



ENERGY STAR® Program Requirements Product Specification for Commercial Dishwashers

Eligibility Criteria DRAFT 3: Version 2.0

Following is the **Draft 3 Version 2.0** product specification for ENERGY STAR qualified commercial dishwashers. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

1) **Definitions**¹: Below are the definitions of the relevant terms in this document.

- A. **Dishwashing Machine**: A machine designed to clean and sanitize plates, pots, pans, glasses, cups, bowls, utensils, and trays by applying sprays of detergent solution (with or without blasting media granules) and a sanitizing rinse.

Machine Types

- B. **Stationary Rack Machine**: A dishwashing machine in which a rack of dishes remains stationary within the machine while subjected to sequential wash and rinse sprays. This definition also applies to machines in which the rack revolves on an axis during the wash and rinse cycles.
- a) **Under Counter**: A stationary rack machine with an overall height of 38 inches or less, designed to be installed under food preparation workspaces. Under counter dishwashers can be either chemical or hot water sanitizing, with an internal booster heater for the latter.
- b) **Single Tank, Door Type**: A stationary rack machine designed to accept a standard 20x20 dish rack which requires the raising of a door to place the rack into the wash/rinse chamber. Closing of the door typically initiates the wash cycle. Subcategories of single tank, stationary door type machines include: single rack, double rack, pot, pan and utensil washers, chemical dump type and hooded wash compartment ("hood type"). Single tank, door type models can be either chemical or hot water sanitizing, with an internal or external booster heater for the latter.
- c) **Pot, Pan, and Utensil**: A stationary rack, door type machine designed to clean and sanitize pots, pans, and kitchen utensils.
- d) **Glasswashing**: A stationary rack, under counter machine specifically designed to clean and sanitize glasses.

Note: The previous definition for single tank, door type machines included "single or multiple wash tank" as a subcategory. One stakeholder noted that they were not aware of any multiple wash tank door type designs currently available in the marketplace. It was EPA's intent to only cover single tank, stationary door type machines and therefore, the definition has been revised to instead identify single or double *rack* designs as subcategories of door type machines.

- C. **Conveyor Machine**: A dishwashing machine that employs a conveyor or similar mechanism to carry dishes through a series of wash and rinse sprays within the machine.
- a) **Single Tank Conveyor**: A conveyor machine that includes a tank for wash water followed by a final sanitizing rinse. This type of machine does not have a pumped rinse tank. This type of machine may include a prewashing section ahead of the washing section and an auxiliary rinse section, for purposes of reusing the final rinse water, between the power rinse and final

¹ Additional terms found throughout this document, and related to machine components and operation, are defined in NSF 170-2010.

rinse sections. Single tank conveyor dishwashers can be either chemical or hot water sanitizing, with an internal or external booster heater for the latter.

- b) Multiple Tank Conveyor: A conveyor type machine that includes one or more tanks for wash water and one or more tanks for pumped rinse water, followed by a final sanitizing rinse. This type of machine may include a pre-washing section before the washing section and an auxiliary rinse section, for purposes of reusing the final rinse water, between the power rinse and final rinse section. Multiple tank conveyor dishwashers can be either chemical or hot water sanitizing, with an internal or external booster heater for the latter.
- c) Flight Type Conveyor: A conveyor machine where the dishes are loaded directly on the conveyor rather than transported within a rack. This machine is also referred to as a rackless conveyor.

Note: In the Draft 2 specification, the definition for single tank conveyor dishwasher was modified to remove the language regarding “an auxiliary rinse section between the power rinse and final rinse sections” based on feedback that if a conveyor includes pumped rinse sections prior to the final sanitizing rinse section then technically it is a multiple tank machine. However, several manufacturers commented that by removing this language it is now unclear where single tank machines that include auxiliary rinse sections to reuse final rinse water fall. Using the NSF 170-2010 Standard as a guide, EPA is proposing a slightly revised definition that aligns with NSF but also includes clarification that single tank machines that include an auxiliary rinse, for purposes of reusing final rinse water, continue to be characterized as single tank for purposes of qualification.

The reference to “permanently installed, vertical pegs” has been removed in the Flight Type Conveyor definition, expanding the scope to flat belt designs.

