



ENERGY STAR® Program Requirements Product Specification for Automatic Commercial Ice Makers

Eligibility Criteria Final Draft: Version 3.0

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Following is the **Final Draft Version 3.0** product specification for ENERGY STAR certified Automatic Commercial Ice Makers. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

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

- A. Automatic Commercial Ice Maker¹: A factory-made assembly (not necessarily shipped in 1 package) that: 1) consists of a condensing unit and ice-making section operating as an integrated unit, with means for making and harvesting ice; and 2) May include means for storing ice, dispensing ice, or storing and dispensing ice.
- B. Air-Cooled: An ice maker wherein motor driven fans or centrifugal blowers move air through the condenser to remove heat from the refrigerant.
- C. Water-Cooled: An ice maker that utilizes water running through the condenser to remove heat from the refrigerant.
- D. Batch-Type Ice Maker¹: An ice maker having alternate freezing and harvesting periods. This includes automatic commercial ice makers that produce cube type ice and other batch technologies.²
- E. Cube Type Ice¹: Ice that is fairly uniform, hard, solid, usually clear, and generally weighs less than two ounces (60 grams) per piece, as distinguished from flake, crushed, or fragmented ice.³
- F. Continuous-Type Ice Maker¹: An ice maker that continually freezes and harvests ice at the same time. The following ice types are produced by continuous machines:
 - a. Flake: typically used for cooling food, commercial and industrial process cooling, and special medical and scientific cooling applications.
 - b. Nugget: typically used for cooling water and beverage drinks, and for a chewable ice with a softer consistency than cube ice.

Ice Maker Categories

- G. Ice Making Head (IMH)¹: Automatic commercial ice makers that do not contain integral storage bins, but are generally designed to accommodate a variety of bin capacities. Storage bins entail additional energy use not included in the reported energy consumption figures for these units.

¹ Based on definitions in 10 CFR Part 431.132. When in conflict, the definitions in 10 CFR Part 431.132 take precedence.

² Referred to as cube type ice maker in AHRI Standard 810-2007 with Addendum 1 (incorporated by reference, see § 431.133).

³ Note that this conflicts and takes precedence over the definition established in AHRI 810-2007 with Addendum 1 (incorporated by reference, see § 431.133), which indicates that “cube” does not reference a specific size or shape.

- 50 H. Remote Condensing Unit (RCU)¹ or Split System Unit: A type of automatic commercial ice maker
51 in which the ice-making mechanism and condenser or condensing unit are in separate sections.
52 This includes ice makers with and without remote compressor.
53
54 I. Self-Contained Unit (SCU)¹: A type of automatic commercial ice maker in which the ice-making
55 mechanism and storage compartment are in an integral cabinet.
56

57 ***Metric Definitions***
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- 59 J. Energy Use¹: The total energy consumed, stated in kilowatt hours per one-hundred pounds
60 (kWh/100 lb) of ice, stated in multiples of 0.1. For remote condensing (but not remote
61 compressor) automatic commercial ice makers and remote condensing and remote
62 compressor automatic commercial ice makers, total energy consumed shall include the energy
63 use of the ice-making mechanism, the compressor, and the remote condenser or condensing
64 unit.
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66 K. Harvest Rate¹: The amount of ice (at 32 degrees F) in pounds produced per 24 hours.
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68 L. Ice Hardness Factor¹: The latent heat capacity of harvested ice, in British thermal units per
69 pound of ice (Btu/lb) divided by 144 Btu/lb expressed as a percent.
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71 M. Potable Water Use: The amount of potable water used in making ice, which is equal to the sum of
72 the ice harvested, Dump or Purge Water, and the Harvest Water expressed in gal/100 lb [L/45.0
73 kg] of ice, stated in multiples of 0.1. Alternatively, the amount of water entering the icemaker per
74 cycle can be measured.
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76 N. Dump or Purge Water: The water from the ice making process that is not frozen at the end of the
77 freeze cycle and is discharged from a batch and continuous type Automatic Commercial Ice-
78 Maker.
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80 O. Harvest Water: The water that has been collected with the ice used to measure the machine's
81 capacity.
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83 P. Basic Model¹: All units of a given type of covered product (or class thereof) manufactured by one
84 manufacturer, having the same primary energy source, and which have essentially identical
85 electrical, physical, and functional (or hydraulic) characteristics that affect energy consumption,
86 energy efficiency, water consumption, or water efficiency.
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88 ***Connected ACIM Definitions***
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- 90 Q. Communication Link: The mechanism for bi-directional data transfers between the ACIM and
91 one or more external applications, devices or systems.
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93 R. Demand Response (DR): Changes in electric usage by demand-side resources from their normal
94 consumption patterns in response to changes in the price of electricity over time, or to incentive
95 payments designed to induce lower electricity use at times of high wholesale market prices or
96 when system reliability is jeopardized.⁴
97
98 S. Demand Response Management System (DRMS): The system operated by a program
99 administrator, such as the utility or third party, which dispatches signals with DR instructions
100 and/or price signals to the ENERGY STAR ACIM products and receives messages from the
101 ACIM product.
102
103 T. Interface Specification: A document or collection of documents that contains detailed technical
104 information to facilitate access to relevant data and product capabilities over a communications
105 interface.
106

