



ENERGY STAR® Program Requirements Product Specification for Pool Pumps

Eligibility Criteria Draft 2 Version 1.0

1 Following is the **DRAFT 2 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 **1 DEFINITIONS**

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

5 **Note:** Definitions, including newly introduced definitions, were sourced from the ANSI/ICC/APSP-15
6 industry standard and modified to provide further clarification, as needed. Stakeholders are invited to
7 provide feedback on the definitions provided in Section 1, below.

8 **1.1 General**

9 A) Pool Pump: A mechanical assembly consisting of a “wet-end,” which houses the impeller, and a
10 motor. The pump increases the “head” and “flow” of the water.

11
12 B) Pump Controls: A switch or variable frequency drive, either external to, or onboard the pump that
13 controls the motor speed.

14
15 **Note:** Based on stakeholder feedback, EPA removed the leaf strainer language from the Draft 2 Pool
16 Pump definition in Section 1.1 General Definitions. EPA is interested in further additional feedback on
17 further implications associated with the removal of the leaf strainer that should be taken into
18 consideration.

19
20 EPA also added a definition for Pump Controls in the Draft 2 specification for the purpose of providing
21 consistent terminology, which was lacking in the Draft 1.

22 **1.2 Pump Types**

23 A) Residential Inground Pool Pump: A primary filter pump intended for installation with a
24 permanently installed Residential Inground Swimming Pool with dimensions as defined in
25 ANSI/NSPI-5 Standard for Residential Inground Swimming Pools.

26
27 B) Residential Aboveground Pool Pump: A primary filter pump intended for installation with a
28 permanently installed Residential Aboveground/Onground Swimming Pool as defined in
29 ANSI/APSP- 4 2007.

30
31 C) Residential Portable Spa Pump: A pump intended for installation with a non-permanently
32 installed residential spa as defined in ANSI/NSPI-6 Standard for Portable Spas. Sometimes
33 referred to as hot tub, but not a jetted bathtub.

34
35 D) Residential Auxiliary Pool Pump: A pump intended for purposes other than a primary pool filter
36 pump, i.e. pool cleaner booster, water feature pumps, etc.

37 **1.3 Product Sub-Types**

38 A) Single-speed Pump: A pump which has an electric motor that operates at only one speed.

- 39 B) Multi-speed Pump: A pump which has an electric motor that can operate at multiple, discrete
40 speeds.
41
42 C) Variable-speed Pump: A pump which has an electric motor that can operate at continuously
43 variable speeds.
44
45 D) Variable-flow Pump: a pump which has an electric motor that can operate at continuously variable
46 speeds, with added controls that automatically adjusts speed to control flow.
47

48 **Notes:** Several stakeholders requested the addition of Variable-flow pumps to the Definition and Scope
49 sections of the specification; Product research shows that Variable-flow pumps are mechanically and
50 functionally equivalent to Variable-speed pumps, but with additional software controls that allow users to
51 set and automatically maintain flow; EPA understands that variable flow operation consumes the same or
52 less energy than variable speed operation, thus similar long term savings are found with Variable-flow
53 pumps as with Variable-speed pumps; Variable-flow pumps were added to Section 1.3 Product Sub-
54 types Definitions and Section 2.1 Included Products; Variable-flow pumps were also incorporated into
55 other locations in the specification where appropriate.
56

57 1.4 Product Ratings

- 58 A) Rated Horsepower (HP): The motor power output designed by the manufacturer for rated
59 revolutions per minute (RPM), voltage and frequency. May be less than Total Horsepower where
60 the Service Factor is > 1.0, or equal to Total Horsepower where the Service Factor = 1.0. Also
61 known as Nameplate Horsepower.
62
63 B) Service Factor: A multiplier applied to Rated Horsepower of a motor to indicate the percent above
64 Nameplate Horsepower at which a pump motor may operate continuously without exceeding its
65 allowable insulation class temperature limit, provided the other design parameters such as rated
66 voltage, frequency and ambient temperature are within limits. A 1.5 HP pump with a 1.65 service
67 factor produces 2.475 HP (Total Horsepower) at the maximum Service Factor point.
68
69 C) Total Horsepower: The product of the Rated Horsepower and the Service Factor of a motor used
70 on a Pool Pump (also known as Service Factor horsepower, SFHP) based on the maximum
71 continuous duty motor power output rating allowable for nameplate ambient rating and motor
72 insulation class. Total Horsepower = Rated Horsepower x Service Factor.