Sanitation Methods

- D. Hot Water Sanitizing (High Temp) Machine: A machine that applies hot water to the surfaces of dishes to achieve sanitization.
- E. Chemical Sanitizing (Low Temp) Machine: A machine that applies a chemical sanitizing solution to the surfaces of dishes to achieve sanitization.
- F. Chemical Dump Type Machine: A low temp, stationary rack machine with a pumped recirculated final rinse.
- G. Dual Sanitizing Machine: A machine designed to operate as either a high temp or low temp machine.

Note: New definitions are proposed for chemical dump and dual sanitizing machines.

Modes and Metrics

- H. Wash Mode: Machine is actively running a cycle and is spraying wash water (i.e., water that is neither part of the final rinse nor the prewashing unit).
- I. Rinse Mode: Machine is at the end of the actively running cycle and is spraying final hot water or chemical sanitizing rinse water.
- J. Dwell Mode: For stationary rack type, machine is actively running a cycle but is not in wash or rinse modes.
- K. Idle Mode: Machine is not actively running a cycle but is still powered on.
- L. Idle Energy Rate: The rate of energy consumed by the dishwasher tank heater while “holding” or maintaining wash tank water at the thermostat(s) set point during the time period specified in

Note: Definitions for idle, wash, rinse, and dwell modes have been proposed above for purposes of product testing. Stakeholders are encouraged to provide feedback on these definitions. A footnote has also been added to the bottom of Page 1 that references NSF 170-2010 for additional terms found within this document and related to machine components and operation.

Additional definitions specific to the ENERGY STAR test method will be based on DOE’s validation testing and may be proposed along with the draft test procedure.

Qualification Terms

M. Product Family: Variations of one model offered within a single product line with design differences limited to: finish/color; length of pre-wash section, voltage, and orientation (e.g., corner, straight through models). Individual models represented by a product family must have the same final rinse water and idle energy consumption.

Note: Several manufacturers offer steam, natural gas, and electric options for any one model. If the difference in fuel source impacts idle energy results then EPA will consider a worst case scenario approach to testing and qualification to reduce burden on manufacturers. As currently written, each option would be required to be tested and certified to be ENERGY STAR qualified. Stakeholders are encouraged to feedback on this approach and any supporting data.

2) Scope:

- A. Included Products: Products that meet the definition of a Commercial Dishwasher as specified herein are eligible for ENERGY STAR qualification, with the exception of products listed in Section 2.B. The following product types are eligible: under counter; single tank, door type; single tank conveyor; multiple tank conveyor and flight type machines. Glasswashing machines; pot, pan, and utensil machines; and dual sanitizing machines are also eligible. Only those under counter machines designed for wash cycles of 10 minutes or less are eligible for ENERGY STAR.
- B. Excluded Products: Dishwashers intended for use in residential or laboratory applications are not eligible for ENERGY STAR under this product specification.

3) Qualification Criteria:

A. Energy and Water Efficiency Requirements:

Table 1: ENERGY STAR Requirements for Commercial Dishwashers				
Machine Type	High Temp Efficiency Requirements		Low Temp Efficiency Requirements	
	Tank Heater Idle Energy Rate*	Water Consumption**	Tank Heater Idle Energy Rate*	Water Consumption**
Under Counter	≤ 0.50 kW	≤ 0.86 GPR	≤ 0.50 kW	≤ 1.19 GPR
Stationary Single Tank Door	≤ 0.64 kW	≤ 0.89 GPR	≤ 0.60 kW	≤ 1.18 GPR
Pot, Pan, and Utensil	≤ 0.70 kW	≤ 0.58 GPSF	≤ 0.60 kW	≤ 0.58 GPSF
Single Tank Conveyor	≤ 1.50 kW	≤ 0.700 GPR	≤ 1.50 kW	≤ 0.790 GPR
Multiple Tank Conveyor	≤ 2.25 kW	≤ 0.540 GPR	≤ 2.00 kW	≤ 0.540 GPR

Single Tank Flight Type	Reported	GPH = 2.975x + 55.00	Reported	GPH = 2.975x + 55.00
Multiple Tank Flight Type	Reported	GPH = 4.96x + 17.00	Reported	GPH = 4.96x + 17.00

* Idle results should be measured with the **door closed** and represent the total idle energy consumed by the machine including all tank heater(s) and controls. Booster heater (internal or external) energy consumption should not be part of this measurement.

** GPR = gallons per rack; GPSF = gallons per square foot of rack; GPH = gallons per hour; **x** = sf of conveyor belt (i.e., W*L) /min (max conveyor speed).

