



ENERGY STAR® Program Requirements Product Specification for Pool Pumps

Eligibility Criteria

1 Following is the **DRAFT 1 Version 1.0** product specification for ENERGY STAR qualified Pool Pumps. A
2 product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

3 **Note:** The intention of the U.S. Environmental Protection Agency (EPA) in launching this specification
4 development effort was to write requirements for Pool Pumps used in residential applications. This
5 continues to be EPA's intention for this Version 1.0; however, the title of the specification has been set to
6 cover the broader pool pump product category to more easily expand the scope beyond residential
7 applications in the future, as appropriate. EPA will use Section 2 below, to clearly identify the current
8 scope of ENERGY STAR coverage.

9 1 DEFINITIONS

10 Provided below are definitions of the relevant terms in this document.

11 1.1 General

12 A) **Pool Pump:** A mechanical assembly consisting of a "wet-end," which houses the impeller, and a
13 motor. There usually is a leaf strainer before the impeller. The pump increases the "head" and
14 "flow" of the water.

15 1.2 Pump Types

- 16 A) **Residential Inground Pool Pump:** A primary filter pump intended for installation with a
17 permanently installed Residential Inground Swimming Pool with dimensions as defined in
18 ANSI/NSPI-5 Standard for Residential Inground Swimming Pools.
19
20 B) **Residential Aboveground Pool Pump:** A primary filter pump intended for installation with a
21 permanently installed Residential Aboveground/Onground Swimming Pool as defined in
22 ANSI/APSP- 4 2007.
23
24 C) **Residential Portable Spa Pump:** A pump intended for installation with a non-permanently
25 installed residential spa as defined in ANSI/NSPI-6 Standard for Portable Spas. Sometimes
26 referred to as hot tub, but not a jetted bathtub.
27
28 D) **Residential Auxiliary Pool Pump:** A pump intended for purposes other than a primary pool filter
29 pump, i.e. pool cleaner booster, water feature pumps, etc.

30 1.3 Product Sub-Types

- 31 A) **Single-speed Pump:** A pump which has an electric motor that operates at only one speed.
32
33 B) **Multi-speed Pump:** A pump which has an electric motor that can operate at multiple, discrete
34 speeds.
35
36 C) **Variable-speed Pump:** A pump which has an electric motor that can operate at continuously
37 variable speeds.

Summary of Comments on ENERGY STAR Pool Pump Spec V1 Draft1 12-08-30

This page contains no comments

38 **1.4 Product Ratings**

- 39 A) **Rated Horsepower (hp):** The motor power output designed by the manufacturer for rated
40 revolutions per minute (RPM), voltage and frequency. May be less than Total Horsepower where
41 the Service Factor is > 1.0, or equal to Total Horsepower where the Service Factor = 1.0. Also
42 known as Nameplate Horsepower.
43
- 44 B) **Service Factor:** A multiplier applied to Rated Horsepower of a motor to indicate the percent above
45 Nameplate Horsepower at which a pump motor may operate continuously without exceeding its
46 allowable insulation class temperature limit, provided the other design parameters such as rated
47 voltage, frequency and ambient temperature are within limits. A 1.5 hp pump with a 1.65 service
48 factor produces 2.475 hp (Total Horsepower) at the maximum Service Factor point.
49
- 50 C) **Total Horsepower:** The product of the Rated Horsepower and the Service Factor of a motor used
51 on a Pool Pump (also known as Service Factor horsepower, SFHP) based on the maximum
52 continuous duty motor power output rating allowable for nameplate ambient rating and motor
53 insulation class. Total Horsepower = Rated Horsepower x Service Factor.

54 **1.5 Technical Definitions**

- 55 A) **Pump Performance Curve:** A curve comparing the Total Head in feet of water to the Rate of Flow
56 in gallons per minute (GPM) for a given pump at a given Motor Speed.
57
- 58 B) **System Curves:** Equation that compares the actual head gained by the fluid from the pump to the
59 system parameters, which include elevation head and friction losses. The curves are used to
60 help size a pump based on the pool size, pipe system, and pool features present in a given pool
61 system. They are plotted on the same graph as pump performance curves, which compare rate
62 of flow to total head.
63
- 64 C) **Rate of Flow (Q):** The total volume throughput per unit of time. For this test method, Rate of Flow
65 is expressed as GPM.
66
- 67 D) **Motor Speed (n):** The number of revolutions of the motor shaft in a given unit of time. For this
68 test method, Motor Speed is expressed as RPM.
69
- 70 E) **Head (H):** Energy content of the liquid at any given point in the system. It is expressed in units of
71 energy per unit weight of liquid. For residential pool pumps, the measuring unit for head is feet of
72 water.
73
- 74 F) **Total Suction Head (H_s):** The head in the inlet section of the pump, calculated as follows:
75

$$H_s = z_s + \frac{(p_s + 1000)}{\rho g} + \frac{U_s^2}{2g}$$

76 Where:

- 77 • z_s is the height from the water level of the suction pressure measuring device,
- 78 • p_s is the suction pressure measured by the pressure measuring device,
- 79 • U_s is the mean velocity at the suction pressure measuring device,
- 80 • ρ is the density of the water, and
- 81 • g is the gravitational acceleration constant.

