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

Eligibility Criteria
Final Draft: Version 3.0

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 Maker: 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 Maker: An ice maker having alternate freezing and harvesting periods. This includes automatic commercial ice makers that produce cube type ice and other batch technologies.

E. Cube Type Ice: 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.

F. Continuous-Type Ice Maker: 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): 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.

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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.
H. Remote Condensing Unit (RCU)\(^1\) or Split System Unit: A type of automatic commercial ice maker in which the ice-making mechanism and condenser or condensing unit are in separate sections. This includes ice makers with and without remote compressor.

I. Self-Contained Unit (SCU)\(^1\): A type of automatic commercial ice maker in which the ice-making mechanism and storage compartment are in an integral cabinet.

**Metric Definitions**

J. Energy Use\(^1\): The total energy consumed, stated in kilowatt hours per one-hundred pounds (kWh/100 lb) of ice, stated in multiples of 0.1. For remote condensing (but not remote compressor) automatic commercial ice makers and remote condensing and remote compressor automatic commercial ice makers, total energy consumed shall include the energy use of the ice-making mechanism, the compressor, and the remote condenser or condensing unit.

K. Harvest Rate\(^1\): The amount of ice (at 32 degrees F) in pounds produced per 24 hours.

L. Ice Hardness Factor\(^1\): The latent heat capacity of harvested ice, in British thermal units per pound of ice (Btu/lb) divided by 144 Btu/lb expressed as a percent.

M. Potable Water Use: The amount of potable water used in making ice, which is equal to the sum of the ice harvested, Dump or Purge Water, and the Harvest Water expressed in gal/100 lb [L/45.0 kg] of ice, stated in multiples of 0.1. Alternatively, the amount of water entering the icemaker per cycle can be measured.

N. Dump or Purge Water: The water from the ice making process that is not frozen at the end of the freeze cycle and is discharged from a batch and continuous type Automatic Commercial Ice Maker.

O. Harvest Water: The water that has been collected with the ice used to measure the machine's capacity.

P. Basic Model\(^1\): All units of a given type of covered product (or class thereof) manufactured by one manufacturer, having the same primary energy source, and which have essentially identical electrical, physical, and functional (or hydraulic) characteristics that affect energy consumption, energy efficiency, water consumption, or water efficiency.

**Connected ACIM Definitions**

Q. Communication Link: The mechanism for bi-directional data transfers between the ACIM and one or more external applications, devices or systems.

R. Demand Response (DR): Changes in electric usage by demand-side resources from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized.\(^4\)

S. Demand Response Management System (DRMS): The system operated by a program administrator, such as the utility or third party, which dispatches signals with DR instructions and/or price signals to the ENERGY STAR ACIM products and receives messages from the ACIM product.

T. Interface Specification: A document or collection of documents that contains detailed technical information to facilitate access to relevant data and product capabilities over a communications interface.
U. **Load Management Entity**: Device, service or system that interacts with the product to shift, control or manage ice maker electrical usage, e.g. a DRMS or energy management system.

V. **Open Standards**: Communication with entities outside the ACIM that use, for all communication layers, standards:

- Included in the Smart Grid Interoperability Panel (SGIP) Catalog of Standards,\(^5\) and/or
- Included in the NIST Smart Grid Framework Tables 4.1 and 4.2, and/or
- Adopted by the American National Standards Institute (ANSI) or another well-established international standards organization such as the International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), International Telecommunication Union (ITU), Institute of Electrical and Electronics Engineers (IEEE) or Internet Engineering Task Force (IETF).

2) **Scope**:

A. **Included Products**: Products that meet the definition of an Automatic Commercial Ice Maker as specified herein that are air-cooled batch or continuous type, and of IMH, RCU, or SCU design, are eligible for ENERGY STAR qualification, with the exception of products listed in Section 2.B. Air-cooled RCUs designed for connection to remote rack compressors that are alternately sold (with the same model number) with a dedicated remote condensing unit are also eligible for ENERGY STAR qualification (based on measured performance with the associated dedicated condensing unit).

B. **Excluded Products**: Water-cooled ice makers, ice makers with ice and water dispensing systems, and air-cooled RCUs that are designed only for connection to remote rack compressors are not eligible for ENERGY STAR qualification.

3) **Certification Criteria**:

A. Measure the energy use and potable water use of each covered product by conducting the test procedure set forth in Section 5. Compare the Energy Use and the measured Potable Water Use values to the ENERGY STAR minimum values presented in Tables 1 and 2.

B. **Energy Use (Energy Consumption Rate)**: The Energy Use requirement is a function of harvest rate in the form of \( L = A \cdot H + b \), where \( L \) is the energy use requirement level, \( H \) is the ice harvest rate for the system under evaluation, \( A \) is a coefficient, and \( b \) is a constant.