- 107 U. Load Management Entity: Device, service or system that interacts with the product to shift,
 108 control or manage ice maker electrical usage, e.g. a DRMS or energy management system.
 109
 110 V. Open Standards: Communication with entities outside the ACIM that use, for all communication
 111 layers, standards:
 112
 113 • Included in the Smart Grid Interoperability Panel (SGIP) Catalog of Standards,⁵ and/or
 114 • Included in the NIST Smart Grid Framework Tables 4.1 and 4.2, and/or
 115 • Adopted by the American National Standards Institute (ANSI) or another well-established
 116 international standards organization such as the International Organization for
 117 Standardization (ISO), International Electrotechnical Commission (IEC), International
 118 Telecommunication Union (ITU), Institute of Electrical and Electronics Engineers (IEEE) or
 119 Internet Engineering Task Force (IETF).

122 **2) Scope:**

- 124 A. Included Products: Products that meet the definition of an Automatic Commercial Ice Maker as
 125 specified herein that are air-cooled batch or continuous type, and of IMH, RCU, or SCU design,
 126 are eligible for ENERGY STAR qualification, with the exception of products listed in Section 2.B.
 127 Air-cooled RCUs designed for connection to remote rack compressors that are alternately sold
 128 (with the same model number) with a dedicated remote condensing unit are also eligible for
 129 ENERGY STAR qualification (based on measured performance with the associated dedicated
 130 condensing unit).
 131
 132 B. Excluded Products: Water-cooled ice makers, ice makers with ice and water dispensing
 133 systems, and air-cooled RCUs that are designed only for connection to remote rack
 134 compressors are not eligible for ENERGY STAR qualification.
 135

137 **3) Certification Criteria:**

- 139 A. Measure the energy use and potable water use of each covered product by conducting the test
 140 procedure set forth in Section 5. Compare the Energy Use and the measured Potable Water Use
 141 values to the ENERGY STAR minimum values presented in Tables 1 and 2.
 142
 143 B. Energy Use (Energy Consumption Rate): The Energy Use requirement is a function of harvest
 144 rate in the form of $L = A * H + b$, where L is the energy use requirement level, H is the ice harvest
 145 rate for the system under evaluation, A is a coefficient, and b is a constant.
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Table 1: ENERGY STAR Requirements for Air-Cooled Batch-Type Ice Makers			
Equipment Type	Applicable Ice Harvest Rate Range (lbs of ice/24 hrs)	Energy Use (kWh/100 lbs ice)	Potable Water Use (gal/100 lbs ice)
IMH	$H < 300$	$\leq 9.20 - 0.01134H$	≤ 20.0
	$300 \leq H < 800$	$\leq 6.49 - 0.0023H$	
	$800 \leq H < 1500$	$\leq 5.11 - 0.00058H$	
	$1500 \leq H \leq 4000$	≤ 4.24	
RCU	$50 \leq H < 1000$	$\leq 7.17 - 0.00308H$	≤ 20.0
	$1000 \leq H \leq 4000$	≤ 4.10	
SCU	$H < 110$	$\leq 12.57 - 0.0399H$	≤ 25.0
	$110 \leq H < 200$	$\leq 10.56 - 0.0215H$	
	$200 \leq H \leq 4000$	≤ 6.25	

⁴ FERC National Assessment & Action Plan on Demand Response, <https://www.ferc.gov/industries/electric/industry-act/demand-response/dr-potential.asp>

⁵ http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/PMO#Catalog_of_Standards_Processes

Equipment Type	Applicable Ice Harvest Rate Range (lbs of ice/24 hrs)	Energy Use (kWh/100 lbs ice)	Potable Water Use (gal/100 lbs ice)
IMH	$H < 310$	$\leq 7.90 - 0.005409H$	≤ 15.0
	$310 \leq H < 820$	$\leq 7.08 - 0.002752H$	
	$820 \leq H \leq 4000$	≤ 4.82	
RCU	$H < 800$	$\leq 7.76 - 0.00464H$	≤ 15.0
	$800 \leq H \leq 4000$	≤ 4.05	
SCU	$H < 200$	$\leq 12.37 - 0.0261H$	≤ 15.0
	$200 \leq H < 700$	$\leq 8.24 - 0.005429H$	
	$700 \leq H \leq 4000$	≤ 4.44	

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Note: Overall EPA received significant support from stakeholders on the proposed Draft 2 certification criteria. However, some commenters requested that the Agency consider amending the energy use criteria for several equipment types, to allow greater ENERGY STAR product availability. EPA understands that certain technological advancements may be more readily available for some ACIM classifications and sizes than others; however, as indicated previously, the Agency aims to identify the most energy efficient products in each category while offering sufficient availability and options among qualifying products to customers and believes the proposed levels satisfy this intention.

