

ENERGY STAR CAC/HP Draft 2 Version 6.0 Comment Matrix

Topic	Stakeholder Comment Summary	EPA Response
ENERGY STAR Canada	One commenter requested the levels be set the same for Canada, recognizing the test method in Appendix M1 has not been adopted by Natural Resources Canada.	EPA is coordinating with NRCAN and intends for the Version 6.0 levels to cover products in Canada.
Connected Criteria	Commenter expressed support for the optional connected criteria, especially as an alternative to full load EER requirements. Products performing in accordance with the requirements specified in AHRI 1380 can address peak load so the EER requirement should be optional.	EPA appreciates this suggestion, but at this time many utilities still value the EER metric, and it is not guaranteed that a Connected unit will enroll in a demand response program and provide those grid benefits to the utility.
Connected Criteria - Load Curtailment	One commenter recommended additional specificity and stated that they have received feedback from HVAC manufacturers requesting specific guidance on the amount of load curtailment that should be matched to the DR signal. AHRI 1380 states "limit input power to maximum of 40% of the benchmark power". This could be adapted to CACHPs by matching different modes to a target thermostat setpoint (2 or 4 degrees depending on the severity of the signal)	The intention of the connected criteria specification is to standardize the demand response commands and corresponding unit power reduction. EPA believes that how the unit reduces power is best left to the HVAC manufacturers, and thus is mirroring AHRI 1380 criteria directly, rather than coming up with some different strategy such as thermostat offset.
Connected Criteria - Load up	Recommend adding "Load-up" mode into the specification, and changing language to be neutral between load reduction or load addition. Recommend changing "Temp. Rise" to "Temp. Offset" in this vein	EPA has kept the language in alignment with AHRI 1380, and believes that HVAC equipment covered in this spec will primarily be used to shed load rather than shift load, as the energy storage resource heat pumps and air conditioners provide depends on the home they are used in.
Connected Criteria - Utility Peak Load	Additional consideration to be given to the Utility Peak Load Price Signal - it is unclear if the logic needed to determine when to shed load is within or outside of the HVAC equipment. Additional conversation on this topic would be appreciated.	At this point, EPA is not seeking a particular response by the HVAC equipment to a peak load pricing signal. One of the advantages of pricing control is that each installation can trade off energy, cost, and service priorities according to their local preferences and resources.

<p>Ducted/Ductless Heat Pumps</p>	<p>Two commenters encouraged EPA to consider differentiating HSPF requirements for cold climate (and possibly all climates) for ducted and ductless units. These commenters believe there is justification for differentiating HSPF levels required for products that use and do not use ducting. As non-ducted systems can be operated at higher fan speeds during the ratings tests the conditions are not equal. One commenter additionally believes there may be cost-effective savings by encouraging compact-ducted systems over multi-zone individual ductless units as the outdoor unit for the multi-split system may end up oversized.</p>	<p>At this time, EPA does not have enough information to confirm the claim that ductless units have an advantage in the HSPF ratings test. In the future if there is evidence that this is the case, then EPA would consider having separate levels. EPA will continue to work with stakeholders to develop and disseminate best practices for sizing ducted, mini-split, and multi-split systems to consumers and contractors.</p>
<p>Payback Analysis</p>	<p>Two commenters noted that payback periods are significantly longer than the estimated average length of home ownership (6-7 years), so most homeowners will never realize the full benefit of purchasing these units. Additional features such as the cold climate additional criteria, CVP, and installation criteria are not included in cost which would increase the payback period. One commenter recommended analyzing ductless and ducted products separately.</p>	<p>Payback periods have been adjusted per the revised levels. EPA based the cost of these units on the 2016 Final Rule Technical Support Document for Residential Central Air Conditioners and Heat Pumps, and the cost of higher efficiency units has likely decreased since that time and will decrease further by 2023. The energy savings predicted also does not account for savings from the cold climate features or the installation features.</p>
<p>Test Burden</p>	<p>One commenter stated that the testing burden imposed by ENERGY STAR needs to be relaxed. It is a deterrent to entry into the program and we believe it has proven unnecessary. The commenter further stated that the AHRI program has sufficient rigor and that the verification process doesn't match the certification process. Enforcement stops at too few tests and HVAC testing has variability that should be considered.</p>	<p>EPA appreciates this comment and will continue to strive to balance test burden with consumer confidence in the ENERGY STAR program. In recognition that the industry is facing significant regulatory changes, EPA has delayed the effective date and removed the CVP requirement for early certification of cold climate heat pumps to reduce testing burden leading up to 2023. EPA is not proposing changes to the certification or verification processes for CAC/HPs.</p>
<p>Test Method</p>	<p>It is the CA IOUs understanding that the translated values from SEER, EER, and HSPF to SEER2, EER2, and HSPF2 may vary from system to system. Encourage EPA and DOE to conduct necessary testing to confirm the average magnitude of CACHP system's shift and update the levels as necessary.</p>	<p>EPA Sees the value the V6 specification will offer in encouraging the release of products that deliver connected functionality and perform well in cold climates now. Further, EPA and DOE feel confident that the crosswalk is a reasonable assessment of the difference in performance between SEER/EER and HSPF and SEER2/EER2 and HSPF2. However, EPA welcomes further input on the accuracy of the crosswalk.</p>

