



ENERGY STAR® Program Requirements Product Specification for Residential Refrigerators

Eligibility Criteria Draft 3 Version 5.0

Following is the **Draft 3 Version 5.0** product specification for ENERGY STAR qualified residential refrigerators. A product shall meet all of the identified criteria to earn the ENERGY STAR.

Note: This Draft 3 Version 5.0 specification contains EPA's proposed revisions for residential refrigerators and freezers, including changes to the energy use requirements, the optional connected criteria and the effective date. Please send comments via email to appliances@energystar.gov no later than October 9, 2012.

1) Definitions: Below are the definitions of the relevant terms in this document. Unless otherwise specified, these definitions are identical with definitions in the DOE test procedures at 10 CFR 430, Subpart B, Appendix A or in 10 CFR 430.2.

- A. **Electric Refrigerator:** A cabinet designed for the refrigerated storage of food, designed to be capable of achieving storage temperatures above 32°F (0°C) and below 39°F (3.9°C), and having a source of refrigeration requiring single phase, alternating current electric energy input only. An electric refrigerator may include a compartment for the freezing and storage of food at temperatures below 32°F (0°C), but does not provide a separate low temperature compartment designed for the freezing and storage of food at temperatures below 8°F (-13.3°C).
- B. **Freezer:** A cabinet designed as a unit for the freezing and storage of food at temperatures of 0 °F (-17.8°C) or below, and having a source of refrigeration requiring single phase, alternating current electric energy input only.
- C. **Electric Refrigerator-Freezer:** A cabinet which consists of two or more compartments with at least one of the compartments designed for the refrigerated storage of food at temperatures above 32 °F (0°C) and below 39°F (3.9°C), and with at least one of the compartments designed for the freezing and storage of food at temperatures below 8 °F (-13.3°C) which may be adjusted by the user to a temperature of 0 °F (-17.8°C) or below. The source of refrigeration requires single phase, alternating current electric energy input only.
- D. **Adjusted Volume (AV):** The sum of the fresh food compartment volume in cubic feet, and the product of an adjustment factor and the net freezer compartment volume.
- E. **Compact refrigerator/refrigerator-freezer/freezer:** Any refrigerator, refrigerator-freezer or freezer with total volume less than 7.75 cubic feet (220 liters) (rated volume as determined in Appendix A and B of 10 CFR § 430 subpart B) and 36 inches (0.91 meters) or less in height.
- F. **Built-in refrigerator/refrigerator-freezer/freezer:** Any refrigerator, refrigerator-freezer, or freezer with 7.75 cubic feet or greater total volume and 24 inches or less depth not including doors, handles, and custom front panels; with sides which are not finished and not designed to be visible after installation; and that is designed, intended, and marketed exclusively (1) to be installed totally encased by cabinetry or panels that are attached during installation, (2) to be securely fastened to adjacent cabinetry, walls or floor, and (3) to either be equipped with an integral factory-finished face or accept a custom front panel.
- G. **Basic Model:** All units of a given type of 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.

Note: EPA is proposing several changes in Draft 3 that have minor impacts on the language in Section 1. First, EPA is proposing the Version 5.0 specification be effective in March 2014 instead of January 2013 as was proposed in Draft 2. The revised Draft 3 has been structured to reference the DOE test procedure that will be used starting in 2014. As a result, references throughout the specification, including those in Sections 1, 3B, 3C, and 5, have been updated to cite the latest DOE test procedure for refrigerators and refrigerator-freezers (Appendix A) that would be used to rate a product's energy performance under Version 5.0. Additionally, EPA is proposing to sunset full-size and compact freezers from the program (See note box in Section 3 for additional discussion). Therefore, EPA has removed the reference to the DOE test procedure for freezers from Section 1.

EPA welcomes comments on the changes being proposed in Section 1.

2) Scope:

- A. **Included Products:** Products that meet the definition of an Electric Refrigerator, Electric Refrigerator-Freezer, and/or Compact Refrigerator/Refrigerator-Freezer, as specified herein and the definition of a consumer product as specified in 10 CFR § 430.2 are eligible for ENERGY STAR qualification.
- B. **Excluded Products:** Commercial models, Freezers, and Refrigerators and Refrigerator-Freezers with total refrigerated volume exceeding 39 cubic feet are not eligible for ENERGY STAR. Products that are covered under other ENERGY STAR product specifications (e.g. Commercial Refrigerators) are not eligible for qualification under this specification. Wine refrigerators or other products that do not meet the definition of an Electric Refrigerator or Electric Refrigerator-Freezer are not eligible for qualification under this specification.

