



ENERGY STAR® Program Requirements Product Specification for Commercial Dishwashers

Eligibility Criteria Draft 2 Version 3.0

6
7 Following is the Draft 2 **Version 3.0** product specification for ENERGY STAR certified commercial
8 dishwashers. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

9
10 1) **Definitions**¹: Provided below are the definitions of the relevant terms in this document.

- 11
12 A. Dishwashing Machine: A machine designed to clean and sanitize plates, pots, pans, glasses,
13 cups, bowls, utensils, and trays by applying sprays of detergent solution (with or without blasting
14 media granules) and a sanitizing rinse.

15 16 **Machine Types**

- 17
18 B. Stationary Rack Machine: A warewashing machine in which a rack of dishes remains
19 stationary within the machine while subjected to sequential wash and rinse sprays. This term
20 also applies to machines in which the rack revolves on an axis during the wash and rinse
21 cycles.

- 22
23 a) Under Counter: A stationary rack machine with an overall height of 38 inches or less,
24 designed to be installed under food preparation workspaces. Under counter
25 dishwashers can be either chemical or hot water sanitizing, with an internal or external
26 booster heater for the latter.

- 27
28 i. Glasswashing: A stationary rack, under counter machine specifically designed
29 to clean and sanitize glasses.

- 30
31 b) Single Tank, Door Type: A stationary rack machine designed to accept a standard 20
32 inch x 20 inch dish rack which requires the raising of a door to place the rack into the
33 wash/rinse chamber. Closing of the door typically initiates the wash cycle. Subcate-
34 gories of single tank, stationary door type machines include: single rack; double rack;
35 pot, pan and utensil washers (PPU); chemical dump and fill type; and, hooded wash
36 compartment ("hood type")². Single tank, door type models can be either chemical or
37 hot water sanitizing, with an internal or external booster heater for the latter.

- 38
39 i. Pot, Pan, and Utensil (PPU): A stationary rack, door type machine designed to
40 clean and sanitize pots, pans, and kitchen utensils.

- 41
42 ii. Dump and Fill: A machine type where after the wash cycle, the drain
43 automatically opens to 'dump' the wash water to a holding tank or to a drain.
44 The rinse tank fill then becomes the water for the next wash cycle.³

- 45
46 C. Conveyor Machine: A dishwashing machine that employs a conveyor or similar mechanism to
47 carry dishes through a series of wash and rinse sprays within the machine.

- 48
49 a) Single Tank Conveyor: A conveyor machine that includes a tank for wash water
50 followed by a sanitizing rinse (pumped or fresh water). This type of machine does not
have a pumped rinse tank. This type of machine may include a prewashing section

¹ Additional terms found throughout this document, and related to machine components and operation, are defined in NSF 170-2015 *Glossary of Food Equipment Terminology*.

² Hood: A device intended for collecting vapors, mists, particulate matter, fumes, smoke, steam or heat before entering an exhaust system (NSF/ANSI 170 3.103).

³ ASTM F953-14, 9.3 Operation Cycle

51 ahead of the washing section and an auxiliary rinse section, for purposes of reusing
52 the sanitizing rinse water, between the power rinse and sanitizing rinse sections.
53 Single tank conveyor dishwashers can be either chemical or hot water sanitizing, with
54 an internal or external booster heater for the latter.

- 55
- 56 b) Multiple Tank Conveyor: A conveyor type machine that includes one or more tanks
57 for wash water and one or more tanks for pumped rinse water, followed by a
58 sanitizing rinse. This type of machine may include a pre-washing section before the
59 washing section and an auxiliary rinse section, for purposes of reusing the sanitizing
60 rinse water, between the power rinse and sanitizing rinse section. Multiple tank
61 conveyor dishwashers can be either chemical or hot water sanitizing, with an internal
62 or external booster heater for the latter.
- 63
- 64 c) Flight Type Conveyor: A conveyor machine where the dishes are loaded directly on
65 the conveyor rather than transported within a rack. This machine is also referred to as
66 a rackless conveyor.

