

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

Purpose:

The purpose of this procedure is to validate the certified performance of ENERGY STAR central heat pumps using the unit under test's Native Controls at the 5°F heating conditions specified by the ENERGY STAR test method for CAC/HP.

Scope:

ENERGY STAR scope (i.e., central CAC/HP meeting the criteria for ENERGY STAR Cold Climate Heat Pump)

Definitions:

Refer to Appendix M1 and ENERGY STAR definitions.

Native Controls means configuring the unit under test with settings specified for field use and removing the unit from "test mode" used for steady-state tests. Native Control settings shall be determined from manufacturer Installation and Operations manual shipped with the unit. In the event that control settings required to operate the unit are not present in the manufacturer I&O manual, the hierarchy shall be product label instructions, then manufacturer default settings. The unit under test shall be operated using these settings without overriding its system controls. For units shipped with a control device (i.e. thermostat or remote-controller), the control device is considered an integral component of Native Control and should be used for testing. For units that are intended to be used with a communicating control but the control device is not shipped with the unit, the manufacturer must specify the communicating control device that is most commonly installed with the unit to be used during testing. For dual or fixed-capacity systems, the laboratory may define a standard control used for those types of products.

Testing Apparatus and Setup:

Refer to Appendix M1 for setup unless otherwise modified by this document.

Test Procedure:

1. *Setup.* Configure the unit under test to operate under Native Controls (i.e., removed from "test mode" used for steady state tests). Set the indoor unit thermostat(s) to the maximum achievable set point and the airflow-control settings of the unit under test shall be the same as those used for the Appendix M1 H₄ test.
2. *Pretest Interval for Steady-state Determination.* Allow the system to operate until either steady-state requirements are achieved or until four (4) hours have elapsed. Steady-state shall be considered to have been met when the test operating and test condition tolerances listed in Table 1 are met for at least 30 minutes. If the system is unable to attain steady-state operation within the four-hour pretest interval, then dynamic equilibrium criteria shall apply during the official test period.

	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	

(1) Applies to non-ducted units only.

3. *Defrost Period.* At conclusion of pre-test interval, conduct a defrost cycle following the provisions of Appendix M1 section 3.10. This defrost cycle may be manually or automatically initiated. Terminate the defrost sequence using the heat pump's defrost controls.
4. *Official Test Period.* Consistent with ASHRAE 37 requirements, the official test period shall not begin until 10 minutes after the conclusion of the defrost period, and test tolerances shall not apply during that time. Once the official test period begins, continuously monitor all instrumentation as required by Appendix M1 (equal intervals that span 5 minutes or less), except for power which shall be recorded each second unless using an integrating power meter. The official test period shall be one hour. For systems that attain the steady-state determination during the pretest interval, test condition and operating tolerances from Table 1 shall apply during the official test period. For systems that were unable to meet the steady-state determination, dynamic equilibrium criteria shall apply during the official test period. Dynamic equilibrium is attained when both the capacity and system power input measured in successive 30-minute intervals are within 2 percent of each other.
5. *Optional adjustments for units having a variable-speed compressor.* If the Percentage of Heating Capacity exceeds 70% and the COP is less than 1.75, the following adjustments are allowed. Control the total sensible cooling addition to the indoor room such that the heating load approaches and eventually equals the certified 5° Heating Capacity. (Note: Heating tests are sensible only. Therefore, no latent addition to the indoor room shall be made). In tandem, incrementally reduce the indoor unit thermostat set point as needed such that the air entering the indoor units approaches the target indoor room dry bulb temperature until the criteria as specified in the Validation Criteria section are met or Percentage Heating Capacity drops below 70% with COP that is still lower than 1.75, which would constitute a failure.

Data to be Recorded During Official Test Period:

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

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

Validation Criteria:

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

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

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