Note: As discussed in the prior note box, EPA has revised the Version 5.0 scope to reflect the Agency's proposal to sunset freezers from the program (see Section 3 note box for additional discussion).

3) Qualification Criteria:

A. Energy Use Requirements

1. Annual Energy Consumption (AEC) shall be less than or equal to Maximum Annual Energy Consumption (AEC_{MAX}), as calculated per Equation 1.

Equation 1. Calculation of Maximum Annual Energy Consumption Requirement

$$AEC_{MAX} = AEC_{BASE} + \sum_{i=1}^n AEC_{ADD_i}$$

where,

AEC_{BASE} is the annual energy consumption base allowance, per Table 1; and

AEC_{ADD_i} is an annual energy functional adder, per Table 2

Table 1: Annual Energy Consumption Base Allowances

Product Class	Annual Energy Consumption Base Allowance, AEC_{BASE} (kWh/year)	% Less Energy than Federal Standard (Compliance Date of: 9/15/2014)
<i>Full-Size Refrigerators and Refrigerator-freezers</i>		
1. Refrigerator-freezers and refrigerators other than all-refrigerators with manual defrost	$7.19 * AV + 202.5$	10%
1A. All-refrigerators—manual defrost	$6.11 * AV + 174.2$	10%
2. Refrigerator-freezers—partial automatic defrost	$7.19 * AV + 202.5$	10%
3. Refrigerator-freezers—automatic defrost with top-mounted freezer without through-the-door ice service —automatic defrost	$7.26 * AV + 210.3$	10%
3–BI. Built-in refrigerator-freezer—automatic defrost with top-mounted freezer without an automatic icemaker	$7.96 * AV + 230.4$	13%
3I. Refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker without through-the-door ice service	$7.26 * AV + 285.9$	10%
3I–BI. Built-in refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker without through-the-door ice service	$7.96 * AV + 303.5$	13%
3A. All-refrigerators—automatic defrost	$6.36 * AV + 181.4$	10%
3A–BI. Built-in All-refrigerators—automatic defrost	$6.98 * AV + 198.8$	13%
4. Refrigerator-freezers—automatic defrost with side-mounted freezer without through-the-door ice service	$7.66 * AV + 268.0$	10%
4–BI. Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer without an automatic icemaker	$8.89 * AV + 310.9$	13%
4I. Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker without through-the-door ice service	$7.66 * AV + 343.6$	10%
4I–BI. Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker without through-the-door ice service	$8.89 * AV + 384.0$	13%
5. Refrigerator-freezers—automatic defrost with bottom-mounted freezer without through-the-door ice service	$7.97 * AV + 285.3$	10%
5–BI. Built-In Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker	$8.18 * AV + 293.1$	13%
5I. Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker without through-the-door ice service	$7.97 * AV + 360.9$	10%
5I–BI. Built-In Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker without through-the-door ice service	$8.18 * AV + 366.2$	13%
5A. Refrigerator-freezers—automatic defrost with bottom-mounted freezer with through-the-door ice service	$8.33 * AV + 427.9$	10%
5A–BI. Built-in refrigerator-freezer—automatic defrost with bottom-mounted freezer with through-the-door ice service	$8.55 * AV + 434.9$	13%
6. Refrigerator-freezers—automatic defrost with top-mounted freezer with through-the-door ice service	$7.56 * AV + 346.9$	10%

7. Refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service	$7.69 * AV + 389.5$	10%
7-BI. Built-in refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service	$8.92 * AV + 437.3$	13%
Compact Refrigerators and Refrigerator-Freezers		
11. Compact refrigerator-freezers and refrigerators other than all-refrigerators with manual defrost	$8.13 * AV + 227.1$	10%
11A. Compact all-refrigerators—manual defrost	$7.06 * AV + 197.2$	10%
12. Compact refrigerator-freezer—partial automatic defrost.	$5.32 * AV + 302.2$	10%
13. Compact refrigerator-freezers—automatic defrost with top-mounted freezer	$10.62 * AV + 305.3$	10%
13I. Compact refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker	$10.62 * AV + 380.9$	10%
13A. Compact all-refrigerators—automatic defrost	$8.25 * AV + 233.4$	10%
14. Compact refrigerator-freezers—automatic defrost with side-mounted freezer	$6.14 * AV + 411.2$	10%
14I. Compact refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker	$6.14 * AV + 486.8$	10%
15. Compact refrigerator-freezers—automatic defrost with bottom-mounted freezer	$10.62 * AV + 305.3$	10%
15I. Compact refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker	$10.62 * AV + 380.9$	10%

Table 2: Annual Energy Functional Adders

Description	Product Class	Annual Energy Consumption Allowance, AEC_{ADD_i} (kWh/year) ²
Connected	All product classes in Table 1 ¹	$0.05 * AEC_{BASE}$

¹ Product must be qualified using the final and validated ENERGY STAR Program Requirements Product Specification for Residential Refrigerators Test Method to Validate Demand Response to use the allowance.

