



ENERGY STAR® Program Requirements Product Specification for Pool Pumps

Test Method to Validate Demand Response Rev. May-2021

1 OVERVIEW

The following test method shall be used for determining product compliance with requirements for Demand Response (DR) functionality in the ENERGY STAR Residential Pool Pumps Connected Functionality Criteria.

2 APPLICABILITY

This test method is applicable to Residential Pool Pumps designed to meet optional connected criteria in the ENERGY STAR Residential Pool Pumps Eligibility Criteria Version 3.1.

3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions in the ENERGY STAR Residential Pool Pumps Eligibility Criteria Version 3.1

- A) Nominal Motor Speed: The rated speed(s) in rotations per minute (RPM) for Single- and Multi-speed pumps, and the speed displayed on the pump controls for Variable-speed and Variable-flow pumps.
- B) Response Time: The amount of time required for the Connected Pool Pump System to respond to a Demand Response signal, as measured during this test.
- C) Utility Equivalent Communication Device: Device capable of communicating with the connected pump and emulating all three signal types described in the Connected Functionality Criteria. It will be controlled by the technician during the conduct of this test procedure, allowing the technician to deliver the required signals.
- D) Acronyms:
 - 1) CPPS: Connected Pool Pump System
 - 2) DR: Demand Response
 - 3) GPM: Gallons Per Minute
 - 4) RPM: Rotations Per Minute
 - 5) UECD: Utility Equivalent Communication Device
 - 6) UUT: Unit Under Test

4 TEST SETUP

Unless otherwise specified, all test setup and condition requirements shall be identical to Sections 4 and 6.1 of the ENERGY STAR Test Method for Pool Pumps (Rev. Jan-2013).

4.1 Connected Pool Pump System (CPPS) Setup

The CPPS and Utility Equivalent Communication Device (UECD) shall be set up in accordance with manufacturer installation instructions.

- A) Connect the CPPS to the Utility Equivalent Communication Device via the applicable communication medium over which the open standards communication method employed by CPPS is available.
 - 1) For CPPS that normally utilize a cloud-based system for communicating with the UECD, the CPPS may bypass the cloud system and be connected directly to the UECD for the purposes of this testing.
- B) Ensure that the CPPS is properly connected and can both receive and send data to the Utility Equivalent Communication Device.

5 DEMAND RESPONSE VERIFICATION TESTS

The following testing shall be performed in the order of the sections, as written.

5.1 CPPS Initialization

- A) Turn on the pump, set it to its maximum speed or flow, and allow it to run for one hour.
- B) After one hour, measure and record nominal motor speed (in RPM) and the rate of flow (in gallons per minute (GPM)).

5.2 Response Time

- A) The CPPS' response time shall be measured during each test and shall be no more than 5 minutes for any test.
- B) Response time measurements shall begin upon receipt of the DR signal by the CPPS.
 - 1) For units that do not provide signal receipt verification, measurements shall begin when the signal is sent from the UECD.

5.3 General Curtailment (Light Shed) Signal Test

- A) For CPPS with Single-speed Pumps:
 - 1) Initiate a 30-minute General Curtailment signal.
 - 2) Verify that the CPPS responds to the signal by limiting total pumping time during the 30-minute signal period to no more than 10 minutes.
 - a) The rate of flow measured during non-pumping portion(s) of the signal period shall be less than 2.0 GPM.
- B) For CPPS with Multi-speed Pumps:
 - 1) Initiate a 30-minute General Curtailment signal.
 - 2) Verify that the CPPS responds to the signal by either:
 - a) reducing its speed to the lowest available speed, as specified by the manufacturer, and remaining at this speed for the duration of the 30-minute signal period, or
 - b) switching to and remaining in off/Standby Mode for the duration of the 30-minute signal period.
 - 3) After completion of the signal period, place the CPPS in off/Standby Mode.