One commenter requested that EPA consider adjusting the proposed Draft 2 Energy Use criteria such that products are available within each harvest rate range, for each equipment type. EPA reviewed the dataset, and for all equipment types and ice harvest ranges where performance data is available, except the Batch IMH (harvest range < 310 lb. ice/day), a minimum of at least one currently available product meets the proposed certification criteria. With an average of 18% of models meeting the criteria overall for all categories and sizes, EPA believes the certification criteria for these products represent challenging, but achievable criteria, while ensuring meaningful savings for end-users. Based on discussions with several ACIM manufacturers throughout this specification revision process, EPA understands that additional highly efficient products can be expected to enter the market in 2018, and could not be included in this data analysis. As such, EPA is maintaining the Draft 2 certification criteria in this Final Draft.

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Remote Condensing Units

One stakeholder suggested EPA consider developing separate certification requirements for batch and continuous ice makers classified as remote condensing units with remote compressors, and without remote compressors. The Agency considered this approach, but based on limited performance data for both RCUs with or without remote compressors, the Agency did not see strong variation between the energy consumption of the products. Based on the available data, EPA established certification criteria for RCUs which allows multiple models of both configurations to meet the proposed levels. Although the U.S. Department of Energy (DOE) separated RCUs with or without remote compressors, the categories are so closely aligned in the federal minimum standards, that there is little or no difference in allowable energy use. For example, batch RCUs with and without remote compressors with a harvest rate of less than 942 lbs. ice/24 hours have identical energy use requirements. Similarly, continuous RCUs with and without remote compressors with a harvest rate of less than 800 lbs. ice/24 hours must meet the same energy use requirements. Based on this rationale, and for reasons mentioned in the Draft 1 comment matrix, EPA is not developing separate criteria for RCUs with and without remote compressors. However, the classification of RCUs with remote compressors and without remote compressors will be reported and will be reflected on the Product Finder to allow customers to choose the best fit for their operation.

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Ice Hardness Factor Rating

Commenters noted that the current ENERGY STAR Product Finder includes continuous ACIMs with an ice hardness factor rating above 100%, and indicated that this may cause confusion for purchasers or other stakeholders. EPA received a request to consider capping the reported ice hardness rating at 100%. While EPA understands the intention of the request, to ensure there is not additional testing burden placed on partners, EPA will maintain reporting of these values consistent with the DOE test procedure. The Agency will work with interested stakeholders to help educate purchasers about the meaning of the ice hardness rating, and how to interpret a value that may exceed 100%.

194 C. Significant Digits and Rounding:

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196 a. All calculations shall be carried out with directly measured (unrounded) values. Final ratings for
197 should be rounded in accordance with the DOE test procedure provisions, when applicable.
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199 b. Directly measured or calculated values that are submitted for reporting on the ENERGY STAR
200 website shall be calculated in accordance with the requirements for determining certified ratings
201 for DOE, when applicable.
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203 D. Additional Reporting Requirement

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205 a. Report the type of refrigerant used in the respective ACIM model, for example: R-404A, R-
206 290, or R-134a.
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208 **Note:** EPA received strong support for requiring reporting of refrigerant type and listing that information in
209 the Product Finder. EPA plans to provide a drop-down list of refrigerants for labs and CBs to select when
210 testing and certifying ACIMs.

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212 One stakeholder requested that EPA convey the message that ACIMs have a current hydrocarbon
213 charge limit of 150 grams, and that there are ACIM classifications and sizes that would require a greater
214 charge. EPA is aware of the hydrocarbon charge limit for ACIMs and understands that certain machines
215 with higher capacity may present additional challenges. EPA expects manufacturers and customers will
216 understand where alternatives can be expected to be used. If needed, EPA can provide educational
217 language clarifying this point on its website.