Note: Chemical dump machines, as defined in Section 1, are exempt from idle energy testing due to the absence of an internal tank maintenance heater.

Note: There has been significant discussion regarding the potential impact of further reductions in final rinse water consumption on cleaning/rinsing performance. Despite EPA requests, evidence has yet to be provided that indicates models listed in the NSF Directory that are able to meet the proposed Draft 3 GPR levels fail to meet these performance expectations. As a reminder, water consumption levels for low and high temp conveyor machines remain at existing Version 1.2 levels. Equipment manufacturers of door type and under counter machines that meet the Draft 3 levels indicate that the number of service calls received on these models is on the same order as standard machines and point out the importance of regular maintenance and using the right detergent and chemicals to ensure continued performance while using less water.

Manufacturers have expressed some concern about the NSF 3 Standard and whether the soils used during testing represent continued performance in the field. EPA understands that the NSF committee is revisiting the test conditions to determine whether the test method emulates real world performance. EPA will continue to follow these efforts and consider adopting any changes once finalized and adjusting performance levels, if needed.

EPA has adjusted the GPR level for high temp under counter machines from 0.84 to 0.86, and the Idle Energy Rate level for high temp multiple tank conveyor machines from 2.00 to 2.25 kW, in response to concerns regarding model availability. New compliances rates for these categories are now 26% and 21%, respectively.

Flight Type Requirements: Following release of the Flight Type Discussion Document, subsequent discussions with manufacturers suggest that a metric based on conveyor area and speed would serve as a good proxy for rewarding flight type designs that reduce water consumption and encouraging redesign or removal of older, less efficient machines. There was some concern from several stakeholders that the auxiliary rinse tanks used in some of the more efficient flight type models (i.e., dual-rinse designs) would actually increase the total energy consumption of the machine. EPA also shared this concern and therefore, worked with manufacturers to collect additional information regarding machines that offer dual rinse. Based on initial manufacturer discussions and some limited test data, EPA found that while the auxiliary tank heater does increase the energy load on the machine this is typically a small (e.g. 5 kW) amount as compared to the drop in booster heater energy (e.g. 15 kW). In addition, there is significant energy savings at the building level tied to the reduction of final rinse water consumption. However, EPA is interested in reviewing additional test data and discussing this issue further with stakeholders.

Flight type requirements have been separated into two bins based on inherent differences suggested by the data set. Separate requirements are proposed for single and multiple tank machines, similar to rack conveyor models. Compared to the levels suggested in the Flight Type Discussion Document, the proposed levels in Table 1 for flight type machines have been slightly adjusted to provide additional consumer choice in response to concerns regarding the high price differential, in particular between dual rinse and standard designs. EPA believes that the proposed Draft 3 water consumption levels provide end users with the ability to identify top performers but now at more varied price points.

Note cont.

EPA received limited idle energy data for flight type machines and stakeholder feedback continues to be mixed regarding usage patterns. Therefore, EPA is proposing an idle energy rate reporting requirement that will: (a) provide EPA with a more robust data set for evaluation under Version 3.0 and (b) offer to interested parties, such as utilities and institutional purchasers, the opportunity to identify those machines that offer additional energy savings beyond ENERGY STAR requirements. The ASTM F1920-11 Standard can be used to determine idle energy rate for flight type machines.

Chemical Dump Machines: Recognizing that for chemical dump machines there is no tank maintenance required and thus idle energy would be limited to controls, EPA is considering excluding these machine types from idle energy testing reducing burden.

Pot/Pan/Utensil Idle Energy Rate: Feedback from manufacturers suggest that the proposed idle energy rate for high temp pot, pan, and utensil machines may be too restrictive, particularly for dedicated models. To date, EPA has received limited additional data so manufacturers are encouraged to provide idle energy rate data based on the ASTM F1696-07 Standard for EPA's consideration in finalizing these requirements.

Heat Recovery: Several stakeholders commented on the importance of heat recovery, particularly with respect to flight type total energy consumption. EPA recognizes the benefits of heat recovery and that these benefits are not currently accounted for in this Draft 3 proposal. It is EPA's intention to use the wash energy test method found in the revised ASTM F1920 and F1696 Standards for the next version of this specification once data can be collected and evaluated. This test method will reward approaches to reducing energy use in other modes, such as heat recovery. In the meantime, EPA may consider a prescriptive requirement that all qualified flight type conveyors include heat recovery and encourages stakeholders to provide comment on this interim approach.