- 82 G) **Total Discharge Head (H_D):** The head in the outlet section of the pump, calculated as follows:
83

$$H_D = z_D + \frac{(p_D + 1000)}{\rho g} + \frac{U_D^2}{2g}$$

84 Where:

- 85 • z_D is the height from the water level of the discharge pressure measuring device,
- 86
- 87
- 88

- 89
- p_D is the discharge pressure measured by the pressure measuring device,
 - U_D is the mean velocity at the discharge pressure measuring device,
 - ρ is the density of the water, and
 - g is the gravitational acceleration constant.

92
93
94 H) **Standby Mode:** duced power state, in multi-speed and variable speed pumps, in which the
95 unit is connected to an ac main, but the motor remains idle, and no water is being pumped
96 through the system.

97 **Note:** EPA and DOE are interested in stakeholder feedback regarding the proposed definition for Standby
98 Mode and whether any product types other than Variable-speed Pumps are capable of Standby Mode.
99 EPA and DOE assume that any power draw in this mode will be due to the speed controller required for
100 Variable-speed Pumps and are also interested in feedback regarding this assumption.

101 1.6 Metric Definitions

102 A) **Energy Factor (EF):** The volume of water pumped in gallons per watt hour of electrical energy
103 consumed by the pump motor (gal/Wh).

104 **Note:** EPA is requesting feedback from stakeholders on the definitions provided in Section 1, above.
105 Where available, definitions were sourced from the ANSI/ICC/APSP-15 industry standard and modified to
106 provide further clarification, as needed. EPA would like stakeholder input as to whether the current
107 definitions for residential pumps would generally exclude commercial pumps, or whether the specification
108 should develop more technical distinctions such as pipe connection requirements, etc.

109 1.7 Acronyms

- 110 A) **ac:** Alternating Current
- 111 B) **ANSI:** American National Standards Institute
- 112 C) **APSP:** Association of Pool and Spa Professionals
- 113 D) **AS:** Australian Standards
- 114 E) **EF:** Energy Factor
- 115 F) **°F:** Fahrenheit
- 116 G) **gal:** gallons
- 117 H) **GPM:** Gallons per minute
- 118 I) **H:** Head
- 119 J) **HI:** Hydraulics Institute
- 120 K) **hp:** Horsepower
- 121 L) **Hz:** hertz
- 122 M) **n:** Motor Speed
- 123 N) **NSPI:** National Spa and Pool Institute 
- 124 O) **Q:** Rate of Flow
- 125 P) **RPM:** Revolutions per minute
- 126 Q) **UUT:** Unit under test
- 127 R) **V:** volts
- 128 S) **W:** watts
- 129 T) **Wh:** watt-hours

Author: Steve.Gutai Subject: Note Date: 9/27/2012 7:25:35 AM -05'00'
Standby mode needs a clearer definition.

Author: mike.giddens Subject: Note Date: 9/25/2012 6:00:36 PM -05'00'
NSPI no longer exists.

130 **2 SCOPE**

131 **2.1 Included Products**

132 A) Products that meet the definition of a Residential Inground Pool Pump, that are Single-speed,
133 Multi-Speed, or Variable-speed pump, as specified herein are eligible for ENERGY STAR
134 qualification, with the exception of products listed in Section 2.B. Only those pool pumps with a
135 Total Horsepower rating of >0.5 HP and ≤ 4 HP can qualify as ENERGY STAR under this
136 specification.

137 **2.2 Excluded Products**

138 A) Residential Aboveground Pool Pumps, Residential Auxiliary Pool Pumps, and Spa Pumps as
139 defined in Section 1 are not eligible for ENERGY STAR under this specification. Residential
140 Inground Pool Pumps with a total Horse Power of ≤0.5 HP and > 4 HP, are not eligible. Multi-
141 speed Pumps with manual speed controls that are not able to connect to an external speed
142 controller, are also not eligible.

143 **Note:**

144 **Pump Size**

145 Stakeholder feedback indicates that there is significant crossover between residential and commercial
146 applications. For example, residential pool pumps are commonly used in light commercial applications,
147 such as small apartment and hotel pools. EPA agrees with stakeholder comments requesting that motor
148 size be used to distinguish between residential and commercial pumps. EPA's current data set is largely
149 based on the available data from the California Energy Commission (CEC) database, which lists products
150 up to 4 HP. EPA would like stakeholder input on limiting the scope of this specification to pumps with a
151 total HP of 4 or less.

152 EPA also set a pump size limit on the low side to address small single speed pumps (0.5 Total HP) that
153 otherwise meet the qualification levels set in this Draft 1 specification. EPA is concerned that by labeling
154 these small single speed pumps, EPA may drive consumers towards small pumps that may be
155 undersized for most applications. EPA understands that the smallest pumps used for primary filtration
156 are typically ¼ Total HP, and that using pumps as small as 0.5 Total HP for primary filtration is unusual.

157 **Above ground Pumps**

158 EPA received comments from multiple stakeholders requesting that the scope of this Version 1.0
159 specification include residential Aboveground Pool Pumps. The CEC database does not include enough
160 data to reflect the total market of Aboveground Pool Pumps and to enable the assessment of possible
161 performance levels. Manufacturers and other interested stakeholders are encouraged to provide
162 performance data, preferably using the ENERGY STAR Draft 2 Test Method, for currently available
163 residential aboveground pool pumps to help build a robust data set from which EPA can better
164 understand the performance of these pump types. Only with this additional input can EPA determine
165 whether expanding the scope to include these product types makes programmatic sense.