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220 **4) Optional Connected Functionality in Automatic Commercial Ice Makers:**

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222 For connected recognition, the following **optional** connected criteria are applicable to Included Products
223 in Section 2.A:

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225 A. Remote Management

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227 The product shall be capable of receiving and responding to remote requests via a
228 communication link that enable intelligent control of ice production in order to reduce energy use
229 and/or energy expense. For example, such functionality could enable interconnection with an
230 external device, or service that actively alters ice production in order to minimize energy expense
231 when enrolled in a Time-of-Use or other time-varying electricity price program.
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234 B. Demand Response (DR)

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236 a. Grid Communications – The product shall include a communication link that facilitates the
237 use of open standards, as defined in this specification, for all communication layers to enable
DR functionality.

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239 **Note:** *Products that enable direct, on-premises, open-standards based interconnection are preferred,*
240 *but alternative approaches, where open-standards connectivity is enabled only with use of off-*
premise services, are also acceptable.

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242 b. Open Access – To enable interconnection with the product over the communication link, an
243 interface specification, application programming interface (API) or similar documentation shall
be made available that, at a minimum, enables DR functionality.

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245 **Note:** *While EPA encourages broad availability of the interface spec or API, dissemination of these*
246 *documents may be limited to certified/qualified developers, integration partners and other similar*
entities.

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248 c. Consumer Override – The product shall be capable of supporting DR event override-ability.

249 **Note:** Based on in field studies with ACIMs supporting DR and Load Shifting strategies, EPA
 250 recommends including automatic DR/Load Shift exit points, based on ice bin levels (sensor). These
 251 exit points include a critical minimum level (often 25% bin capacity), and a sudden ice drop indicator
 252 (often 10% bin level in 5 minutes); these exit points ensure that end user ice levels are protected from
 253 sudden rushes, and from ice levels dropping below levels required for business operations.
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255 C. Capabilities Summary – A ≤ 250-word summary description of the product’s Remote
 256 Management and DR capabilities/services shall be submitted. In this summary, EPA
 257 recommends noting the following, as applicable:

- 258 • Overview of Remote Management capability that the product supports, notable capabilities
 259 that can reduce energy usage or reduce energy expense.
- 260 • DR services that the product has the capability to participate in such as load dispatch,
 261 ancillary services, price notification and price response.
- 262 • Whether the product can be directly addressed via the interface specification, API or similar
 263 documentation.
- 264 • List open communications supported by the product, including applicable certifications.
- 265 • Feedback to Load Management Entity, e.g. verification/M&V, override notification.
- 266 • Measures to limit DR impacts, including automatic DR exit strategies, if any.
- 267 • DR response configurability/flexibility by the customer and/or Load Management Entity.
 268

Note: EPA appreciates the stakeholder comments and discussions on the connected section, and agrees that the flexibility in the specification DR requirements is in part to allow manufacturers to implement more than one connectivity pathway when appropriate for their customer base. EPA notes that both CTA-2045 and Open ADR 2.0 are designed to streamline the connection from device to utility, and would be a viable communications approach to incorporating Demand Response in Commercial Ice Machines. EPA encourages Demand Response approaches that place the highest priority on maintaining ice levels and quality, and notes that ice level sensors are one likely approach to this strategy. EPA also agrees that this technology in Commercial Ice Machines is not yet widely established and is ready to serve as a technical and educational resource for partners.

EPA reminds stakeholders that connected functionality in ACIMs is optional and does not preclude eligible products from ENERGY STAR certification. However, for products that do incorporate connected functionality and meet the optional criteria provided in Section 4, the Agency will work with the manufacturer and certification body, as needed, in developing the summary description of the product’s Remote Management and DR capabilities mentioned in Section 4.C.

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 271 **5) Test Requirements:**

- 272 A. Units shall be selected for testing per the sampling requirements defined in 10 CFR § 429.45,
 273 which references 10 CFR § 429.11.
- 274 B. When testing commercial ice makers, the following test methods shall be used to determine
 275 ENERGY STAR certification:
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Table 3: Test Methods for ENERGY STAR Qualification	
ENERGY STAR Requirement	Test Method Reference
Energy Use (kWh/100 lbs ice)	10 CFR Part 431.134
Potable Water Use (gal/100 lbs ice)	AHRI Standard 810-2007 with Addendum 1, (AHRI 810) <i>Performance Rating of Automatic Commercial Ice-Makers</i>

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Note: EPA received a comment requesting that the Agency consider verification testing alternatives to alleviate the cost burden on manufacturers. While EPA is currently conducting a component verification inspection pilot for one product category, EPA has not determined which (if any) product category may be selected in the future.

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6) Effective Date: The ENERGY STAR Automatic Commercial Ice Maker specification shall take effect on **January 28, 2018**. 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: The Version 3.0 effective date has been aligned with the DOE energy conservation standards for ACIMs.

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7) 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.