73 1.5 Testing and Qualification

- 74 A) Pump Performance Curve: A curve comparing the Total Head in feet of water to the Rate of Flow
75 in gallons per minute (GPM) for a given pump at a given Motor Speed.
76
77 B) System Curves: Equation that compares the actual head gained by the fluid from the pump to the
78 system parameters, which include elevation head and friction losses. The curves are used to
79 help size a pump based on the pool size, pipe system, and pool features present in a given pool
80 system. They are plotted on the same graph as Pump Performance Curves, which compare Rate
81 of Flow to Total Head.
82
83 C) Normal Operating Point: Point that corresponds to the rate of flow, total head, and energy
84 consumption at which a pump will operate given a specific system curve. It corresponds to the
85 point of intersection of the pump performance and system curves.

86 **Note:** EPA and DOE have included the definition for Normal Operating Point that was proposed in the
87 Framework Document since it is used in Section 6.2 of the Final Draft Test Method. Providing a definition
88 will help to clarify the test method.

- 89 D) Rate of Flow (Q): The total volume throughput per unit of time. For this test method, Rate of Flow
90 is expressed as GPM.

E) Motor Speed (n): The number of revolutions of the motor shaft in a given unit of time. For this test method, Motor Speed is expressed as revolutions per minute (RPM.).

F) Most Efficient Speed: The speed with the highest Energy Factor for a given pump.

Note: EPA received stakeholder feedback requesting further clarification regarding the definition of Low Speed as specified in Table 1 for ENERGY STAR Qualification. Based on stakeholder feedback, EPA has updated Table 1 to specify that the Most Efficient Speed be used for qualification of Multi- and Variable-speed and Variable-flow Pumps and has proposed a definition for Most Efficient Speed. EPA welcomes stakeholder feedback on the proposed definition.

G) Head (H): Energy content of the liquid at any given point in the system. It is expressed in units of energy per unit weight of liquid. For residential pool pumps, the measuring unit for head is feet of water.

H) Total Suction Head (H_S): The head in the inlet section of the pump, calculated as follows:

$$H_S = z_S + \frac{(p_S \times a)}{\gamma} + \frac{U_S^2}{2g}$$

Where:

- z_S is the height from the water level of the suction pressure measuring device, in feet (ft),
- p_S is the suction pressure measured by the pressure measuring device, in pounds per square inch (psi),
- U_S is the mean velocity at the suction pressure measuring device, in ft/s,
- a is a conversion constant equal to $144 \text{ in}^2/\text{ft}^2$, and
- γ is the specific weight of water, in lb/ft^3 .

I) Total Discharge Head (H_D): The head in the outlet section of the pump, calculated as follows:

$$H_D = z_D + \frac{(p_D \times a)}{\gamma} + \frac{U_D^2}{2g}$$

Where:

- z_D is the height from the water level of the discharge pressure measuring device, in ft,
- p_D is the discharge pressure measured by the pressure measuring device, in psi,
- U_D is the mean velocity at the discharge pressure measuring device, in ft/s,
- a is a conversion constant equal to $144 \text{ in}^2/\text{ft}^2$, and
- γ is the specific weight of water, in lb/ft^3 .

Note: EPA received stakeholder feedback requesting that units be shown for all variables included in the Total Head equations. EPA has updated the equations and has converted them to English units to align with the System Curve equations provided in Section 5.1 of the Final Draft Test Method, which are also in English units.

J) Standby Mode: A reduced power state in which the unit is connected to an ac main power source and pump controls/timers remain On, but the motor remains idle, and no water is being pumped through the system.