166 **Pump Controls**

167 EPA also received comments suggesting that pumps without onboard controls be excluded under the
168 Version 1.0 specification. EPA does not believe that this is appropriate because this would eliminate a
169 majority of the residential pumps on the market that would otherwise meet the ENERGY STAR Energy
170 Factor levels. EPA is instead proposing to require within the Eligibility Criteria – Section 4: Additional
171 Labeling Requirements (see the note box in Section 4 for more details).
172
173

174

Author: Steve.Gutai Subject: Note Date: 9/27/2012 7:31:52 AM -05'00'

The pump/motor combination THP range should be the criteria. We disagree that the two categories (residential & light commercial) should be differentiated and separated for this specification document. The reality is that this range of THP pump product will be used for residential and commercial pools.

Author: mike.giddens Subject: Note Date: 9/27/2012 10:43:48 AM -05'00'

Author: Steve.Gutai Subject: Note Date: 9/26/2012 5:27:16 PM -05'00'

This scope should be changed to >.5THP and <4THP

175 **3 QUALIFICATION CRITERIA**

176 **3.1 Energy Efficiency Requirements**

177 A) The Energy Factor of the pump must meet the criteria provided in Table 1, below.
178
179

Pump Sub Type	Speed Setting	Energy Efficiency Level
Single Speed Pump	Single Speed	EF ≥ 3.8
Multi- and Variable Speed Pump	Low Speed	EF ≥ 3.8

180 **Note: Explanation of Table 1 Criteria**

181 The levels proposed in Table 1, above, are representative of the top performing energy efficient pool
182 pumps using the industry accepted Energy Factor metric. Data plots showing the CEC data and the
183 proposed Draft 1 level lines can be found on the ENERGY STAR Pool Pumps specification development
184 webpage, which can be accessed through www.energystar.gov/newspeccs.

185 Similar to other ENERGY STAR specifications, EPA is taking a technology neutral approach in allowing
186 all pump sub-types the opportunity to qualify, while rewarding inherently more efficient designs. The
187 performance levels are based on the Pool Pump Performance Curve A, low speed Energy Factor. EPA
188 received mixed recommendations on which curve to use, however, stakeholders generally agree that
189 Curve A represents the typical U.S. pool. EPA decided to retain this metric because of the robust data
190 set available and the belief that it is sufficient for testing all pump sizes.

191 EPA did not set a performance level at the high speed based on the understanding that pool pumps
192 operate for the majority of their time at the low speed. Furthermore, the greatest product differentiation
193 based on Energy Factor, and thus the greatest opportunity for energy savings, is at the low speed. EPA
194 did consider setting a high speed EF level as a way to ensure that future products did not compromise
195 efficiency, however our understanding is that low speed and high speed EFs trend in the same direction.
196 EPA is interested in feedback on whether a high speed EF should be added to the efficiency
197 requirements.

198 **Qualification Rate**

199 Due to the limited data on single speed pumps in the CEC database (CA Title 20 excludes pool pumps
200 with split-phase or capacitor start – induction run type motors, and single speed pumps of a capacity of 1
201 HP or more), EPA estimated the total number of single speed pumps on the market by counting the
202 models listed in online catalogues from the top three manufacturers - Pentair, Hayward, and Jandy
203 (Energy Factors were not listed) and combining them with the CEC dataset. EPA's analysis assumes that
204 manufacturers are listing their most efficient single speed pumps in the CEC database and therefore non-
205 listed pumps will have lower EF's and will not meet the proposed levels. EPA estimates that 21% of all
206 market available pumps are able to meet the Energy Factor levels proposed in Table 1 representing a
207 broad selection of highly efficient, cost effective products from a range of manufacturers.

208

Author: Steve.Gutai Subject: Note Date: 9/26/2012 5:31:43 PM -05'00'
RPM should be defined as "highest RPM" pump motor is capable of.

Author: Steve.Gutai Subject: Note Date: 9/26/2012 5:29:39 PM -05'00'
RPM should be defined as lowest speed , below 1725 RPM, per manufacturers recommendation

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209 **Alternative Evaluation Methods**

210 EPA recognizes that APSP-10 may provide an alternate method for evaluating and comparing pump
211 energy performance by standardizing a method of binning pool pumps into low, medium, and high head
212 groups, which allows for application based comparisons in terms of Energy Factor. However, the
213 standard is not yet complete for consideration at this time. EPA will continue to monitor the development
214 of this evaluation method and, once a robust data set is prepared, we will determine if any changes to the
215 approach and metric are warranted.

216 **Other Pool Pump Performance Considerations**

217 For qualification purposes, EPA intends to only use the Energy Factor for Curve A, but stakeholders
218 noted that there might be informational value in listing the Energy Factors for performance Curves B and
219 C (as well as A) on the ENERGY STAR Qualified Product List (QPL), for appropriate pump sizing
220 purposes for other pool designs. EPA is interested in working with stakeholders to identify opportunities
221 to better inform consumers about best practices in sizing pumps.

222 In addition, EPA recognizes that energy performance can be diminished due to many external factors
223 when performing in the field and is interested in working with stakeholders to identify opportunities to
224 inform and educate consumers about best practices to optimize actual energy savings.

225 B) Pool pump motor controls for use with a Multi-speed, or Variable-speed Pumps shall have the
226 capability of operating the Pool Pump at least at two speeds. The control's default filtration speed
227 setting shall be no more than one-half of the motor's maximum rotation rate. Any high-speed
228 override capability shall be for a temporary period not to exceed one 24-hour cycle without
229 resetting to default settings.

