



Draft ENERGY STAR® Cold Climate Heat Pump Controls Verification Procedure (CVP)

1 **Purpose:**

2 The purpose of this procedure is to validate the certified performance of ENERGY STAR cold climate
3 central heat pumps using the unit under test's native controls at the 5°F conditions specified by the
4 ENERGY STAR test method for CAC/HP.

5 **Scope:**

6 ENERGY STAR scope (i.e., central CAC/HP capable of operating at two or more distinct capacities or
7 have a capacity which is continuously variable).

8 This procedure applies to units certified using either Appendix M or Appendix M1. Units certified using
9 Appendix M1 must provide all applicable metrics (SEER2, EER2, HSPF2) and measurements per that
10 test method, and follow the appropriate directions below. Units certified using appendix M must provide all
11 applicable metrics (SEER, EER, HSPF) and measurements per that test method, and follow the
12 appropriate directions below. Certification using a hybrid of testing between Appendix M and Appendix
13 M1 will not be permitted.

14 **Note:** This CVP will be revised after January 1, 2023 to reflect that only Appendix M1 may be used for
15 certification after that date.

16 **Definitions:**

17 Refer to Appendix M and ENERGY STAR definitions. If certifying using Appendix M1, refer to Appendix
18 M1 and ENERGY STAR definitions.

19 *Native controls* means configuring the unit under test in settings specified for field use in manufacturer
20 Installation and Operations manual shipped with the unit and operating the unit under test using these
21 settings without overriding its system controls.

22 **Note:** The idea of native controls is clear for non-ducted units that are delivered with a remote, or that use
23 a wired remote. However, there is ambiguity about what it would mean for units which are typically
24 installed with a separate thermostat or controller. EPA would like feedback about appropriate specification
25 of controls for use in this test for ducted units.

26 **Testing Apparatus and Setup:**

27 Refer to Appendix M for general setup unless otherwise modified by this document. If certifying using
28 Appendix M1, refer to Appendix M1 for setup unless otherwise modified by this document.

29 **Test Procedure:**

- 30 1. The unit under test shall be configured to operate under native controls (i.e., removed from "test
31 mode" used for steady state tests).
- 32 2. Set the indoor unit thermostat(s) to the maximum achievable set point and the airflow-control
33 settings of the unit under test shall be as specified in Table 1. If certifying using appendix M1, the
34 airflow-control settings shall be the same as those used for the Appendix M1 H₄ test.

- 35 3. Control the indoor and outdoor ambient conditions as specified in Table 1. If certifying using
 36 appendix M1, control indoor and outdoor ambient conditions to H₄ conditions as specified in
 37 Appendix M1.

Table 1. Test Conditions of 5°F Test				
Air Entering Indoor Unit Temperature (°F)	Air Entering Outdoor Unit Temperature (°F)	Air Entering Indoor Unit Temperature (°F)	Air Entering Outdoor Unit Temperature (°F)	Heating Air Volume Rate
Dry bulb	Wet bulb	Dry bulb	Wet bulb	
70	60(max)	5	3(max)	Heating Full-Load ¹

38 ¹. Defined in section 3.1.4.4 of Appendix M.

- 39 4. Allow the system to operate until steady-state requirements are achieved. Steady-state shall be
 40 considered to have been met when the test operating and test condition tolerances listed in Table
 41 2 are met for at least 30 minutes. Alternatively, steady state is achieved when dynamic behavior
 42 does not exceed the frequency response capability of the capacity measurement instrumentation
 43 (e.g. psychrometers) and both the capacity and system power input measured in successive 30-
 44 minute intervals are within 2 percent of each other.

Table 2. Test Tolerance for H ₄ x Test		
	Test operating tolerance	Test condition tolerance
Indoor dry-bulb, °F:		
Entering temperature	4.0	2.0
Leaving temperature	4.0	-
Indoor wet-bulb, °F:		
Entering temperature	2.0	-
Outdoor dry-bulb, °F:		
Entering temperature	4.0	2.0
Leaving temperature	-	-
Outdoor wet-bulb, °F:		
Entering temperature	2.0	1.0
Leaving temperature	-	-
External resistance to airflow, inches of water	0.05	0.02(1)
Electrical voltage, % of rdg	2.0	1.5
Nozzle pressure drop, % of rdg	8.0	

45 (1) Applies to non-ducted units only.