67

68 D. Heat Recovery Machine: Warewashing equipment equipped with heat recovery equipment; a
69 heat exchanger that recovers energy from other heat sources (i.e. waste water, exhaust duct)
70 for the purpose of heating potable water⁴. This includes but is not limited to drain water heat
71 exchangers, wash compartment heat exchangers, exhaust heat exchangers, and supple-
72 mental heat pumps. High temp equipment claiming Energy Recovery Credit in 3(C) shall meet
73 at least one of the following features in 1(D)(a-c); Low Temp equipment must meet 1(D)(a).

- 74
- 75 a) Inlet Water Preheat: Heat recovery system provides sufficient preheat capacity to
76 system to raise incoming inlet water temperature at least 40 °F.
- 77
- 78 b) Drain Water Tempering Avoidance: Reduces wastewater / condensate line
79 temperature sufficient to avoid the need for drain water tempering under normal
80 operation (e.g. tempering needed during the draining of recirculating tank would still
81 be allowable). Wastewater temperature must be 140 °F or less⁵.
- 82
- 83 c) Ventless: Performs sufficient heat recovery and vapor storage (e.g. integrated hood)
84 where the use of a Type II ventilation hood is not required under normal operating
85 conditions (i.e. Btu/hr vented to kitchen area).
- 86

87 **Note:** A Heat Recovery Machine term and definition in Section 1(D) were included in Draft 1 of the
88 commercial dishwasher specification due to the potential energy savings and consumer benefit this
89 technology offers through heat recovery technology. This section has been further updated to
90 reference NSF 170-2015, and has added energy recovery features for claiming an energy recovery
91 credit which is defined later in this product specification. Low temp machines are not excluded from
92 heat recovery scope, based on feedback from manufacturers. However, the primary consumer benefit
93 for low temp from heat recovery is expected to be the 40 °F or greater temperature increase, since
94 low temp machines have a reduced need for drainwater tempering and ventilation. EPA seeks input
95 on definitions for each of the listed systems to ensure inclusivity of existing and upcoming technology
96 and feedback on user amenity requirements.

97

98 **Sanitation Methods**

99

- 100 E. Hot Water Sanitizing (High Temp) Machine: A machine that applies hot water to the surfaces
101 of dishes to achieve sanitization.
- 102
- 103 F. Chemical Sanitizing (Low Temp) Machine: A machine that applies a chemical sanitizing
104 solution to the surfaces of dishes to achieve sanitization.

⁴ NSF 170.3.98 heat recovery equipment

⁵ International Plumbing Code-2012 Section 701.7 Connections

105
106 G. Chemical Dump and Fill Type Machine: A low temp, stationary rack machine with a pumped
107 recirculated sanitizing rinse and with or without a dedicated tank heater⁶.

108
109 H. Dual Sanitizing Machine: A machine designed to operate as either a high temp or low temp
110 machine.

111
112 **Heaters**

113
114 I. Circulating Water Heater: A water heater that is used with an external storage tank and is
115 thermostatically controlled to circulate water through the external storage tank and back to the
116 heater to be reheated.

117 J. Instantaneous Water Heater:

118 a) Tank Type Instantaneous Water Heater: An automatic, thermostatically controlled water
119 heater that has an input rating of at least 4000 Btu/hr per gal of stored water.

120 b) Watertube Type Instantaneous Water Heater: An automatic, self-contained water heater
121 that requires water flow to activate the heat source and does not utilize a separate hot
122 water storage tank.

123 K. Storage Water Heater: A water heater that heats and stores water within the appliance at a
124 thermostatically controlled temperature for delivery on demand, and that has an input rating of
125 less than 4000 Btu/hr per gal of stored water.

126 L. Booster Heater: A water heater that raises the temperature of preheated water 40 to 80 °F. The
127 preheated water is supplied to the unit [booster heater] at temperatures that are typically between
128 100 and 140 °F ⁷. This booster heater can be either integral to the dishwasher, or externally
129 connected.⁸

130 **Note:** EPA received requests from stakeholders to clarify the measurement of idle and washing
131 energy in booster heaters, and where external booster heaters would be separated from in-building
132 water heating for calculation purposes. EPA notes that external booster heaters would have to meet
133 the definition in 1(N), including operating on preheated water, which would generally differentiate this
134 unit from traditional hot water systems. EPA notes that ASTM F1696/1920 provides a calculation for
135 primary hot water energy consumption, which accounts for system hot water energy based on a 60 °F
136 baseline. EPA intends to collect this information to better address total energy demand of the
137 dishwasher in a future specification revision.