230 **Note:** EPA has proposed aligning with the ANSI/ICC/APSP -15 standard requirements in regards to
231 default filtration speed settings and high-speed override limitations. EPA believes that these
232 requirements ensure that low speed operation is properly prioritized and that any manual high speed
233 override does not undermine the potential for energy savings when operating in the field. EPA welcomes
234 comments on these requirements.

235 **3.2 Significant Digits and Rounding:**

- 236 A) All calculations shall be carried out with directly measured (unrounded) values.
- 237
- 238 B) Unless otherwise specified, compliance with specification limits shall be evaluated using directly
239 measured or calculated values without any benefit from rounding.
- 240
- 241 C) Directly measured or calculated values that are submitted for reporting on the ENERGY STAR
242 website shall be rounded to the 2 decimal places.

243 **4 ADDITIONAL REQUIREMENTS**

244 **4.1 Informational statement**

245 A) Partner shall mark a qualifying multi- or variable-speed pool pump without onboard controllers
246 permanently and legibly on an accessible and conspicuous place on the unit, in characters no
247 less than 1/4", with the nameplate HP of the pump with the statement, "This pump must be
248 installed with a multi-, or variable-speed pump motor controller." This statement provides
249 information that the pool pump product must be matched with a controller to ensure the energy
250 savings potential is realized due to the speed reduction capabilities of the pool pump.

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251 **Note:** EPA is proposing requiring an informational statement be placed on the pump, which is currently
252 required by ANSI/ICC/APSP-15 and CA Title 20 for multi-speed and variable-speed pumps without
253 onboard controllers. This statement is necessary to properly inform the installer that a pump with
254 adjustable speeds must be installed with a controller to achieve the energy savings that it is certified to
255 deliver.

256 **4.2 Additional reporting requirements**

257 A) The Energy Factors for performance using Curve B and Curve C shall be reported for all
258 products.

259 **5 TEST REQUIREMENTS**

260 **5.1 Number of Units Required for Testing**

- 261 A) Representative Models shall be selected for testing per the following requirements:
 - 262 1) For qualification of an individual product model, a product configuration equivalent to that
263 which is intended to be marketed and labeled as ENERGY STAR is considered the
264 Representative Model;
 - 265 2) Qualification based on product family is not acceptable under this specification. Each
266 individual model shall be tested and meet the requirements of this specification to be qualified
267 as ENERGY STAR.
- 268 B) A single unit of each Representative Model shall be selected for testing.

269 **Note:** EPA would like input on the appropriateness of a product family approach to testing and qualifying
270 Pool Pumps. A product family approach would require that a representative model be selected and
271 tested to represent the performance of a larger class of similar products. This helps reduce the burden
272 on the manufacturer when a large number of model iterations are available to consumers but product
273 performance does not vary.

274 **5.2 Test Methods**

275 A) When testing Pool Pumps, the following test methods shall be used to determine ENERGY STAR
276 qualification.
277

Table 2: Test Method for ENERGY STAR Qualification	
ENERGY STAR Requirement	Test Method Reference
Energy Factor (gal/Wh)	ENERGY STAR® Test Method for Determining Pool Pump Energy Use

278 **Note:** EPA encourages manufacturers to submit any test data available on single speed pumps
279 preferably using new ENERGY STAR Draft 2 Test Method. This will help EPA evaluate Single-speed
280 Pump performance against Multi- and Variable-speed Pumps.

281

282 **6 EFFECTIVE DATE**

283 The ENERGY STAR Pool Pump specification shall take effect on **February 1, 2013**. To qualify for
284 ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on the
285 model's date of manufacture. The date of manufacture is specific to each unit and is the date on
286 which a unit is considered to be completely assembled.

287 **Note:** EPA intends to finalize the Version 1.0 specification by February 1, 2013, at which point products
288 may begin to qualify immediately.

289 Please note that to earn ENERGY STAR qualification manufacturers must have their products third-party
290 certified by an EPA-recognized Certification Body (CB) to the Version 1.0 requirements. For more
291 information, visit www.energystar.gov/3rdpartycert.

292 **7 FUTURE SPECIFICATION REVISIONS**

293 EPA reserves the right to change the specification should technological and/or market changes affect
294 its usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to
295 the specification are arrived at through industry discussions. In the event of a specification revision,
296 please note that the ENERGY STAR qualification is not automatically granted for the life of a product
297 model.

298 **8 REFERENCES**

- 299 1) ANSI/NSPI – 5 2003. Residential Inground Swimming Pools
300 2) ANSI/APSP – 4 2007. Standard for Aboveground/Onground Residential Swimming Pools
301 3) ANSI/NSPI – 6 1999. Residential Portable Spas

This page contains no comments



ENERGY STAR® Program Requirements
Product Specification for
Residential Pool Pumps

Draft 2 Test Method
Rev. Aug-2012

1 **1 OVERVIEW**

2 The following test method shall be used for determining product compliance with requirements in the
3 ENERGY STAR Eligibility Criteria for Pool Pumps.

4 **2 APPLICABILITY**

5 ENERGY STAR test requirements are dependent upon the feature set of the product under evaluation.
6 The following guidelines shall be used to determine the applicability of each section of this document:

- 7 • Section 6 shall be conducted on all eligible pool pump products.

8 **3 DEFINITIONS**

9 Unless otherwise specified, all terms used in this document are consistent with the definitions in the
10 ENERGY STAR Eligibility Criteria for Residential Pool Pumps.