ENERGY STAR Draft Cold Climate Heat Pump Controls Verification Procedure

Comment Matrix

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General	<p>Three commenters expressed support for the CVP in its current state. One commenter further stated that this will help appropriately size electric resistance supplemental heat or avoid it all together.</p> <p>Three commenters stated concerns with the draft CVP and that it needs to be vetted prior to implementation, and that the CVP would be a significant burden. One commenter proposed a one-year period to test and vet the proposed CVP, but that divergence from the federal test procedure is not supported. One commenter does support addressing a CVP through the DOE's federal test procedure rulemaking process, but that EPA should eliminate the proposal to perform a CVP as it will stress resources in preparation for 2023. A third commenter stated that while a substantial amount of work has been done to evaluate the system control in HVAC equipment, there is not enough certainty, repeatability, and reproducibility to use this method and the CVP needs to be vetted and validated by a third party. Commenter does not believe the CVP offers enough value for the level of effort it would require to finalize.</p>	<p>EPA appreciates all of these comments. EPA did not receive feedback on specific aspects of the draft CVP method that would result in issues with test repeatability or uncertainty. Additionally, the CVP will not be required until 2023, which can allow partners to vet the CVP method and convey test results and additional concerns if they arise.</p>
Test Tolerances	<p>One commenter noted that the time to obtain the 5-degree test conditioning within the tolerances described in Table 2 would be a lengthy process.</p> <p>Two other commenters noted that the tolerances CVP differ from the DOE Appendix M1 test method. One commenter also states that the proposed tolerances give too wide a range to validate performance and ensure qualification.</p>	<p>Condition tolerances for indoor air room temperature are wider in the CCHP CVP method than for the Appendix M1 H4₂ Test. This was done to reduce the time (and burden) associated with achieving test room conditions for the 5°F test point and to accommodate momentary fluctuations due to dynamic response. Less stringent condition tolerances are not expected to affect repeatability or reproducibility for two reasons. First, no change in system state (e.g. compressor speed response) is expected to occur throughout the entire tolerance range. And second, the CVP is only used to verify performance with pass/fail criteria and is not used as a ratings test.</p>