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Applicable Ice Harvest Rate Range (lbs of ice/24 hrs)</th>
<th>Energy Use (kWh/100 lbs ice)</th>
<th>Potable Water Use (gal/100 lbs ice)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IMH</strong></td>
<td>( H &lt; 300 )</td>
<td>( \leq 9.20 - 0.01134H )</td>
<td>( \leq 20.0 )</td>
</tr>
<tr>
<td></td>
<td>( 300 \leq H &lt; 800 )</td>
<td>( \leq 6.49 - 0.0023H )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( 800 \leq H &lt; 1500 )</td>
<td>( \leq 5.11 - 0.00058H )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( 1500 \leq H \leq 4000 )</td>
<td>( \leq 4.24 )</td>
<td></td>
</tr>
<tr>
<td><strong>RCU</strong></td>
<td>( 50 \leq H &lt; 1000 )</td>
<td>( \leq 7.17 - 0.00308H )</td>
<td>( \leq 20.0 )</td>
</tr>
<tr>
<td></td>
<td>( 1000 \leq H \leq 4000 )</td>
<td>( \leq 4.10 )</td>
<td></td>
</tr>
<tr>
<td><strong>SCU</strong></td>
<td>( H &lt; 110 )</td>
<td>( \leq 12.57 - 0.0399H )</td>
<td>( \leq 25.0 )</td>
</tr>
<tr>
<td></td>
<td>( 110 \leq H &lt; 200 )</td>
<td>( \leq 10.56 - 0.0215H )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( 200 \leq H \leq 4000 )</td>
<td>( \leq 6.25 )</td>
<td></td>
</tr>
</tbody>
</table>

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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.

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 RCU’s 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 RCU’s which allows multiple models of both configurations to meet the proposed levels. Although the U.S. Department of Energy (DOE) separated RCU’s 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 RCU’s with and without remote compressors with a harvest rate of less than 942 lbs. ice/24 hours have identical energy use requirements. Similarly, continuous RCU’s 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 RCU’s with and without remote compressors. However, the classification of RCU’s 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.

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%.

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Applicable Ice Harvest Rate Range (lbs of ice/24 hrs)</th>
<th>Energy Use (kWh/100 lbs ice)</th>
<th>Potable Water Use (gal/100 lbs ice)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMH</td>
<td>H &lt; 310</td>
<td>≤ 7.90 – 0.005409H</td>
<td>≤ 15.0</td>
</tr>
<tr>
<td></td>
<td>310 ≤ H &lt; 820</td>
<td>≤ 7.08 – 0.002752H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>820 ≤ H ≤ 4000</td>
<td>≤ 4.82</td>
<td></td>
</tr>
<tr>
<td>RCU</td>
<td>H &lt; 800</td>
<td>≤ 7.76 – 0.00464H</td>
<td>≤ 15.0</td>
</tr>
<tr>
<td></td>
<td>800 ≤ H ≤ 4000</td>
<td>≤ 4.05</td>
<td></td>
</tr>
<tr>
<td>SCU</td>
<td>H &lt; 200</td>
<td>≤ 12.37 – 0.0261H</td>
<td>≤ 15.0</td>
</tr>
<tr>
<td></td>
<td>200 ≤ H &lt; 700</td>
<td>≤ 8.24 – 0.005429H</td>
<td></td>
</tr>
<tr>
<td></td>
<td>700 ≤ H ≤ 4000</td>
<td>≤ 4.44</td>
<td></td>
</tr>
</tbody>
</table>
C. Significant Digits and Rounding:

a. All calculations shall be carried out with directly measured (unrounded) values. Final ratings should be rounded in accordance with the DOE test procedure provisions, when applicable.

b. Directly measured or calculated values that are submitted for reporting on the ENERGY STAR website shall be calculated in accordance with the requirements for determining certified ratings for DOE, when applicable.

D. Additional Reporting Requirement

a. Report the type of refrigerant used in the respective ACIM model, for example: R-404A, R-290, or R-134a.

Note: EPA received strong support for requiring reporting of refrigerant type and listing that information in the Product Finder. EPA plans to provide a drop-down list of refrigerants for labs and CBs to select when testing and certifying ACIMs.

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

4) Optional Connected Functionality in Automatic Commercial Ice Makers:

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

A. Remote Management

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

B. Demand Response (DR)

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

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

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

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

c. Consumer Override – The product shall be capable of supporting DR event override-ability.
Note: Based on in field studies with ACIMs supporting DR and Load Shifting strategies, EPA recommends including automatic DR/Load Shift exit points, based on ice bin levels (sensor). These exit points include a critical minimum level (often 25% bin capacity), and a sudden ice drop indicator (often 10% bin level in 5 minutes); these exit points ensure that end user ice levels are protected from sudden rushes, and from ice levels dropping below levels required for business operations.

C. Capabilities Summary – A ≤ 250-word summary description of the product’s Remote Management and DR capabilities/services shall be submitted. In this summary, EPA recommends noting the following, as applicable:

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

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.

5) Test Requirements:

A. Units shall be selected for testing per the sampling requirements defined in 10 CFR § 429.45, which references 10 CFR § 429.11.

B. When testing commercial ice makers, the following test methods shall be used to determine ENERGY STAR certification:

<table>
<thead>
<tr>
<th>ENERGY STAR Requirement</th>
<th>Test Method Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Use (kWh/100 lbs ice)</td>
<td>10 CFR Part 431.134</td>
</tr>
<tr>
<td>Potable Water Use (gal/100 lbs ice)</td>
<td>AHRI Standard 810-2007 with Addendum 1, (AHRI 810) Performance Rating of Automatic Commercial Ice-Makers</td>
</tr>
</tbody>
</table>
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.

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.

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.