11 **4 TEST SETUP**

12 **4.1 Input power**

13 A) All products shall be connected to an ac mains as specified in Table 1 below depending on the
14 voltage required by the pump. For any pump that can use a combination of the listed voltage
15 sources, test the pump using the higher rated voltage source.

16 **Table 1: Input Power Requirements for All Products**

Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion	Frequency	Frequency Tolerance
115 V ac	+/- 1.0 %	2.0 %	60 Hz	+/- 1.0 %
230 V ac	+/- 1.0 %	2.0 %	50 Hz	+/- 1.0 %
100 V ac	+/- 1.0 %	2.0 %	50 Hz/60 Hz	+/- 1.0 %

17 **4.2 General**

- 18 A) Ambient Temperature: Ambient temperature shall be from 65° F to 82° F.
19 B) Relative Humidity: Relative humidity shall be from 10% to 80%.

Summary of Comments on ENERGY STAR Test Method for Pool Pumps

Page: 1

Author: mike.giddens Subject: Note Date: 9/25/2012 3:56:31 PM -05'00'
This table needs to be expanded to include 230 V ac Voltage, 60HZ frequency for Input Power Requirements.

This page contains no comments

- 20 C) Power Meter: Power meters shall possess the following attributes:
- 21 1) Crest Factor: Possesses an available current crest factor of 3 or more at its rated range
- 22 value.
- 23 2) Minimum Frequency Response: 3.0 kHz
- 24 3) Minimum Resolution:
- 25 i) 0.01 W for measurement values less than 10 W;
- 26 ii) 0.1 W for measurement values from 10 W to 100 W; and
- 27 iii) 1.0 W for measurement values greater than 100 W.
- 28 D) Measurement Accuracy:
- 29 1) Power measurements with a value greater than or equal to 0.5 W shall be made with an
- 30 uncertainty of less than or equal to 2% at the 95% confidence level.
- 31 2) Power measurements with a value less than 0.5 W shall be made with an uncertainty of less
- 32 than or equal to 0.01 W at the 95% confidence level.
- 33 3) Flow rate measurements shall be made with an uncertainty of less than or equal to 1.5% at
- 34 the 95% confidence level.
- 35 4) Pressure measurements shall be made with an uncertainty of less than or equal to 1.0% at
- 36 the 95% confidence level

37 **5 TEST CONDUCT**

38 **5.1 Measurement Requirements**

- 39 A) Reported Values: Values reported for each test performed in Section 6 shall follow the guidelines
- 40 presented in *Australian Standards (AS) 5102.1-2009, Performance of household electrical*
- 41 *appliances – Swimming pool pump-units, Part 1: Energy consumption and performance; Section*
- 42 *4.3.2: Number of readings and Section 4.3.3: Duration of readings.*
- 43 B) Steady Conditions: For conditions to be considered stable, conditions must meet the criteria set
- 44 forth in *AS 5102.1-2009, Performance of household electrical appliances – Swimming pool pump-*
- 45 *units, Part 1: Energy consumption and performance; Section 4.5 Stability of Operation.*

46 **Note:** The Measurement Requirements language above is identical to that published in the Draft 1 Test
 47 Method. However, DOE and EPA did not receive comments on this proposal and encourage
 48 stakeholders to provide feedback in their Draft 2 comments.

49 The standard used for pool pump testing by the California Energy Commission (CEC) does not include
 50 any requirements for the duration of a reading and the number of readings to be taken for each reported
 51 value. It also does not require steady state conditions to begin taking readings. The inclusion of Section
 52 5.1 does not alter testing but ensures that values are more accurate and the test is more repeatable.

53 **5.2 Test Requirements**

- 54 A) Speeds for Testing:
- 55 1) Single speed pumps shall be tested at the only available speed.
- 56 2) Multi-speed pumps shall be tested at all possible motor speeds.
- 57 3) Variable-speed pumps shall be tested at the minimum, maximum, and most efficient speeds
- 58 available. Manufacturers shall report all speeds tested.

59 **Note:** DOE has altered the speeds required for testing variable-speed pumps to align with the Association
 60 of Pool & Spa Professionals (APSP)-15 Standard for Energy Efficiency for Residential Inground
 61 Swimming Pools and Spas. DOE believes testing at these speeds will provide the most accurate
 62 representation of a pump's full range of efficiencies. DOE is interested in stakeholder feedback regarding
 63 this change. DOE is also interested in feedback regarding the differences (if any are present) between the
 64 speeds proposed here and those proposed for the CEESM Efficient Residential Pool Pump Specification.

- 65 B) For each speed tested, the following values shall be reported for the normal operating point
 66 corresponding to each of the three system curves (A, B, and C) listed below.
- 67 1) Motor nominal speed (RPM)
 - 68 2) Rate of flow (GPM)
 - 69 3) Power (watts and volt amps)
 - 70 4) Energy Factor (gal/Wh)
- 71 C) A graph of the pump performance curve for each speed tested shall also be reported.
- 72 D) The three system curves to be used are: 

73 **Equations 1, 2, & 3: Calculation of Pool Curves A, B, & C**

74 Curve A: $H = 0.0167 \times Q^2$

75 Curve B: $H = 0.050 \times Q^2$

76 Curve C: $H = 0.0082 \times Q^2$

77 *Where:*

- 78 • *H is the total system head in feet of water.*
 79 • *Q is the flow rate in GPM.*

80 **6 TEST PROCEDURES**

81 **6.1 UUT Pre-Test Initialization**

- 82 A) Prior to the start of testing, the UUT shall be initialized as follows:
- 83 1) Set up the UUT per *American National Standards Institute/Hydraulics Institute (ANSI/HI) 1.6,*
 84 *Centrifugal Pump Tests; Section 1.6.5.5 Performance test setup;* with the additional guidance
 85 in Section 5.
 - 86 2) Connect the UUT to its power source.
 - 87 3) Turn the UUT ON and allow it to run for one hour before the first test is performed.
- 88 a) After this initial warm-up period is completed, pumps need only be run for 30 minutes
 89 before subsequent tests.