² Calculated allowance shall be rounded down to the nearest tenth before being applied in Equation 1.

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104 **Note:** Since receiving comments on the Draft 2 Refrigerator/Freezer specification, EPA has been working with
105 stakeholders to address concerns with the proposed energy requirements and to further develop the optional
106 connected criteria. As a result of the extended schedule for completing the Version 5.0 revision and in light of the
107 new DOE test procedure and 2014 federal standards for R/F products, EPA is proposing a single specification
108 change in 2014.

109 After considering the feedback received on Draft 2, EPA is incorporating the latest DOE product classes and
110 expressing the ENERGY STAR requirements as a “percent above” the federal standard. Products are to be rated
111 using the new DOE test procedure (Appendix A). EPA is proposing that most full-size and compact refrigerators
112 and refrigerator-freezers use at least 10% less energy than the 2014 Federal standard. The Agency is proposing
113 built-in products use at least 13% less energy than the 2014 standard to ensure ENERGY STAR label remains a
114 leadership mark and that efficiency is improved beyond what is required today under Version 4.1.

115 With this revised proposal, EPA’s intent is to provide meaningful savings for consumers seeking ENERGY STAR
116 refrigerators while also considering the potential efficiency impacts associated with the proposed 5% allowance
117 for products with connected functionality, and to ensure a selection of labeled products from various
118 manufacturers in each of the configurations that consumers seek. The Agency is proposing new energy use
119 requirements that will be effective in March 2014, aligning with the DOE standard change and easing the
120 transition burden for manufacturers. Given the 2014 effective date and considering some of the high-efficiency
121 design options noted below, EPA has developed levels that it believes will provide consumers with a selection of
122 cost-effective options in 2014, while ensuring the ENERGY STAR label is a differentiator in the marketplace.

123 Based on research and discussions with stakeholders, EPA is aware of a variety of design options in use today
124 that could be used to meet the proposed levels, such as variable speed compressors and vacuum insulation
125 panels, alternative refrigeration cycles such as dual-loop refrigerators that use independent refrigeration cycles for
126 the refrigerator and freezer compartments, and dual-evaporator units. Additionally, new alternatives for foam
127 blowing agents and refrigerants that have been recently listed as acceptable substitutes for ozone-depleting
128 substances by the EPA’s Significant New Alternatives Program (SNAP) could provide new avenues for improving
129 energy-efficiency.

130 After considering prior comments received from stakeholders and the amended DOE standards for freezers, EPA
131 proposing to sunset full-size and compact freezers from the program. The amended standards that manufacturers
132 will have to comply with starting in 2014 require full-size freezers to use at least 25-30% less energy than the
133 current Federal standard. Given the stringency of these new requirements, one manufacturer has recommended
134 EPA consider sunsetting freezers from the ENERGY STAR program. At this point in time, EPA is uncertain that
135 there will be options in the marketplace that provide cost-effective savings for consumers beyond the new Federal
136 standards. The Agency would be open to further evaluating the opportunity to label freezers in Version 5.0 or a
137 later specification, if data becomes available indicating there are new cost-effective opportunities to differentiate
138 freezers based on energy efficiency.

139 B. Determination of Adjusted Volume: Adjusted Volume (AV) shall be calculated in accordance with the DOE
140 test procedure in 10 CFR 430 Subpart B, Appendix A.
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142 **Note:** EPA has revised Section B to cite the DOE test procedure (Appendix A) for refrigerators and refrigerator-
143 freezers that specifies how adjusted volume is to be calculated.
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C. Significant Digits and Rounding:

1. All calculations shall be carried out as specified in Appendix A to Subpart B of Part 430 and 10 CFR 430.23(a)(5).
2. The Maximum Annual Energy Consumption specification limit, as determined by Equation 1, shall be rounded off to the nearest kWh per year. If the equation calculation is exactly halfway between the nearest two kWh per year values, the Maximum Annual Energy Consumption shall be rounded down to the lower of these values.

Note: EPA has revised the significant digits and rounding requirements to cite the applicable sections of the Code of Federal Regulations (CFR). Additionally, EPA has updated Section C to cite Appendix A.