Note: EPA received stakeholder feedback requesting further clarification regarding the definition for Standby Mode. EPA has updated the definition for Standby Mode to clarify that pump controllers/timers shall remain On. EPA has also removed references in the definition to pump types, as the pump type does not necessarily influence if the pump has a controls that remain On when the pump is not running.

K) Product Family: A group of product models that are (1) made by the same manufacturer, (2) subject to the same ENERGY STAR qualification criteria, and (3) of a common basic design (identical motor and wet-end design); Product models within a family differ from each other according to one or more characteristics or features that either (1) have no impact on product performance with regard to ENERGY STAR qualification criteria, or (2) are specified herein as acceptable variations within a product family; For pool pumps, acceptable variations within a product family include:

i. Color

L) Representative Model: The product configuration that is tested for ENERGY STAR qualification, and is intended to be marketed and labeled as ENERGY STAR.

Note: EPA received stakeholder feedback that a product family approach would be appropriate for pool pumps in order to account for minor variations having no impact on product performance, for example variations in product color. EPA agrees that units with aesthetic differences should be able to qualify based on the testing of a representative model as long as the performance is the same across the units being represented. This will help to reduce testing burden on the manufacturer and ensure that all units included within the family will meet ENERGY STAR requirements and end user expectations. Therefore, EPA has made appropriate modifications to Section 1.5 and Section 5 Test Requirements to add this product family approach.

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

1.6 Acronyms

A) ac: Alternating Current

B) ANSI: American National Standards Institute

C) APSP: Association of Pool and Spa Professionals

D) EF: Energy Factor

E) °F: Degrees Fahrenheit

F) gal: gallons

G) GPM: Gallons per minute

H) H: Head

I) HI: Hydraulics Institute

J) hp: Horsepower

K) Hz: hertz

L) n: Motor Speed

M) NSPI: National Spa and Pool Institute

N) Q: Rate of Flow

O) RPM: Revolutions per minute

P) UUT: Unit under test

Q) V: volts

R) W: watts

S) Wh: watt-hours

176 2 SCOPE

177 2.1 Included Products

- 178 A) Products that meet the definition of a Residential Inground Pool Pump, that are Single-speed,
179 Multi-speed, Variable-speed, or Variable-flow as specified herein are eligible for ENERGY STAR
180 qualification, with the exception of products listed in Section 2.2. Only those pool pumps that are
181 single phase and with a Total Horsepower rating of >0.5 HP and ≤ 4 HP can qualify as ENERGY
182 STAR under this specification.
183

184 **Note:** The current data set, based on the California Energy Commission (CEC) database, which
185 represents all of CA Title 20 compliant pool pumps, lists residential pool pump products up to 4 Total HP.
186 EPA received one comment to extend the upper end of the size limit, however, without additional
187 performance data to support its inclusion. EPA is unable to fully evaluate whether these larger pumps are
188 appropriate to cover under this Version 1.0 specification and therefore, will maintain the same upper size
189 limit of 4 Total HP. EPA may be willing to extend in the future given more data and information on the
190 scope to include these larger sized pumps, in the future, provided test data is made available and that
191 their inclusion continues to meet program principles.

192
193 EPA has added a requirement that eligible pumps must be single-phase; Stakeholders have indicated
194 that the combination of this and the size limit will serve to focus this specification on residential grade
195 products alone. EPA is interested in getting stakeholder input on any other distinguishing features that
196 could be referenced to help further differentiate residential from commercial products.
197

198 2.2 Excluded Products

- 199 A) Residential Aboveground Pool Pumps, Residential Auxiliary Pool Pumps, and Spa Pumps as
200 defined in Section 1 are not eligible for ENERGY STAR under this specification. Multi-speed
201 Pumps with manual pump controls that are not sold ready to connect to external pump controls,
202 are also not eligible.

203 **Note:**

204 **Size Limit**

206 EPA removed the size limit range from Section 2.2 Excluded Products and now only is specifically called
207 out in Section 2.1 Included Products so as not to confuse it with the included products size limit range.