90 **6.2 Pump Flow Testing**

- 91 A) Perform the following steps for each pump speed tested.
- 92 1) Measure and record the pump flow rate at maximum flow, Q_{MAX}  gallons per minute (GPM).
 - 93 2) Increase the flow from dead head (zero flow) to Q_{MAX} in increments of Q , where Q is defined
 94 in Table 2 and depends on Q_{MAX} .

Author: Steve.Gutai Subject: Note Date: 9/27/2012 7:38:43 AM -05'00'
 This section needs clarity. Row 217 of the Draft 1, Version 1 Product Spec doc it states that only curve A is used for qualification to the Energy Star program.

Author: Steve.Gutai Subject: Note Date: 9/27/2012 7:44:45 AM -05'00'
 Maximum flow rate needs a clear definition.
 The Maximum flow rate should be defined as the point where the pump and system curve intersect.

Table 2: Flow Rates for Measurement



112 **7 REFERENCES**

- 113 1) ANSI/HI 1.6:2000. Centrifugal Pump Tests
- 114 2) AS 5102.1:2009. Performance of household electrical appliances – Swimming pool pump-units –
- 115 Energy consumption and performance
- 116 3) APSP-15. Standard for Energy Efficiency for Residential Inground Swimming Pools, and Spas.

Author: mike.giddens Subject: Note Date: 9/25/2012 4:01:53 PM -05'00'
Standby mode testing limits need to be defined.

Author: mike.giddens Subject: Note Date: 9/25/2012 5:56:21 PM -05'00'
ANSI/HI 1.6 has been replaced/superseded by ANSI/HI 14.6



**ENERGY STAR® Pool Pumps Connected Functionality
Discussion Document
August 2012**

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On November 29, 2011, the U.S. Environmental Protection Agency (EPA) released a Residential Pool Pumps Framework Document noting interest in promoting and encouraging smart grid connected functionality in pool pumps, as EPA believes it is a feature that will be of great interest to utilities and consumers. It is important to EPA that ENERGY STAR products be future-oriented and flexible. At a basic level, smart grid functionality involves the capability to receive, interpret and act upon certain demand response signals. EPA is interested in highlighting products with connected functionality on the ENERGY STAR Qualified Product List (QPL), so that consumers, rebate program administrators and other interested stakeholders are better able to identify and advance those products into the marketplace. Given the value proposition ENERGY STAR represents for consumers, EPA believes the connected functionality in an ENERGY STAR qualified product should enable utility direct load controls as well as more consumer oriented functionality. This discussion document details our initial thoughts on potential additional requirements that pool pumps would need to meet to be recognized as "Connected" on the ENERGY STAR QPL.

Along with the release of the Draft 1 Version 1.0 specification for Pool Pumps, EPA and the U.S. Department of Energy (DOE) have developed this ENERGY STAR Pool Pumps Connected Functionality Discussion Document to engage stakeholders in further discussions regarding the development of potential connected functionality criteria and a testing procedure. When a final set of connected functionality criteria are developed, EPA intends to incorporate connected functionality criteria into the ENERGY STAR Pool Pumps specification. The timeline for finalizing the connected functionality criteria is independent of the specification development timeline and will continue even as the pool pump specification is completed, though the initial goal is to create criteria release with the Version 1.0 specification, which is scheduled for completion in January 2013.

EPA will host a conference call on **September 28, 2012** to discuss the ideas and strategies presented in this document with stakeholders. Written comments are also welcome and should be submitted to poolpumps@energystar.gov no later than **September 25, 2012**.

Framework Document Feedback

On November 29, 2011, EPA released a Residential Pool Pumps Framework Document prompting stakeholders to provide information to EPA on connected functionality and the potential feature set including demand response, load control, consumption reporting, and remote management.

The following are the main issues on which EPA received comments from stakeholders:

Programmatic Framework

EPA received feedback that it would be challenging for the ENERGY STAR program to properly address smart grid and connected functionality. Primary concerns raised included that the technologies are not yet present and proven in the market place as typically required by ENERGY STAR, smart grid does not necessarily provide direct energy saving benefits to the consumer, and there is no mechanism in the industry to test and verify the claimed benefits.

EPA believes that by engaging stakeholders early in the development process, the ENERGY STAR program can play a key role in facilitating and accelerating market adoption of connected products. EPA and DOE are currently in the process of developing connected functionality criteria and testing procedures for Residential Climate Controls, Refrigerators/Freezers, and Room Air Conditioners. Connected functionality feature sets are crafted on a per product basis to include a balance of both near-term direct consumer benefits, and longer term, broader, societal, and grid benefits. For connected pool pumps, near-term direct consumer benefits include communications to enable home energy management

Summary of Comments on ENERGY STAR® Connected Functionality Discussion Document

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Author: Steve Gutai Subject: Note Date: 9/27/2012 8:12:23 AM -05'00'
Per the [Energy Star Pool Pumps Connected Functionality Discussion Document August 2012](#), confirm the timeline for "connected functionality criteria" is an independent timeline and not required currently to become compliant for the ENERGY STAR Pool Pumps Specification.