- D. Model Numbers: Model numbers used for ENERGY STAR qualified product submissions shall be consistent with Federal Trade Commission (FTC) and Department of Energy (DOE) submissions.

4) Connected Product Criteria:

Note: EPA has revised the connected communication criteria based upon stakeholder input including comments from a group of appliance manufacturers and utilities and supplemental comments from a group of utility stakeholders. These comments focused on the definition of a Connected R/F System (addressed in section 4A) and on communication with entities outside the Connected R/F System (addressed in section 4B). EPA recognizes that defining connectivity for home appliances is complex and appreciates stakeholders' involvement in helping to shape how connectivity is defined within the ENERGY STAR refrigerator specification.

A. Connected Refrigerator-Freezer System

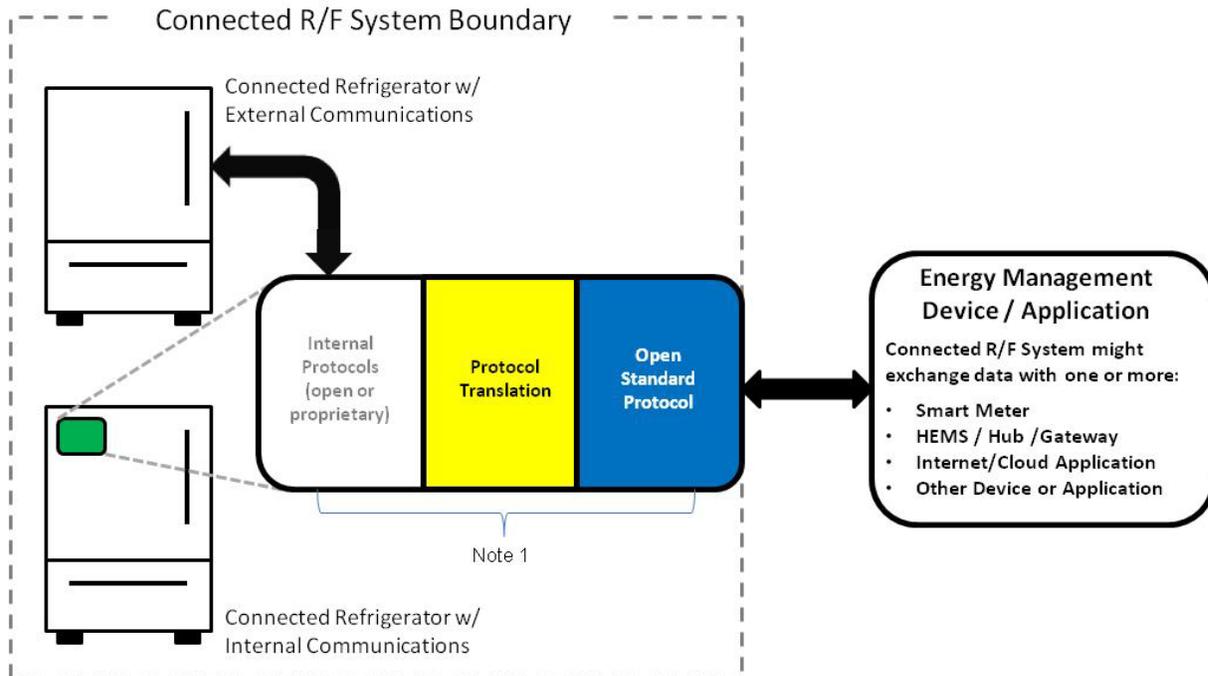
To be recognized as connected and to be eligible for the connected allowance, a "connected refrigerator or refrigerator-freezer system" (Connected R/F System, as shown in Figure 1) shall include the base refrigerator or refrigerator-freezer plus all elements (hardware, software) required to enable communication in response to consumer-authorized energy related commands. These elements may be resident inside or outside of the base appliance. This capability shall be supported through one or more means, as identified in section 4B2.

The specific design and implementation of the Connected R/F System is at the manufacturer's discretion provided it meets the communication requirements in section 4B and includes at least one supported configuration that is capable of receiving and directly responding to open standards-based energy related commands on the consumer's premises.

The product must continue to comply with the applicable product safety standards – the addition of the functionality described below shall not override existing safety protections and functions. The appliance must meet manufacturer's internal minimum performance guidelines, e.g., food preservation.

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Figure 1. Connected Refrigerator/Freezer System Boundary – Illustrative Example



Note 1: Communication device(s), link(s) and/or processing that enables open standards-based communication between the Connected R/F System and Energy Management Device/Application(s). These elements could be within the base appliance, and/or an external communication module, a hub/gateway, or in the Internet/cloud.