- 46 5. Once steady state has been achieved, continuously monitor all instrumentation as required by
 47 Appendices M and M1 (equal intervals that span 5 minutes or less), except for power which shall
 48 be recorded each second unless using an integrating power meter. The official test period shall
 49 be one hour.

- 50 6. *For units having a variable-speed compressor, if the Percentage of Heating Capacity exceeds*
 51 *70% and the COP is less than 1.75*

52 Control the total sensible cooling addition to the indoor room such that the heating load
 53 approaches and eventually equals the certified 5° Heating Capacity. (Note: Heating tests are
 54 sensible only. Therefore, no latent addition to the indoor room shall be made). In tandem,
 55 incrementally adjust the indoor unit thermostat set point as needed such that the air entering the
 56 indoor units approaches the target indoor room dry bulb temperature until the criteria as specified

57 in section Validation Criteria are met or Percentage Heating Capacity drops below 70% with COP
58 that is still lower than 1.75, which would constitute a failure.

59 **Note:** EPA requests feedback on Test Procedure item 6. In some cases, a system's Percentage of
60 Heating Capacity may exceed 70% with a COP below 1.75. Such a system would not meet the proposed
61 validation criteria and be ineligible for the ENERGY STAR Cold Climate Heat Pump designation.
62 However, such a system is likely to save energy in the field compared to systems with near 70%
63 Percentage Heating Capacity and COP above 1.75 because it would be able to meet higher heating
64 demands with heat pump heating vs electric resistance heating. The procedure in item 6 provides a path
65 to eligibility for such systems, by allowing the test to recognize that at a lower Percentage Heating
66 Capacity, the COP is likely to be higher. As long as a 5°F condition can be found in which the system
67 meets both criteria when under native control, it will be considered to qualify. Should the Percentage
68 Heating Capacity fall below 70% and the COP still does not meet a minimum of 1.75, the unit will not
69 qualify.

70 **Data to be recorded:**

71 Continuously record all required parameters and calculate the space heating capacity $Q_{h,x}^{k=2}(5)$ and total
72 electrical power consumption $E_{h,x}^{k=2}(5)$ as specified in Appendix M (section 3.10). For units certifying using
73 Appendix M1, use section 3.10 of Appendix M1. Evaluate the Coefficient of Performance (COP)
74 accordingly.

75 Calculate Percentage Heating Capacity @ 5°F using heating capacity $Q_{h,x}^{k=2}(5)$ measured during the CVP
76 divided by heating capacity @ 47°F $Q_{h,x}^{k=2}(47)$ certified to ENERGY STAR (i.e., determined from Appendix
77 M H1_N test for units having variable-speed compressors where the compressor speed shall be the
78 maximum speed that the system controls would operate at 47°F, otherwise from Appendix M H1₂ test). If
79 certifying using Appendix M1, determine heating capacity from Appendix M1 H1_N or H1₂ test.

80 **Validation Criteria:**

81 COP and Percentage Heating Capacity @ 5°F obtained as described in this procedure must be equal or
82 greater than the criteria below to earn the ENERGY STAR Cold Climate Heat Pump designation:

83 (Table 4A in Certification Criteria section of the ENERGY STAR specifications)

COP @ 5°F	Percentage of Heating Capacity @ 5°F
1.75	70%

84

85 **Note:** These validation criteria are being applied as a screen for purposes of ENERGY STAR certification
86 in order to ensure a broad range of products with superior cold climate field performance are able to earn
87 the label. There is no requirement that manufacturer-certified or advertised values for COP or Heating
88 Capacity be equivalent to or within a tolerance of the values measured per the CVP, In order to reduce
89 burden, EPA has opted not incorporate elements of consistency or accuracy sufficient to validate CCHP
90 performance within a tolerance of certified/advertised values. Such a CVP would likely include additional
91 elements of a load-based test (which have not been proved to be repeatable or reproducible at this time).
92 EPA welcomes feedback on the relative merits of such a method and/or proposal for the method itself.