59 functionality, remote management, and scheduled operation to increase convenience and to tailor
60 operation to periods of low cost.

61
62 EPA proposes that qualified pool pump products meeting the connected functionality criteria would be
63 recognized as 'Connected' on the ENERGY STAR QPL, so that they can be easily identified by
64 consumers and interested utilities. EPA plans to initially qualify products based on literature reviews until
65 a connected functionality test procedure is available. EPA also seeks to promote open access and
66 interoperability in products with connected functionality through the use of standards-based
67 communications and the release of Application Programming Interfaces (APIs). EPA looks forward to
68 working with stakeholders to develop connected functionality criteria for pool pumps, as well as education
69 materials on the associated benefits.

70 **Standards and Definitions**

71
72 EPA received comments from stakeholders that connected functionality is not well defined in the market
73 place and is lacking standardization.
74 EPA recognizes that the lack of standardization is a barrier to entry for many manufacturers and believes
75 the ENERGY STAR program can play a role in helping to encourage adoption of open standards through
76 ENERGY STAR recognition. Specifically, EPA is considering a requirement that products with connected
77 functionality include a standardized modular communication interface (MCI) that uses only standards-
78 based open communications for the MCI. Products that meet these criteria are likely to enable low-cost
79 consumer upgradeability for Home Energy Management (HEM) and/or Smart Grid interconnection. EPA
80 may consider more robust criteria in the future as relevant standardization efforts mature.

81 **Level of Requirement**

82 Stakeholders commented that connected functionality should not be a requirement for ENERGY STAR
83 qualification.

84
85 As currently proposed, the Version 1.0 Pool Pump specification allows pool pumps without connected
86 functionality to qualify for ENERGY STAR. EPA is developing optional criteria for ENERGY STAR
87 qualified pool pumps that wish to also be recognized as 'Connected' on the ENERGY STAR website.
88 EPA is interested in feedback on the Agency's plan to recognize connected functionality on the qualified
89 product list and the proposed scope of the connected functionality requirements. EPA's initial approach
90 for incorporating connected functionality into the specification and proposed requirements are provided
91 below.

92 **Proposed Connected Functionality Requirements**

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94
95 1. **Scope** - Connected functionality criteria will apply to pool pumps capable of multi-speed, or
96 variable-speed operation, and scheduled operation, through the use of controls that are either
97 integrated into and/or sold with the pool pump. Connected functionality will not be a requirement
98 for pool pumps to qualify as ENERGY STAR. However, qualified products that meet all sections
99 of the optional connected functionality criteria will be recognized in the ENERGY STAR Qualified
100 Products List as 'Connected' pool pumps.

101
102 **Note:** Stakeholder feedback indicated that pool controls come in various form factors including integrated
103 controls, integrated but detachable, and external but sold with the pump. EPA's intention is to ensure that
104 this specification acknowledges and includes all ways that controls are packaged and sold with the pump.
105 Comments or feedback on the scope of the connected functionality criteria are welcome.

106 **2. Criteria**

- 107
108
109 a. Pool Pump Scheduling Capability – the pool pump shall be delivered with consumer
110 configurable scheduling functionality with the following **minimum** capabilities:
111 i. Ability to set a weekday and weekend schedule.
112 ii. Two schedule periods per day.
113 iii. Two speeds available per schedule period
114 iv. On/off capability per schedule period
115

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Author: Steve.Gutai Subject: Note Date: 9/27/2012 8:10:11 AM -05'00'
NRTL should verify claims.

Author: Steve.Gutai Subject: Note Date: 9/27/2012 8:09:17 AM -05'00'
Product should not be released until a "final" connected functionality test procedure is agreed by all stakeholders.

Author: Steve.Gutai Subject: Note Date: 9/27/2012 8:13:22 AM -05'00'
Section 2 (Criteria) of the Energy Star Pool Pumps Connected Functionality Discussion Document August 2012 needs thorough consideration for practical implementation. While we agree there is an opportunity with connected functionality, our feeling is the current language indicates prescriptive functionality, versus performance based requirements.

Author: mike.giddens Subject: Note Date: 9/25/2012 6:37:11 PM -05'00'
Lines 107 - 114 reads as though this is a product specification, rather than a product performance based requirement.

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Note: EPA has proposed these minimum scheduling capabilities as a baseline that will enable the pool pump to automatically perform the bulk of its energy consumptive pumping during non-peak hours or when energy availability and pricing are favorable. It also allows users that need to pump during peak hours to automatically set the pump to run at low speeds during those periods. EPA encourages feedback on this scheduling capability section.

- b. Peak Period Avoidance – the pool pump controller shall be delivered with a default schedule that limits high speed (above half speed) run-times to outside of the traditional peak load periods of 6 – 10 a.m. and 3 – 7 p.m. The consumer shall be able to modify the default schedule, without limitation.

Note: EPA would like feedback on the impact of setting the as-shipped schedule such that the high speed cleaning occurs outside of two peak load periods – a winter morning peak load period and a summer evening peak load period. Limiting high-speed cleaning to outside of the morning winter peak load period may provide both grid and consumer benefits in southern regions that have both a large installed base of pools running year round, and a significant penetration of electrical resistance heating that drives winter peaks on cool mornings.