- 4) Program the CPPS to schedule a 1-hour pumping operation at maximum speed/flow set to begin 10 minutes after completion of the previous signal period.
 - 5) Initiate a 30-minute General Curtailment signal.
 - 6) Verify that the CPPS remains in the off/Standby Mode for the duration of the 30-minute signal period.
 - a) The rate of flow measured at any point during the signal period after the pump ceases pumping shall be less than 2.0 GPM.
- C) For CPPS with Variable-speed/flow Pumps:
- 1) Initiate a 30-minute General Curtailment signal.
 - 2) Verify the CPPS responds to the signal by reducing its speed or flow, for Variable-speed or Variable-flow pumps respectively, to a speed or flow equal to or less than 1/3 that measured in Section 5.1.B), for the duration of the 30-minute signal period.
 - 3) After completion of the signal period, reduce the CPPS speed or flow, for Variable-speed or Variable-flow pumps respectively, to less than 1/3 that measured in Section 5.1.B).
 - 4) Program the CPPS controls to schedule a 1-hour pumping operation at maximum speed/flow set to begin 10 minutes after completion of the previous signal period.
 - a) For CPPS with controls that require a specific pumped volume, use the rate of flow measured in Section 5.1.B) to calculate the necessary pumped volume for a 1-hour pumping operation at maximum flow.
 - 5) Initiate a 30-minute General Curtailment signal.
 - 6) Verify that the CPPS does not increase speed or flow, for Variable-speed or Variable-flow pumps respectively, for the duration of the 30-minute signal period.

5.4 Grid Emergency (Full Shed) Signal Test

- A) Clear the CPPS controls of all scheduled pumping operations, set the CPPS to maximum speed/flow, and allow it to run for at least 10 minutes after completion of the previous signal period.
- B) Initiate a 20-minute Grid Emergency signal.
- C) Verify that the CPPS ceases all pumping after receipt of the Grid Emergency signal and does not pump for the duration of the 20-minute signal period.
 - 1) The rate of flow measured at any point during the 20-minute signal period shall be less than 2.0 GPM.
- D) Repeat steps A-C of Section 5.4 two more times, to verify compliance with the Grid Emergency signal requirements.

5.5 Load Up Signal Test

- A) All CPPS – perform test 1) or 2), as applicable:
 - 1) For CPPS with controls capable of scheduling pumping operation based on total desired volume pumped:
 - a) Program the CPPS such that it would:
 - i. Start scheduled daily pumping activities after initiation of the Load Up signal in Step 5.5.A)1)b), and
 - ii. Deliver a specific daily pumped volume.
Note: configuring the CPPS to minimize programed pumping will speed testing

- b) Initiate a Load Up signal with a duration that requires a pumping duration that significantly exceeds that required to deliver the specific daily pumped volume.
 - c) Verify that the CPPS turns on and begins pumping.
 - i. Measure and record the rate of flow (in GPM) and time elapsed (in minutes) for the duration of pumping operation.
 - d) Verify that the CPPS ceases all pumping operations after the programmed daily pumping volume, $\pm 5\%$, is reached.
 - i. Actual pumped volume shall be calculated as the average rate of flow measured during pumping operation multiplied by the time elapsed.
- 2) All other CPPS
- a) Program the CPPS such that it would:
 - i. Start the scheduled pumping operation one hour after completion of the Grid Emergency signal test, and
 - ii. Deliver a 30-minute pumping operation.
 - b) Set the CPPS to the off/Standby Mode and allow the CPPS to cool down for 10 minutes.
 - c) Initiate a 1-hour Load Up signal.
 - d) Verify that the CPPS turns on, begins pumping but ceases all pumping operations after 30 minutes, ± 1 minute.
- B) For CPPS with Multi-speed, Variable-speed, and Variable-flow Pumps:
- 1) Program the CPPS to initiate pumping at a speed that is less than the maximum speed/flow and for a duration that exceeds 1-hour.
 - 2) After the start of pumping, allow the CPPS to run for at least 10 minutes.
 - 3) Measure and record the nominal motor speed (in RPM) and the rate of flow (in GPM).
 - 4) Initiate a 30-minute Load Up signal.
 - 5) Verify that the CPPS increases its nominal motor speed and rate of flow for the duration of the 30-minute signal period.

6 REFERENCES

- A) ENERGY STAR Test Method for Pool Pumps (Rev. Jan-2013).