<p>Validation within a tolerance of performance</p>	<p>Commenter stated that validating within a tolerance of advertised performance would give consumers greater confidence that the performance in the field would align with the performance expected based on the Appendix M1 rating. The commenter further encouraged EPA, DOE, and industry stakeholders to work together to improve the representativeness of the DOE M1 procedure.</p>	<p>EPA and DOE agree that validating within a tolerance would be ideal. However, as the experience of developing a dynamic load based test (EXP-07) shows, achieving it would be considerably more complex. EPA and DOE have proposed the CVP as an interim step to confirm the representativeness of M1 testing by establishing pass/fail performance criteria at the 5°F heating condition with the unit operating under its own Native Controls. We look forward to further developments in this area.</p>
<p>Relevance to EXP-07</p>	<p>One commenter noted that many groups are focusing on the CSA EXP-07 test and that they do not support EPA moving forward with a different cold climate procedure.</p> <p>Two other commenters expressed support and that the CVP contributes to the evolution of heat pump testing protocols and can act as a bridge between fixed-speed testing and a long-term endpoint of a dynamic load-based test</p>	<p>EPA is open to adding low ambient performance criteria in terms of CSA EXP-07 in the future and hopes that experience with the CVP will advance all of our knowledge of low ambient testing and Cold Climate Heat Pump controls behavior. EPA and DOE believe the CVP to be a valuable method for taking into account system control behavior in the immediate future until a more detailed dynamic testing method is finalized.</p>
<p>Thermostat use and placement</p>	<p>One commenter stated that the CVP needs to address issues with the use and placement of thermostats, and that consistency is an issue for ductless units.</p>	<p>During the CVP, the unit under test will be set to the maximum temperature setpoint, which is often 10+ degrees warmer than the indoor room temperature of 70°F. EPA understands that Cold Climate Heat Pumps (and CAC/HP's more generally) respond to this temperature delta instead of the absolute indoor temperature, and that the temperature delta is expected to be much larger than any temperature differences due to thermostat placement or sensor variability. EPA expects in all cases that minor variability in temperature measurement would still result in the same control response from the tested unit (i.e., outside of control deadband). For these reasons, EPA finds that no significant amount of uncertainty is introduced by the relative use and placement of thermostats during the CVP.</p>
<p>Compatibility with Third-party thermostats</p>	<p>Commenter notes that at this time many variable-speed heat pump systems are not compatible with third-party thermostats, or they do not perform as well as intended when they are connected. This commenter suggests requiring that all CAC/HP units must be compatible with third party thermostats to earn the ENERGY STAR. The commenter further suggests that this would allow for a standard thermostat to be specified in the CVP for all units.</p>	<p>EPA appreciates this comment but does not intend to require that CAC/HP units must be compatible with all third-party thermostats. At this time, there are not market offerings or technical standards that allow 3rd party thermostats to achieve the same efficiency with variable speed units that proprietary thermostats do, for some variable speed equipment.</p>

<p>Overlap with Connected Thermostat specification</p>	<p>Notes that there is significant overlap with a potential connected thermostat specification that recognizes a controller with a variable speed HVAC unit, and recommend harmonized scope exclusions or a requirement to certify to both specifications.</p>	<p>EPA recognizes that there is overlap with the connected thermostat specification but does not intend to label thermostats under the CAC/HP specification at this time. EPA is revising the Connected Thermostats specification and is continuing to work to recognize variable speed communicating controllers and invites stakeholders to participate in that process as well.</p>
<p>Claimed performance at 5°F</p>	<p>Two commenters stated concerns about the CVP as a verification of a steady state test. One commenter does not support the CVP as DOE requires that claimed performance at 5F must be based on the Appendix M1 test procedure. As the compressor RPM will likely be different under the unit's native controls, the capacity and COP will likely be different than those achieved in the M1 test. This commenter believes that additional work is needed to prove the value of the CVP and improve and validate the procedure before it is included in the ENERGY STAR program.</p> <p>A second commenter expressed that the draft VRF CVP identifies system behavior using normal field controls, for the purpose of validating conditions utilized in fixed speed steady-state tests. The proposed EPA CVP does not utilize fixed speed operation at 5°F at all (Table 1, Line 38), so there is no verification of controls and no fixed speed operation, as the CVP name suggests. The H42 test is optional in DOE Appendix M1. Therefore, a manufacturer may have not run this test and a direct comparison of fixed speed to “native controls” is not possible.</p>	<p>DOE test procedure Appendix M1 requires that the H42 test is conducted at the maximum compressor speed that the system controls would operate the compressor in normal operation in 5°F ambient temperature. For this reason, EPA does not expect significant differences between a system operating under Native Controls vs a properly specified speed for the system test under appendix M1.</p> <p>EPA has is requiring that the H42 test is conducted for heat pumps certifying to the cold climate designation, so that is the fixed speed test that is verified by the CVP.</p>
<p>Alternate Temperature CVPs</p>	<p>This stakeholder recommended that this CVP be extended to incorporate similar testing for full-load cooling at 95 degrees, part-load heating at 17 degrees, and low-load heating at 47 degrees.</p>	<p>At this time, there is insufficient test data that shows that native controls significantly differ from the rated performance at these listed temperatures to include in the specification. In addition, the development of these tests is out of scope of the current revision effort.</p>