138 **Modes and Metrics**

139
140 M. Wash Mode: For stationary rack machines, the dishwasher is in wash mode when it is actively
141 running a cycle and is spraying wash water (i.e., water that is neither part of the sanitizing rinse,
142 post sanitizing rinse, nor the prewashing unit).

143
144 N. Rinse Mode: For stationary rack machines, the dishwasher is in rinse mode when it is at the end
145 of the actively running cycle and is spraying hot water or chemical sanitizing rinse water or a post-
146 sanitizing rinse. If there is a post-sanitizing rinse, it shall be included in rinse mode.

147
148 a) Pumped Rinse: Recirculated water that is pumped from a tank and sprayed onto dishes
149 after washing and before the final sanitizing rinse is applied.

150

⁶ Some dump and fill models may be equipped with a sustainer heater that re-heats stored water if operating interval is too long between cycles.

⁷ NSF 170-2015.3.226.1. Note that in warewashing, final rinse for high temp machines is 180-195 °F.

⁸ ASTM F1696-18, 10.7.6.3. If possible, sub-monitor the energy of the booster heater during the washing energy performance test.

- 151 b) Nonrecirculating Pumped Final Sanitizing Rinse: A fresh water rinse that is pumped once
152 over wares and achieves sanitization using either chemical sanitizers or high
153 temperature.
154
155 c) Recirculating Final Sanitizing Rinse: Fresh water that is pumped repeatedly over wares
156 and achieves sanitization using either chemical sanitizers or high temperature.
157
158 d) Post Sanitizing Rinse: Using sprays of fresh, potable water applied after the sanitizing
159 step.
160
161 O. Dwell Mode: For stationary rack machines, the dishwasher is in dwell mode when it is actively
162 running a cycle but is not in wash or rinse modes (e.g., the period of time between the wash
163 mode and the rinse mode).
164
165 P. Idle Mode: For all dishwasher types, the dishwasher is in idle mode when it is not actively running
166 but is still powered on and ready to wash dishes at the required temperature.
167
168 Q. Energy Saver Mode: An operational setting that is designed to reduce energy during idle mode
169 through temporary shut-down of certain machine components (pumps or belt motors) or reduction
170 of certain temperature set points.
171
172 R. Idle Energy Rate: The rate of energy consumed by the dishwasher while “holding” or maintaining
173 wash tank water at the thermostat(s) set point during the time period specified and outside of an
174 active cycle.
175
176 S. Washing Energy: The rate of energy consumed by the dishwasher while “washing” or “sanitizing”
177 dish loads, as expressed in kWh/rack⁹. **Note**: Rinse modes detailed in *Section 1 N. Rinse Mode*
178 are included in washing energy calculations.
179
180 T. Water Consumption: Gallons per rack, per square foot, or per hour depending on the machine
181 type monitored during testing to determine the rate of water usage. Note: measurement begins
182 after dishwasher is stabilized, therefore excludes water for filling or replenishing tanks¹⁰.
183

184 **Certification Terms**

- 185
186 U. Product Family: Variations of one model offered within a single product line with design
187 differences limited to: finish/color; length of pre-wash section, voltage, and orientation (e.g.,
188 corner, straight through models). Individual models represented by a product family must have
189 the same sanitizing and post sanitizing rinse water and idle energy rate.
190

Note: For clarification purposes, EPA is proposing a number of revisions to existing definitions and including additional terms, many requested specifically via stakeholder feedback and subsequent conversations. When possible, EPA is aligning with ASTM 1696/1920 and/or NSF170-2015.

One commenter requested clarification between hood type and door type machines; and a definition for hood type was added in a footnote per NSF/ANSI-2015 170 3.103. A definition for dump and fill type machine is included in section 1(B)(b)(ii) based on ASTM F953 and is modified from Draft 1 in section 1(G) to account for tank heaters (otherwise called sustainer or sump heaters) intended to maintain temperatures between cycles and which are optional features in some low-temp machines (primarily, under-counters). EPA is currently tracking the dump and fill type machine data until further wash energy points become available to formally separate this category out. Consumer choice dictates to retain this category.