208 **Manual Pump Controls**

209
210 EPA continues to support excluding Multi-speed pumps with manual switches that are not sold ready to
211 connect with external pump controls; EPA believes that the ability to connect to external pump controls
212 must be a product feature at the point of sale without the need for in-field retrofits or after-market
213 modifications; To this end, EPA modified the proposed language in Section 2.1 Included Products to more
214 clearly and specifically addresses the “as sold” conditionality of the requirement.

215 Additionally, “speed controls” was replaced with “pump controls” in Section 2.2 Included Products to
216 correlate with the new definition added in Section 1.

217 **Future Scope Expansions**

218
219 Stakeholders have expressed interest in expanding the scope in future specification revisions to include
220 **aboveground pool pumps, commercial inground pool pumps, and replacement motors.** EPA
221 recognizes that each of these product groupings may represent significant energy savings opportunities;
222 however, EPA has identified unique issues that call for the tailoring of the current test method before
223 these product types can be considered more fully for inclusion in this specification. For example, the
224 following issues have been identified:

- Aboveground pool pumps are commonly sold as part of a fully pre-designed piping and filtering system, and stakeholder feedback indicates that it may make sense to test these products as part of a system.
- Three-phase inground commercial pool pumps cannot be tested under ANSI/HI 1.6 Centrifugal Pump Test and a more appropriate test method would need to be identified and evaluated.
- Replacement motors can be installed and paired with an unknown variety of wet ends in the field, so it is not clear if energy factor is an appropriate performance metric.

Any information that stakeholders may be able to provide to help define approaches to testing and measuring performance for these product groupings will be essential to enable future scope expansions.

3 QUALIFICATION CRITERIA

3.1 Energy Efficiency Requirements

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

Table 1. Pool Pump Energy Factor Criteria at Pool Performance Curve A		
Pump Sub Type	Speed Setting	Energy Efficiency Level
Single-speed Pump	Single Speed	EF ≥ 3.8
Multi-speed, Variable-speed and Variable-flow Pump	Most Efficient Speed	

Note:

Explanation of Table 1 Criteria

EPA received stakeholder support for the Draft 1 performance criteria. EPA believes that the performance levels continue to be representative of the top performing energy efficient residential pool pumps on the market using the industry accepted Energy Factor metric; EPA estimates that 21% of pumps available in the market are able to meet the Energy Factor levels proposed in Table 1, representing a broad selection of highly efficient, cost effective products from a range of manufacturers.

Data plots showing the CEC Curve A data can be found on the ENERGY STAR Pool Pumps specification development webpage, which can be accessed through www.energystar.gov/newspeccs. Additionally, EPA has maintained a focus on low speed requirements exclusively in this draft, having not received opposition to this approach proposed in Draft 1.

Single-speed Pumps

Several stakeholders requested the removal of "Single-speed pumps" from the scope and/or from being specifically called out in the specification. EPA maintains that the inclusion of Single-speed pumps is appropriate and aligns with the program principle of supporting technology neutral requirements when possible. (http://www.energystar.gov/index.cfm?c=prod_development.prod_development_index).

In addition, EPA received a comment concerned that including Single-speed pumps may conflict with current state codes. However, the current market of available Single-speed pumps and their tested performance indicates that the proposed scope and criteria of this Draft 2 specification does not result in the qualification of products that would not also be able to meet the requirements of current state codes.

Alternative Evaluation Methods

EPA did not receive any comments with regards to using APSP-10 as an alternate method for evaluating and comparing pump energy performance; This test method, which is currently under development, proposes binning pool pumps into low, medium, and high head groups, which allows for application based comparisons in terms of Energy Factor. EPA will continue to monitor the development of this evaluation method for possible application in future specification revisions.

Other Pool Pump Performance Considerations

Stakeholders supported EPA's approach of listing Energy Factors for performance Curves B and C (as well as A) on the ENERGY STAR Qualified Product List (QPL) for appropriate pump sizing purposes for other pool designs. EPA is interested in working with stakeholders to identify any other opportunities that can help to better inform consumers and pool professionals about best practices in sizing pumps.

Educational Content

EPA recognizes that pool pump energy performance can be greatly impacted by installation, operational, and maintenance related factors. EPA remains interested in working with stakeholders to identify opportunities to inform and educate both end users and pool professionals about best practices to help optimize the actual energy savings realized in the field.