<p>Low Load CVP Testing</p>	<p>Two commenters suggest that verifying minimum capacity under low load conditions is at least as important to support overall cold-climate efficiency. While the performance at 5F is important for appropriate sizing and prevent excessive use of backup heat, seasonal heating performance in most of the U.S. is not heavily driven by the COP at 5F. This commenter notes that field testing and anecdotal evidence supports that many units may cycle under low load conditions rather than stabilize at their rated minimum capacity. Commenter proposed a low-load CVP to evaluate the performance of the unit under native controls to confirm that the unit performance matches the rated minimum capacity. The test would consist of setting the indoor and outdoor chambers to simulate a low load condition, and allow the unit to operate under native controls. The indoor conditioning equipment would then be set to measure the equipment capacity in real time, subtract the intended load, and either increase or decrease the indoor room temperature to simulate the building thermal properties. The setup would be allowed to stabilize, and then the unit capacity would be measured to determine if the compressor has reached a steady state operating condition.</p>	<p>EPA appreciates this comment, but does not believe that the low load condition testing is accomplishable in a reasonable time period. EPA supports efforts for dynamic load testing which can address this issue.</p>
<p>ER Heating Control</p>	<p>Commenter encourages EPA and DOE to consider approaches to differentiate products based on their ER control strategy.</p>	<p>EPA intends to pursue allowing communicating thermostats for variable capacity systems to certify under the connected thermostat specification. This will include addressing this issue. .</p>
<p>Airflow-control settings</p>	<p>The commenter notes that the DOE M1 test procedure allows for the airflow control setting to be different for the various test conditions as long as the setting is automatically controlled by the unit. If different indoor airflow settings are used at the 47 and 5 degree test conditions, which would impact the capacity ratio.</p>	<p>As long as the differences in airflow during the test reflect what automatic controls would do in field conditions, the ratio of capacities would be realistic and therefore a useful metric.</p>
<p>Difference from the VRF CVP</p>	<p>The draft VRF CVP prescribes operating conditions of three indoor dry bulb ramp rates that span across a starting indoor dry bulb temperature and a target return air dry bulb temperature at which all indoor units eventually become thermally inactive. In comparison, EPA's proposed CVP requires the thermostat to be set at the maximum achievable set point while also requiring incremental adjustment to the thermostat set point for certain variable-speed systems.</p>	<p>Thank you for this comment.</p>

Humidifier	Commenter states that in low-ambient conditions there is little moisture content in the ambient air, so moisture may be intentionally added by a humidifier. By precluding any latent addition to the indoor room for certain variable-speed systems in the CVP. The CVP would not achieve the intended field performance.	The CVP method already incorporates indoor room humidity via a wet-bulb temperature of 60°F with 2°F operating tolerance.
Test Chamber Capability	Commenter states that older psychrometric test chambers may not be capable of achieving the low ambient conditions and would require costly upgrades or require the purchase of additional expensive test chambers. Alternatively, this will stress the newer psychrometric chambers which are reserved for advanced development.	The test chamber upgrades necessary to conduct CVP will be commensurate with systems conducting M1 H42 testing. While large market saturation for these kind of test chambers may be expected, manufacturers pursuing the Cold Climate designation must also conduct the Appendix M1 H42 test, so would have already had to make the upgrades to their chambers.
Tolerance for performance	Commenter states that with the unknown level of test uncertainty, it is unrealistic that there is no tolerance for capacity or COP metrics.	EPA does not allow tolerances for the certification of ENERGY STAR products. However, the CVP will only verify that the minimum cold climate requirements are met, and so does not require that the performance in the CVP is within a tolerance of the certified H42 performance.
COP Measurement	Commenter clarifies that they have fairly high confidence in the manufacturer's performance data for capacity at low ambient conditions, but emphasizes that the efficiency at that capacity must also be confirmed by the CVP. This commenter states that the proposed CVP better reflects the expected COP than using engineering data.	EPA/DOE appreciates this comment.
Onboard Diagnostics	Recommends promoting a stakeholder working group for the development of a universal communication application layer for onboard diagnostics for variable-capacity CAC/HP systems.	EPA appreciates this comment and supports promoting better installation and maintenance through product functionality.