⁹ ASTM F1920-15. 10.8.2.2 For flight type machines, kWh is measured over 5 batches of 10 dishloads, with the first (6th batch) ignored for stabilization.

¹⁰ ASTM F1696-18: 10.7.6.1 To begin stabilizing the dishwasher, load the dishwasher with an empty rack and initiate 5 consecutive wash cycles...engage the next wash cycle for a total of 10 racks...record total water consumption.

Definitions for non-recirculating pumped final sanitizing rinse and recirculating final sanitizing rinse were added to sections 1(N)b and 1(N)c, respectively. Similarly, a new section on heaters is added to account more explicitly and directly for circulating water heaters, instantaneous water heater types, storage water heaters, and booster heaters in sections 1(I-L). Pumped rinse and post-sanitizing rinse mode definitions are now included in section 1(N). In response to stakeholder feedback, EPA proposed a new term and definition for *Washing Energy* in Section 1(S) in Draft 1 and received support from stakeholders for the new metric and definition. Additional clarifications to metrics, including water consumption, are also footnoted in that section. For example, one commenter was interested in whether the units for washing energy (kWh/rack) applied to flight types and EPA included footnotes citing ASTM F1920-15 to indicate that the units apply for flight types.

Regarding 'Power Rinse', EPA requests stakeholder feedback on this definition of the dishwasher term due to stakeholder request. EPA notes this term was not specifically defined in ASTM 1696/1920 or NSF170-2015. Definitions for warewashing machine heating equipment were added from NSF 170-2015 per stakeholder feedback.

EPA requests stakeholder feedback on these proposed definition changes.

191
192
193
194
195
196
197
198
199
200
201
202
203
204
205
206

2) **Scope:**

- A. **Included Products:** Products that meet the definition of a Commercial Dishwasher as specified herein are eligible for ENERGY STAR certification, 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 high temp flight type conveyor machines. Glasswashing machines; high temp PPU machines; dual sanitizing and heat recovery machines are also eligible. Only those under counter machines designed for wash cycles of 10 minutes or less are eligible for ENERGY STAR. This Version 3.0 specification only covers electric models.
- B. **Excluded Products:** Dishwashers intended for use in residential or laboratory applications are not eligible for ENERGY STAR under this product specification. PPU and Flight Type products which are only rated for Low temp operation; steam, gas, and other non-electric models are not eligible for ENERGY STAR certification under this Version 3.0.

Note: EPA received limited feedback on the removal of low temp flight type and low temp PPU machines from Version 3.0 scope. One commenter indicated that those machines should remain in the scope but should be separated from the high temp machines. EPA notes that these machines were in scope in Version 2.0 and were separated from high temp machines. However, the PPU and flight type machine request to drop low temp from scope was based on stakeholder comments regarding lack of availability of these models in a solely low temp configuration. EPA welcomes data submissions of product performance and availability on these machine types if the stakeholders wish to establish this product category within scope.

EPA notes that dual sanitizing machines (PPU and flight) are still eligible for certification and are assigned performance metrics based on high temp operation, which is consistent with Version 2.0. Certification data will reflect the high temperature categorization of these products.

207
208

209 3) **Certification Criteria:**

210

211

212

A. Energy and Water Efficiency Requirements:

Table 1: ENERGY STAR Requirements for Commercial Dishwashers			
Machine Type	Low Temperature Efficiency Requirements		
	Idle Energy Rate*	Washing Energy	Water Consumption**
Under Counter	≤ 0.25 kW	≤ 0.15 kWh/rack	≤ 1.19 GPR
Stationary Single Tank Door	≤ 0.30 kW	≤ 0.15 kWh/rack	≤ 1.18 GPR
Single Tank Conveyor	≤ 0.85 kW	≤ 0.16 kWh/rack	≤ 0.79 GPR
Multiple Tank Conveyor	≤ 1.00 kW	≤ 0.22 kWh/rack	≤ 0.54 GPR