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

Note: A stakeholder requested that the default filtration speed and high-speed override criteria in Section 3.1 Energy Efficiency Requirements be expanded to cover external pump controls in addition to onboard pump controls; External Pump Controls fall outside of the scope of the Version 1.0 specification which covers pumping products for which there is sufficient data. External controls require a separate set of definitions, criteria, testing, market availability research and performance data, which constitutes a separate product program or substantial expansion to the current scope. . In the future, EPA may consider covering external controls if doing so aligns with the ENERGY STAR Guiding Principles.

Additionally, "Pool pump motor controls" was replaced with "Pump controls" in Section 3.1 to correlate with the new definition added in Section 1.

3.2 Significant Digits and Rounding:

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

4 CONNECTED FUNCTIONALITY CRITERIA

EPA has developed the following optional criteria for ENERGY STAR qualified pool pumps that wish to also be recognized as 'Connected' on the ENERGY STAR website.

Note: The initial criteria was presented in the Connected Functionality document distributed to stakeholders in August 2012.

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.

EPA will continue to work with stakeholders to refine the criteria and the development of potential connected functionality criteria for pool pumps, as well as education materials on the associated benefits.

When a final set of CF criteria are developed, EPA intends to incorporate CF criteria into the ENERGY STAR Pool Pumps specification. The timeline for finalizing the CF criteria is independent of the specification development timeline and will continue even as the pool pump specification is completed.

5 ADDITIONAL REQUIREMENTS

5.1 Informational statement

- A) Partner shall mark a qualifying Multi-speed, Variable-speed, and Variable-flow pool pump without onboard pump controls permanently and legibly on an accessible and conspicuous place on the unit, in characters no less than ¼", with the nameplate HP of the pump with the statement, "This pump must be installed with a multi-, or variable-speed pump motor controller." This statement provides information that the pool pump product must be matched with pump controls to ensure the energy savings potential is realized due to the speed reduction capabilities of the pool pump.

Note: A stakeholder suggested reducing the font size requirement in Section 4.1 Informational Statement. The font size requirements are aligned with ANSI/ICC/APSP-15 and CEC Title 20, which EPA believes reduces the burden on the manufacturer. As previously noted, the purpose of this statement is to properly inform the installer that an ENERGY STAR pump with adjustable speeds must be installed with a controller to achieve the energy savings that it is certified to deliver.

Additionally, "speed controller" was replaced with "pump controls" in Section 4.1 Informational Statement to correlate with the new definition added in Section 1.

5.2 Additional reporting requirements

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

6 TEST REQUIREMENTS

6.1 Number of Units Required for Testing

- A) Representative Models shall be selected for testing per the following requirements:

- 1) For qualification of an individual product model, the Representative Model shall be equivalent to that which is intended to be marketed and labeled as ENERGY STAR.
- 2) For qualification of a Product Family, the highest energy using model within that Product Family can be tested and serve as the representative model. When submitting Product Families, manufacturers continue to be held accountable for any efficiency claims made about their products, including those not tested or for which data was not reported.

- B) A single unit of each Representative Model shall be selected for testing.

Note: As mentioned in a Section 1 note box, EPA has added the allowance of product family testing in Draft 2 due to stakeholder feedback indicating that there are many part number model variations offered that have no impact on energy performance; This is also in alignment with CEC Title 20 section 1606-(a)-(1)-(C); The product family approach is intended to minimize test burden on manufacturers and EPA would like further input on the proposed method of specifying a product family approach to testing and qualifying Pool Pumps.

- C) When testing Pool Pumps, the following test methods shall be used to determine ENERGY STAR qualification.

Table 2: Test Method for ENERGY STAR Qualification	
ENERGY STAR Requirement	Test Method Reference
Energy Factor (gal/Wh)	ENERGY STAR® Version 1.0 Test Method for Determining Pool Pump Energy Use

7 EFFECTIVE DATE

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

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

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

8 FUTURE SPECIFICATION REVISIONS

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

9 REFERENCES

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