Supplemental Devices: A request was made that the specification address the use of supplemental devices that increase the amount of water consumed onsite but are not normally tested or reported in the NSF water consumption rating. Examples provided include prewash temperature control modules and drain water tempering controls. In the case of drain water tempering controls, EPA understands that these devices may be required by state code for cooling the water prior to entering the drain system, prohibiting EPA from requiring that they be removed. Also, these devices can be attached during the manufacturing process or sold separately, thus complicating the qualification and verification of such units. EPA is interested in stakeholder feedback on whether prescriptive requirements should be included in this Version 2.0 specification that encourages the use of supplemental devices that are designed to limit this additional water consumption or whether the inclusion of an education disclaimer noting the possible energy impacts of additional devices is sufficient to educate consumers about additional energy implications.

- B. Dual Sanitizing Machines: As defined in Section 1, these machines shall meet both the high temp and low temp requirements presented in Table 1, above, to qualify as ENERGY STAR.
- C. Dual Purpose Door Type Machines: Machines designed to be used either as a standard door type machine or a pot, pan, and utensil machine shall meet the performance requirements for both of those sub categories.
- D. Calculations for Water Consumption: The following calculations shall be used to determine machine water consumption for purposes of ENERGY STAR qualification.

a. Gallons Per Hour Calculations

1) Fresh Water and Pumped Water Final Rinse Stationary Type Machines

$$\text{Gallons per Hour} = \frac{\sum_{n=1}^5 \frac{\text{Measured Weight of water for cycle } n \text{ (lbs)}}{(WT_n + RT_n + DT_n + LT)(\text{seconds})}}{5 \text{ cycles} * \frac{8.34 \text{ lbs}}{\text{gal}} * \frac{1 \text{ hour}}{3600 \text{ seconds}}}$$

Where:

WT_n = Wash time (i.e. amount of time spent in wash mode) in seconds as recorded during test n
 RT_n = Rinse time (i.e. amount of time spent in rinse mode) in seconds as recorded during test n
 DT_n = Dwell time (i.e. amount of time spent in dwell mode) in seconds as recorded during test n
 LT = Load time (30 seconds for under counter dishwashers, 5 seconds for straight through door-type dishwashers, 7 seconds for corner door-type dishwashers, 30 seconds for front load/unload door-type dishwashers)

2) Fresh Water and Pumped Water Final Rinse Conveyor Type Machines

$$\text{Gallons per Hour} = \frac{\sum_{n=1}^5 \frac{\text{Measured Weight of water for test run } n \text{ (lbs)}}{\text{Measured test duration (seconds)}}}{5 \text{ cycles} * \frac{8.34 \text{ lbs}}{\text{gal}} * \frac{1 \text{ hour}}{3600 \text{ seconds}}}$$

b. Gallon per Rack Calculations

1) Fresh Water and Pumped Water Final Rinse Stationary Rack Type Machines

$$\text{Gallons per Rack} = \frac{GPH * (WT + RT + DT + LT)}{\frac{3600 \text{ seconds}}{\text{hour}} * NR}$$

Where:

GPH= Water use in gallons per hour, as calculated in previous section.
 WT= Manufacturer specified wash time (i.e. amount of time spent in wash mode) in seconds
 RT= Manufacturer specified rinse time (i.e. amount of time spent in rinse mode) in seconds
 DT = Manufacturer specified dwell time (i.e. amount of time spent in dwell mode) in seconds
 LT = Load time (30 seconds for under counter dishwashers, 5 seconds for straight through door-type dishwashers, 7 seconds for corner door-type dishwashers, 30 seconds for front load/unload door-type dishwashers)
 NR = Number of racks washed per cycle

2) Fresh Water and Pumped Water Final Rinse Conveyor Type Machines

$$\text{Gallons per Rack} = \frac{GPH * RL * \frac{1 \text{ ft}}{12 \text{ in}}}{CS * \frac{60 \text{ minutes}}{\text{hour}}}$$

Where:

GPH= Water use in gallons per hour, as calculated in previous section.
 RL= Rack length (use 20 in.)
 CS= Manufacturer specified maximum conveyor speed in feet per minute

c. Gallon per Square Foot of Rack Calculation for Pot, Pan, and Utensil Machines

$$GPSF = \frac{GPR}{\text{Square foot of rack}}$$

Where:

GPR= Gallons per rack, as calculated in previous section.