213

214

Table 2: ENERGY STAR Requirements for Commercial Dishwashers			
Machine Type	High Temperature Efficiency Requirements		
	Idle Energy Rate*	Washing Energy	Water Consumption**
Under Counter	≤ 0.30 kW	≤ 0.35 kWh/rack	≤ 0.86 GPR
Stationary Single Tank Door	≤ 0.55 kW	≤ 0.35 kWh/rack	≤ 0.89 GPR
Pot, Pan, and Utensil (PPU)	≤ 0.90 kW	≤ 0.55 + 0.05 x SF _{rack} †	≤ 0.58 GPSF
Single Tank Conveyor	≤ 1.20 kW	≤ 0.36 kWh/rack	≤ 0.70 GPR
Multiple Tank Conveyor	≤ 1.85 kW	≤ 0.36 kWh/rack	≤ 0.54 GPR
Single Tank Flight Type	Reported	Reported	GPH ≤ 2.975x + 55.00
Multiple Tank Flight Type	Reported	Reported	GPH ≤ 4.96x + 17.00

215

216

217

218

219

220

221

222

223

* 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 unless it cannot be separately monitored per ASTM F1696-18 and ASTM F1920-15 Sections 10.8 and 10.9, respectively. ** GPR = gallons per rack; GPSF = gallons per square foot of rack; GPH = gallons per hour; x = maximum conveyor speed (feet/min as verified through NSF 3 certification) x conveyor belt width (feet). † PPU Washing Energy is still in format kWh/rack when evaluated; SF_{rack} is Square Feet of rack area, same as in PPU water consumption metric.

224

225

226

227

B. Washing Energy: The total washing energy shall include internal or external booster heater energy in addition to the tank, heat, motor, control, and any additional auxiliary energy, expressed in kWh/rack.

228

229

230

231

232

Note: EPA has revised multiple requirement levels for the Draft 2 specification based on additional wash performance data and stakeholder feedback.

Washing Energy

233

234

235

236

Multiple stakeholders collaborated independently with EPA to construct a masked dataset, with several additional data points for wash performance for both stationary door and single tank rack conveyor machines. This dataset contained stakeholder data and test data from select competitive machines, all tested in accredited laboratories. Overall, more than 5 major manufacturers were represented, and at

237 least 15 unique high temp wash data points were added to the EPA analysis dataset since Draft 1.

238

239 EPA thanks stakeholders for their participation in this effort; this data has allowed the Washing Energy
240 requirements to be fine-tuned to a larger data set and ensure that multiple manufacturers are represented
241 in the final data set. EPA has made minor revisions to requirement levels where appropriate based on the
242 data. This data set confirmed that the performance requirements drawn in Draft 1 were near the location
243 they would have been placed based on the full data set.

244

245 EPA further analyzed this data set, splitting energy recovery and non-energy recovery machines into
246 separate data sets and analyzing them individually. The outcome of this analysis was limited by the
247 number of wash data points, but did provide evidence in support the Energy Recovery Credit described in
248 the next section.

249

250 **Washing Energy: Pot Pan and Utensil**

251

252 EPA received feedback from manufacturers specific to PPU dishwashers, noting that the Draft 1 wash
253 requirement would have difficulty accounting for the sizing differences of single vs double width PPU
254 machines. Based on this feedback, EPA has run a specific analysis where all PPU machines in the data
255 set were sorted into bins based on rack sq.ft., and new wash requirements were estimated based on
256 these bins.

257

258 This analysis determined that a single value (kWh/rack*sf) was not sufficient to properly address the wash
259 requirement differences for the size bins, so this metric was converted to a linear function of sq.ft., and
260 refined to ensure both single and double width products were provided a suitable requirement. EPA notes
261 that limited PPU wash performance was available at the time of this analysis, so is requesting that
262 stakeholders submit additional feedback and data to ensure that their products are accounted for in the
263 fit.

264

265 **Water Consumption**

266

267 EPA received considerable feedback from stakeholders on current and future dishwasher performance
268 constraints relating to water consumption. Most feedback noted that sanitization performance is not
269 impacted by current and in some cases proposed water levels. However, rinseability, where particulates
270 are removed from ware and not redeposited, is very sensitive to the water level at lower water
271 allowances. Technologically, this is due to soil buildup in the recirculating tank and reduced water
272 consumption in rinse cycles. EPA is aware of industry development efforts to quantify rinseability via the
273 NSF 3 standard. EPA's intent is to incorporate this industry test procedure in a future revision once it has
274 been developed and approved by industry, to further ensure efficiency is not delivered at the expense of
275 dishwasher performance. EPA also acknowledges the energy consumption increases if ware is washed
276 twice. Due to these considerations, EPA is proposing to revert to Version 2.0 water consumption
277 requirements for all product types. EPA appreciates manufacturer feedback on this topic and looks
278 forward to future water efficiency developments, such as reducing the water used for drain water
279 tempering via energy recovery.

