American Council for an Energy-Efficient Economy (ACEEE) on the request for information (RFI) for test procedures for single package vertical air conditioners and single package vertical heat pumps (SPVUs). 83 Fed. Reg. 34499 (July 20, 2018). We appreciate the opportunity to provide input to the Department.

As described below, we encourage DOE to revise the metrics for both cooling and heating efficiency to better reflect the energy consumption of SPVUs in the field. These changes would provide better information to consumers in making purchasing decisions and encourage the adoption of features such as variable-speed compressors and innovative defrost strategies, which would ultimately provide savings for consumers. We also appreciate and support DOE's efforts to ensure that the test procedure is clear and applied consistently in order to improve repeatability and reproducibility and to protect manufacturers by ensuring that any verification or enforcement testing is conducted the same way as manufacturers conduct their own testing.

**We encourage DOE to develop a new cooling efficiency metric for SPVUs that better reflects annual energy consumption including part-load operation and fan energy use outside of cooling mode.** The current efficiency metric for SPVUs—EER—reflects only full-load, steady-state performance. Since SPVUs rarely (if at all) operate at full-load in the field, the current full-load efficiency ratings are not providing good information to consumers. The current metric provides no way for manufacturers to demonstrate the potential improved efficiency of SPVUs with variable-speed compressors and also fails to capture the benefits of technologies such as thermostatic and electronic expansion valves (TXVs and EEVs).<sup>1</sup> Further, the current test procedure captures fan operation only when the compressor is running. By failing to capture fan operation for economizing, ventilation, and other functions outside of cooling mode, the test procedure may be significantly underestimating fan energy consumption.

A metric similar to IEER would capture part-load performance and better reflect annual energy consumption. However, IEER was developed using data for school, office, and retail building types. The

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<sup>1</sup> <https://www.regulations.gov/document?D=EERE-2012-BT-STD-0041-0027>. pp. 4-2, 4-3.

locations and usage patterns for SPVUs, which are mostly used in modular buildings, likely differ substantially from the assumptions and data that went into developing IEER. Consequently, we encourage DOE to investigate a part-load performance metric that better reflects SPVU usage. DOE's analysis for the most recent SPVU standards rulemaking could inform the development of load points and weightings for a part-load performance metric. In the analysis for the 2015 SPVU final rule, DOE developed building simulation models for modular classrooms, modular offices, and telecommunication shelters.<sup>2</sup>

A new metric for SPVUs should also capture fan energy use when the compressor is off. We encourage DOE to investigate the operation of the supply fan for economizing, ventilation, and any other functions when the compressor is not running.

**We encourage DOE to incorporate defrost and performance at lower ambient temperatures in the heating efficiency metric.** As DOE notes in the RFI, single package vertical heat pumps (SPVHPs) typically include a defrost cycle. However, because heat pumps are tested at an outdoor dry-bulb temperature of 47 °F—a temperature at which defrost is not required—defrost energy is not captured in the current test procedure.<sup>3</sup> We encourage DOE to incorporate the impact of defrost on heating capacity and total energy use in the test procedure. Incorporating defrost would allow the test procedure to better reflect actual heating capacity and efficiency in the field, which would provide better information to consumers and encourage manufacturers to develop innovative defrost strategies.

We also encourage DOE to incorporate performance at lower ambient temperatures in the metric for heating efficiency. We understand that SPVHPs typically include backup electric resistance heating, which is used when the heat pump cannot meet the heating load. By testing SPVHPs only at 47 °F, the test procedure does not differentiate the ability of equipment to maintain good heating capacity using the heat pump cycle at low ambient temperatures. For example, a unit could be designed to shut off the heat pump cycle and switch to electric resistance heating at an outdoor temperature of 40 °F, for example, which would significantly degrade efficiency. Yet the efficiency impact of this design relative to a unit that maintained good heating capacity using the heat pump cycle at much lower ambient temperatures would not be captured at all in the current test procedure. Incorporating performance at lower ambient temperatures in the heating efficiency metric would encourage equipment designs that provide good efficiency performance at low ambient temperatures, which will ultimately benefit consumers.

**We encourage DOE to investigate a dynamic, load-based test procedure to measure both cooling and heating efficiency of SPVUs.** A load-based test would better capture how SPVUs perform in the field under varying loads, including capturing the impact of cycling losses, the potential benefits of variable-speed operation, and the importance of control strategies. Recent work by the CSA Group in developing such a test for residential central air conditioners and heat pumps could potentially serve as a model for a load-based test for SPVUs.<sup>4</sup>

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<sup>2</sup> <https://www.regulations.gov/document?D=EERE-2012-BT-STD-0041-0027>. pp. 7-1 to 7-5.

<sup>3</sup> 83 Fed. Reg. 34504.

<sup>4</sup> CSA EXP07 Public Review Draft/September 2017.

**We encourage DOE to revise the external static pressure values to better reflect field conditions.**

Almost all SPVUs have rated cooling capacities less than 65,000 Btu/h.<sup>5</sup> For ducted SPVUs with cooling capacities less than 65,000 Btu/h, the minimum external static pressures are between 0.1 and 0.2 inches of water.<sup>6</sup> We believe that these values may be significantly lower than typical external static pressures in the field. If the external static pressure values used for testing are significantly lower than typical values in the field, the test procedure may be significantly underestimating fan power consumption. We encourage DOE to investigate typical external static pressures in SPVU installations and to revise the values in the test procedure to better reflect field conditions.

**We believe that it is important to standardize which resistive elements should be present for testing.**

DOE notes in the RFI that for SPVUs with an outdoor-side fan drive that is non-adjustable, “standard ratings shall be determined at the outdoor-side airflow rate inherent to the equipment when operated with all of the resistance elements associated with inlets, louvers, and any ductwork and attachments considered by the manufacturer as normal installation practice.” However, DOE’s review found that it is not clear which resistive elements would be consistent with “normal installation practice.”<sup>7</sup> We encourage DOE to work to standardize which resistive elements should be present for testing both to ensure that the test is representative of field installations and to improve repeatability and reproducibility.

**We are generally supportive of the Department’s efforts to establish a consistent, comprehensive set of charging instructions and guidelines for multiple categories of air conditioners and heat pumps.**

For SPVUs we note that many manufacturers appear to ship SPVUs with the refrigerant already charged.<sup>8</sup> However, we do not believe that obviates the need for the Department’s approach. Consistent charge instructions, including for verification of correct charge, help ensure a consistent, predictable testing regime and accounts for the possibility of changes to the way these products are offered in the future.

Thank you for considering these comments.

Sincerely,



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Appliance Standards Awareness Project



Joe Vukovich  
Energy Efficiency Advocate  
Natural Resources Defense Council

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<sup>5</sup> As of August 29, 2018, 98% of models in the DOE Compliance Certification Database had rated cooling capacities less than 65,000 Btu/h.

<sup>6</sup> Table 4 of ANSI/AHRI 390-2003.

<sup>7</sup> 83 Fed. Reg. 34501.

<sup>8</sup> See, e.g., [Friedrich VERT-I-PAK Single Package Vertical Heat Pump Product Profile](#).



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