Square foot of rack = Manufacturer specified rack area in ft² for machine tested

Note: DOE is proposing the calculations above for GPH and GPR for purposes of testing and qualifying machines for ENERGY STAR. The GPSF calculation for pot, pan, and utensil machines is essentially the same as proposed in Draft 2 but a slight clarification is proposed in regards to determining square foot of rack. Stakeholders are encouraged to provide feedback on these equations.

E. Industry Standard Certifications: All machines shall be certified to the NSF/ANSI 3-2010 Standard, *Commercial Warewashing Equipment*.

Note: The reference to NSF/ANSI 3-2010 has been moved from Table 2, below, to this section since it does not provide a method for measuring final rinse water consumption. However, its inclusion in this ENERGY STAR specification is important to ensure that reported final rinse water consumption continues to be tied to sanitation.

F. 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 the nearest significant digit as expressed in the corresponding specification limit.

4) Test Requirements:

- A. Representative Models shall be selected for testing per the following requirements:
 - a. 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.
 - b. For qualification of a product family, any model within that product family can be tested and serve as the representative model.
- B. When testing commercial dishwashers, the following test methods shall be used to determine ENERGY STAR qualification:

Table 2: Test Methods for ENERGY STAR Qualification	
ENERGY STAR Requirement	Test Method Reference
GPH, GPR, and GPSF	<i>ENERGY STAR Test Method for Final Rinse Water Consumption</i>
Idle Energy Rate – Under Counter and Single Tank, Door Type Machines	ASTM Standard F1696-07, <i>Standard Test Method for Energy Performance of Single-Rack Door-Type Commercial Dishwashing Machines</i>
Idle Energy Rate – Single and Multiple Tank, Rack and Flight Type Conveyor Machines	ASTM Standard F1920-11, <i>Standard Test Method for Energy Performance of Rack Conveyor Commercial Dishwashing Machines</i>

Note: The ASTM Standard F1920 was recently finalized and therefore, the test method reference provided in Table 2 above now reflects the 2011 version. Changes made during this revision process were limited to the washing energy rate test procedure and aligning temperature conditions with the requirements of NSF 3-2010. It is anticipated that idle energy tests applied using both the 2007 and 2011 versions would yield comparable results. Therefore, idle energy rates as reported for ENERGY STAR qualification should remain valid for purposes of determining levels in this Version 2.0. According to the ASTM Task Group Lead, additional revisions are anticipated to ensure machine stabilization prior to measuring washing energy rate. While these changes will not impact the idle energy test method, EPA will need to update the reference once finalized. EPA will also update the reference for ASTM Standard F1696 once finalized.

Concurrent with the industry updates to the test procedures, DOE is also in the process of testing commercial dishwashers to validate the ASTM, NSF, and ENERGY STAR test procedures listed in Section 4, above. It is important that prior to EPA finalizing this Version 2.0 specification, these test procedures are validated and revised, as needed, to produce accurate and repeatable results. Clarifications to the procedures may also be required to ensure that all EPA recognized laboratories are applying the test conditions and methods in the same manner. DOE anticipates finishing this testing and method review effort by the end of September. Once final, EPA will release DOE's proposed test procedure for commercial dishwashers for stakeholder review, which will incorporate any clarifications to external industry test methods, as well as the proposed ENERGY STAR test method, into a step-by-step format for measuring and determining performance.

- 5) **Effective Date:** The ENERGY STAR Commercial Dishwasher Specification shall take effect on **September 1, 2012**. 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 anticipates releasing a Final Version 2.0 specification by December 2011. As such, the effective date provided above has been changed to allow manufacturers 9 months to work with certification bodies and update product literature, as needed to comply with the new requirements.

As of September 1, 2012, only those models that have been third party certified by an EPA recognized Certification Body will remain on the ENERGY STAR Qualified Product List. Upon finalization, manufacturers can immediately begin qualifying models to the new Version 2.0 specification. More information regarding product qualification will be provided along with the Final Draft specification. For information on third party certification visit: www.energystar.gov/3rdpartycert.

- 6) **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.

ASTM Test Standard Review: EPA will revisit this specification once the revision processes for ASTM F1696 and ASTM F1920 are complete to evaluate new performance requirements that capture total machine energy consumption.