280

281 Stakeholders also commented on the history and context of the water consumption requirement, noting
282 that the requirement was developed as a proxy for energy use absent the ASTM industry test procedures
283 to measure washing energy performance. EPA recognizes the history of the requirement but remains
284 committed to protecting against trade-offs between energy efficiency gains and increased water
285 consumption. EPA is proposing to retain this water requirement, but not adjust the levels while no
286 sufficient metric can quantify the impact of water consumption on rinseability performance. EPA
287 welcomes stakeholder information that further quantifies the relation between water consumption and
288 dishwasher performance (sanitization, rinseability).

289

290 **Water Consumption: Dump and Fill Machines**

291

292 EPA received stakeholder comments on dump and fill dishwashers specific to water consumption. A
293 commenter noted that reduced water allowances were approaching the pump minimum water levels for
294 safe equipment operation (e.g. cavitation). This issue was particularly challenging in dump and fill
295 machines due to water in the lines counting toward the total water allowance (per rack). EPA notes that

296 the water consumption requirement rollback to Version 2 would also address these concerns.

297 **Idle Energy Rate**

298
299 EPA received limited feedback on proposed idle performance requirements; feedback was generally
300 favorable on the proposed levels.

301
302 EPA received a specific comment on the fact that booster idle energy is collected in the ASTM test
303 procedures, but not included in the idle energy rate metric, and the commenter recommended its
304 inclusion. EPA conducted additional outreach on this topic and received feedback and data. This
305 information suggested that the idle power requirements for booster heaters are approximately 15-20% of
306 the total idle power draw (door closed) of warewashing equipment under normal test conditions.

307
308 EPA agrees with the recommendation that booster energy be incorporated into the idle energy rate
309 requirement in a long term approach but notes that the ability to set requirements requires a suitable
310 dataset. Current data is limited to idle power without booster energy, with rare exceptions for non-sub-
311 meter-able booster heaters; lab feedback indicates this is a rare situation. EPA is proposing to collect
312 booster idle energy, to address this data gap and develop metrics for inclusion in a future revision.

313
314 One stakeholder commented on the ability of some machines to allow the temperature in the holding
315 tanks to be reduced when idling with the door closed, so long as the machine can resume to a normal
316 wash cycle rapidly. EPA notes that the ASTM test procedures include measurement of a Closed Door
317 Energy Saver Mode Idle Energy Rate. EPA requests manufacturer feedback on this topic, including how
318 often machines are designed and tested with this energy saver idle functionality. Provided sufficient
319 models are following this testing pathway, this data may be collected for incorporation in a future revision.

320
321 **Idle Energy Rate: Flight Type Machines**

322
323 EPA received feedback that flight type machines are typically purchased for their un-paralleled
324 throughput; as such, most flight type machines are either running continuously for the duration of a shift
325 or ware-washing window (e.g. after lunch to before dinner) or powered down. This feedback suggests that
326 very little of the product time is spent in an idle state, therefore an idle performance requirement would be
327 irrelevant to the in-the-field product energy usage. EPA finds this assessment well supported and is
328 instead focusing on the collection of wash energy for this product type, for the potential development of a
329 more representative metric in a future revision.

330
331 EPA thanks stakeholders for their essential contributions to the Draft 2 analysis, and further encourages
332 stakeholders to provide supplemental data if there are areas that are not aligned with stakeholder
333 experience / product performance. EPA welcomes stakeholder feedback on all aspects of the
334 performance requirement revisions in Draft 2.

335
336 C. Energy Recovery Credit: To be eligible for this credit, dishwashers shall:

- 337
338 a. Have at least one Energy Recovery feature, as defined in Section 1(D)(a-c); and,
339 b. Must be tested at energy recovery water inlet temperature in the corresponding ASTM
340 test procedure (70 °F ± 3 °F).