Similarly, limiting high-speed cleaning to outside of the evening Summer peak period may provide both grid and consumer benefits in many regions that have late afternoon to early evening peaks driven by residential air conditioning use. EPA is also interested in understanding whether default settings should limit pump operation entirely during these two peak load periods. Stakeholders are encouraged to provide comment on whether this would be a viable option, potential impacts on pool cleaning performance, and any other opportunities for energy savings to the consumer. Stakeholders are also encouraged to comment on how to implement default settings that provide peak load shedding.

In addition, EPA believes that consumer control is important to ensuring a quality consumer experience, hence the requirement that consumers have the ability to modify the default schedule. EPA welcomes comments or feedback on this specific proposal and any other details regarding consumer interactivity and control over connected functionality features.

- c. Energy Management – the product shall be capable of recording the following data and settings changes and transmitting them upon request to connected devices external to the pool pump controller. Settings changes shall be recorded when they occur, or at least once every 24-hours, in the absence of change:
 - 1. Unique ID
 - 2. All programmable settings, including program schedules
 - 3. Current operational status (e.g. off, on-low, on-high, RPMs)
 - 4. Per day run time and gallons pumped (for prior 7 days)
 - 5. Scheduled Demand Response (DR) and/or load management events
 - 6. Data representative of the product's 15-minute interval energy consumption, during pumping operation only

Note: EPA developed this initial list of data reporting attributes as a starting point based on what is currently offered in the market place and what could benefit the consumer. Stakeholder feedback is encouraged to help develop and refine this list, as well as to discuss any challenges or opportunities there may be when reporting data to a home energy management system. The intent of consumption reporting and energy management functionality is to enable simple, actionable energy use feedback to consumers intended to drive reduced energy consumption and cost savings.

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215 **Note:** EPA believes that a standards-based modular communication interface (MCI) will enable open
216 access, interoperability, and low-cost interconnection using standardized modules to support a wide
217 variety of communication protocols. The MCI approach presents an opportunity for different stakeholder
218 groups to leverage connected product capabilities, including utilities and service providers.
219

220 In regards to requiring standards-based communications, EPA has identified and has been tracking
221 standardization activities related to Smart Grid and Home Area Network (HAN) communications.
222 Although Smart Grid standardization activities continue under aggressive timelines, EPA believes
223 standardization has reached a level of maturity to justify requiring it in connected Pool Pumps.
224

225 In regards to standardization associated with modular communications, EPA is tracking the Consumer
226 Electronic Association's CEA-2045 draft standard and believes there are significant benefits associated
227 with its use in Connected Pool Pumps, including availability of a modular form-factor that enables
228 consumer-installable communications flexibility, including, wired, powerline communications, and wireless
229 communications. CEA is also developing a certification program for both products that include CEA-2045
230 modularity and for the universal modules that enable communications in these products. The certification
231 program will ensure that certified products demonstrate a required base level of Demand Response
232 functionality. EPA is interested in stakeholder feedback on the suitability of CEA-2045 as well as any
233 other standards-based approaches to modular communications. In addition, EPA is interested in
234 stakeholder feedback on the impacts and benefits of added criteria requiring the MCI communication
235 module be included with the pool pump product at the time of sale (or shortly after) or leaving the port
236 open at the time of sale. Comments and feedback on these communication criteria are welcome.
237

- 238 f. Open Access – To enable interconnection with the product for purposes of Energy
239 Management and Load Control, the following shall be made available to interested
240 parties:
 - 241 i. Documentation regarding the accuracy of energy consumption reporting; and
 - 242 ii. An interface specification, API or similar documentation, that enables access to
243 the Energy Management and Load Control capabilities described in this section.
244
- 245 g. Information to Consumers – If additional modules, devices, and/or infrastructure are part
246 of the configuration required to activate the product's communications capabilities
247 specified in Section 2c, prominent labels or other forms of consumer notifications with
248 instructions shall be displayed at the point of purchase and in the product literature.
249 These shall provide specific information on what consumers must do to activate these
250 capabilities (e.g. *"This product requires installation of a network module to enable
251 interconnection with the Smart Grid, Energy Management System, and/or with other
252 external devices, systems or applications."*)
253

254 **Product Criteria Verification**

255 Compliance with connected functionality will be made through examination of the product and/or product
256 documentation. Additionally, the demand response functionality will need to be verified using an
257 ENERGY STAR test method that will be developed by DOE. DOE welcomes feedback on any designs,
258 applications, or elements that should be considered in the development of the Demand Response test
259 method process to verify demand response functionality. As with other ENERGY STAR connected
260 products, DOE seeks prototype connected products for participation in its test procedure development
261 process. DOE will be reaching out to manufacturers to begin discussions regarding demand response
262 and test method development.

263 **Comment Submission**

264 Interested stakeholders are encouraged to send written comments to EPA by **September 25, 2012** and
265 attend the stakeholder meeting scheduled for **September 28, 2012** to discuss the connected functionality
266 opportunity in greater detail. All EPA correspondence and specification development documents will be
267 posted to the ENERGY STAR Product Development Web page at www.energystar.gov/newspecs. In
268 addition, all written comments received by EPA will be posted here unless requested otherwise by the
269 submitter.

270 Stakeholders with questions regarding the specification can contact Christopher Kent, EPA, at (202) 343-
271 9046 and kent.christopher@epa.gov or Erica Porras, ICF International, at (202) 862-2972 or
272 Erica.porras@icfi.com. For test method questions, please contact Ashley Armstrong, DOE at
273 Ashley.Armstrong@ee.doe.gov.

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