341
342 The Energy Recovery Credit is calculated as:

343
344
$$E_{\text{Credit}} [\text{kWh/rack}] = V [\text{gal/rack}] \times 0.097 [\text{kWh/gal}] \leq E_{\text{Credit_max; MachineType}}$$

345
346 An energy recovery credit for eligible models is to be applied once to dishwasher, not to exceed
347 $E_{\text{Credit_max}}$ values listed in **Table 3**. Credit is subtracted from ASTM measured washing energy
348 value to obtain an adjusted (credited) value. Specification requirements apply to the adjusted
349 value (i.e., $Wash_{\text{Measured}} - E_{\text{Credit}}$).

350
351 **Note:** This credit $E_{\text{Credit_max}}$ addresses an estimated 40 °F heating difference from inlet
352 temperature between energy recovery and conventional dishwashers, up to the median water
353 consumption of dishwashers in each type. A future revision to the specification where primary hot

354
355

water energy is incorporated into washing energy would support the removal of this credit.

Machine Type	Credit Value (kWh/rack)
Under Counter	0.07
Stationary Single Tank Door	0.07
Pot, Pan, and Utensil (PPU)	0.07 (kWh/Rack)
Single Tank Conveyor	0.06
Multiple Tank Conveyor	0.04

356
357

Note: Between Draft 1 release and the development of Draft 2, EPA constructed an Energy Recovery (ER) Credit for eligible dishwashers. This credit was intended to address the water inlet temperature testing requirement differences in ASTM between ER machines and non-ER machines, 70 °F and ≤140 °F (typically 110-120 °F), respectively. This credit was based on energy supplied to heat a volume of water by 40 °F; the water volume was approximated to be the median water consumption of the warewashing machines, by type. After stakeholder feedback, the scope of the credit remains open to both high temp and low temp machines, provided high temp machines meet one of the user amenity requirements in 1(D)(a-c), and low temp machines meet 1(D)(a).

Flight type dishwashers are excluded from the credit due to a lack of data to estimate and quantify the impact of the credit on program requirements, combined with the current reporting only wash data requirement. PPU dishwashers are given the same credit as stationary door type machines, since PPU is a subtype of door type dishwashers. Stakeholders are encouraged to provide additional data on PPU dishwasher energy recovery performance, as it may be possible to calculate a specific energy recovery credit for this product type with more information.

ER Credit Feedback

EPA collected considerable feedback on the ER Credit via one on one outreach with stakeholders. Feedback received was generally in support of developing a credit, but in most cases, requested that the credit be based on actual product water consumption instead of a product average / median. EPA agrees with this approach and has adjusted the ER Credit formula to provide a credit based on the measured water consumption (per rack) of the dishwasher. Due to the estimated size of the credit, EPA is proposing to include a maximum credit value per dishwasher, at the median water consumption value of each product type. EPA evaluated both the median and 75th percentile water consumption limits and noted that the similarity between the two values was sufficient to remain on the median level. EPA anticipates that minor decreases in water consumption organically from within each product type will reduce the impact of the cap.

EPA notes that the lack of a suitable energy recovery test procedure to reference (in the context of commercial dishwashers), was a key driver in developing the user amenity requirements in 1(D)(a-c), and is also a driver in applying a cap to the maximum credit that can be applied to a given product type. Additional information would be needed from manufacturers and third parties to make subsequent refinements including the type of heat recovery technology and associated energy savings.

Primary Hot Water Energy Use

EPA notes that the *primary hot water energy use* calculation in ASTM F1696-18 and F1920-15 (section 11) is a useful way to account for the difference in water inlet temperatures between energy recovery and non-energy recovery dishwashers as prescribed in the ASTM test procedures. EPA is not able to develop wash performance requirements based on this metric for this Version 3 revision, due to lack of available performance data in the format of this metric. EPA is instead requiring this data be collected for an

eventual changeover in a future revision.

358
359
360
361
362
363
364
365
366
367
368
369
370
371
372
373
374
375
376
377
378
379
380

- B. User-Adjustable Conveyor Machines: Conveyor machines that offer multiple speeds adjustable by the end user must meet the ENERGY STAR requirements using the maximum conveyor speed setting tested to and certified to NSF/ANSI Standard 3. Water consumption values using the maximum conveyor speed setting shall be used for certification purposes. Water consumption using the slowest conveyor speed shall also be reported to EPA.
- C. Dual Sanitizing Machines: As defined in Section 1, these machines shall meet both the high temp and low temp requirements presented in Tables 1 and 2, above, to earn ENERGY STAR certification.
- D. Dual Purpose Door Type Machines: Machines designed to be used either as a standard door type machine or a PPU machine shall meet the performance requirements for both of those subcategories.
- E. Post Sanitizing Machines: Machines offering a post sanitizing rinse will be evaluated for ENERGY STAR certification with the post sanitizing rinse turned on during testing. The final rinse water consumption will include both sanitizing and post sanitizing rinses.
- F. Industry Standard Certifications: All machines shall be certified to the NSF/ANSI 3-2019 Standard, *Commercial Warewashing Equipment*, OR a more recent NSF/ANSI 3 published standard.

Note: EPA updated the industry standard certification requirement in Section 3(F) to reflect the current NSF/ANSI 3-2019 standard. EPA also added the caveat that machines may certify to newer versions of NSF 3 if requested, as NSF 3-2019 is published recently and NSF 3-2020 is anticipated. EPA expects that any units that are submitted for ENERGY STAR certification will have first been certified under current and applicable NSF standards.

381
382
383
384
385
386
387
388
389
390
391
392
393
394

4) **Test Requirements:**

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

Table 3: Test Methods for ENERGY STAR Certification	
Dishwasher Category	Test Method Reference
Under-counter; stationary single tank door; pot-pan-utensil	ASTM F1696-18, <i>Standard Test Method for Energy Performance of Stationary-Rack, Door-Type Commercial Dishwashing Machines</i>
Single tank conveyor; multiple tank conveyor; single tank flight; multiple tank flight	ASTM F1920-15, <i>Standard Test Method for Energy Performance of Rack Conveyor Commercial Dishwashing Machines</i>

395
396
397
398
399

- C. Multiple Voltages: For dishwashers with multiple voltage-versatility and those that are available in different voltage configurations, the representative model shall be tested at the most energy consumptive (worst case scenario) rating, according to the manufacturer.

Note: EPA appreciates stakeholder feedback as it pertains to the ASTM F1696 and F1920 industry test

procedures. EPA is aware of ongoing test procedure development via the F26 working group and encourages stakeholders to follow and contribute to this process to further refine these test procedures. EPA intends to remain aligned with newly released versions of these test procedures after a review period. EPA notes that major test procedure changes, such as measurement of performance metrics, are typically not incorporated until the next full, in this case, commercial dishwasher revision, after ASTM test procedure publication including any energy performance changes.

400
401
402
403
404
405
406
407
408
409
410
411
412
413
414
415

D. 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 second decimal place.

- 5) **Effective Date:** The ENERGY STAR Commercial Dishwasher Specification shall take effect on **TBD**. To certify 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: The EPA anticipates this specification development process will be completed in early 2020 with the effective date following 9 months after.

416
417
418
419
420
421
422
423
424
425
426
427
428
429
430
431
432
433
434
435
436
437
438
439
440
441
442
443
444
445

- 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 certification is not automatically granted for the life of a product model.

A. Considerations for Future Revisions: EPA is committed to continuing to develop performance requirements for commercial dishwashers that more accurately reflect in-the-field performance and new technology that provides energy and water benefits to consumers.

- a. **New Performance Data Collected**
 - i. Booster heater idle energy
 - ii. Primary hot water energy use
 - iii. Flight type washing energy
- b. **New Categorization Data Collected**
 - i. Dump and Fill
 - ii. Energy Recovery
 - iii. Flight Type, Single vs Dual Rinse
- c. **Industry Test Procedures**
 - i. NSF 3 – Rinseability metric
 - ii. ASTM F1696 and ASTM F1920 updates
- d. **Other Considerations**
 - i. Drain water tempering savings
 - ii. Cycles between recirculating tank flush (Adaptive Solids Removal)
 - iii. Heat pump applications

Note: EPA does not consider this list exhaustive and welcomes stakeholder feedback on other areas of interest in the commercial dishwasher specification for consideration in either subsequent dot revisions or revisions in Version 4.0. On timeline, most of these technical changes will require at least the Version 3.0

449 dataset, once fully populated by certified products. Other items are dependent on industry publication
450 dates for new and existing standards in development.