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Note: Section 4A defines the Connected R/F System and includes a new diagram (Figure 1) that serves as an illustrative example to help clarify possible architectures and functions of a Connected R/F System. Several key elements of this Connected R/F System and supporting diagram are:

1. The elements required to enable communication in response energy related signals could be resident inside or outside of the base appliance. Built-in, manufacturer specific modular, and standards based modular communications, listed in section 4B2 below, could be used.
2. The Connected R/F System uses open standards, defined in section 4B1 below, for communication outside of the system.
3. Protocol translation that enables a Connected R/F System to communicate with devices external to the system using an open protocol occurs within the R/F system boundaries.
4. Communication modules and/or other devices (e.g., gateway) required to enable communication using an open protocol are included within the R/F system boundaries.

The design and implementation of the Connected R/F System is at the manufacturer’s discretion, provided the product meets the criteria in section 4B and satisfies the minimum requirements for achieving grid connectivity, discussed below.

Grid Connectivity

The Agency received comments from a group of utility stakeholders expressing concern with a communications architecture that does not provide open standards-based communication access within a consumer’s home or on site, e.g., an open standards-based grid interconnection is only in the internet/cloud with proprietary signaling to/from the base connected appliance. Utilities expressed reservations with having protocol translation occur in the cloud since it requires 1) consumers to have an Internet connection; and 2) utilities to interface with an appliance manufacturer’s cloud based solution which could drive cost and complexity, introduce data privacy and security concerns, and reduce consumer choice by not providing options on who “manages” their appliances. These utilities recommended that the ENERGY STAR connected criteria not allow architectures that do not

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217 provide an open-standard based means for achieving grid connectedness with the appliance within the
218 consumer's home.

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220 As a general principle, it has been EPA's longstanding practice to promote use of open protocols and open
221 access since this can enhance innovation and consumer choice. EPA has been working closely with stakeholders
222 to define connectivity for refrigerators in a way that recognizes both immediate value-added opportunities
223 associated with convenience features and energy management opportunities (e.g., alerts), while also helping to
224 "jump start" the market for refrigerators with smart grid capabilities. Discussions with both appliance manufacturer
225 and utility stakeholders have indicated there are a number of different approaches for achieving grid connectivity;
226 further collaboration between manufacturers and utilities will be necessary to best shape how connectivity
227 evolves. At this formative stage, EPA believes it is important that ENERGY STAR products listed as connected
228 preserve flexibility for consumers and utilities by being able to, at a minimum, receive and directly respond to
229 open standards-based signals from a utility or another 3rd party service provider, without having to depend on a
230 service supplied by the product's manufacturer via the Internet/cloud. This both expands consumer choice and
231 ensures there can be competition in the marketplace for providing demand response (DR) and related energy
232 services for connected products. To this end, EPA proposes in section 4A that a Connected R/F System, at a
233 minimum, be capable of receiving and directly responding to open standards-based energy related commands on
234 the consumer's site. Any of the configurations outlined in section 4B2 could meet this requirement. EPA notes this
235 does not prevent an appliance manufacturer from *also* providing a cloud-based-solution for DR.

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237 EPA has also made several modifications (shown in Figure 1) to the original diagram submitted by manufacturers
238 and utilities to add clarity, including the following:

- 239 - Interconnection is illustrated by a double-pointed arrow to indicate flexibility in regards to the physical link, e.g.
240 wired or wireless.
- 241 - Clarifications were made to the Energy Applications examples to more clearly relay that communications
242 hardware and software, including communications modules, whether proprietary or standardized, are within the
243 R/F system boundary.
- 244 - A footnote was added under Figure 1 explaining that the white-yellow-blue box represents communication
245 device(s), link(s) and/or processing that enables open standards-based communication between the Connected
246 R/F system and Energy Management Device/Application(s). These elements could be within the base appliance,
247 and/or an external communication module, a hub/gateway, or in the Internet/cloud. The minimum requirements for
248 grid connectivity discussed above specify there be at least one supported configuration where protocol translation
249 occurs on site.

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251 EPA encourages feedback on the revised language and Connected R/F System boundary diagram.

252 253 B. Communications

- 254 1. Open Standards – Communication with entities outside the R/F System that enables connected
255 functionality (sections 4D through 4H) must use, for all communication layers, standards:
 - 256 • Included in the Smart Grid Interoperability Panel (SGIP) Catalog of Standards,¹ and/or
 - 257 • Included in the NIST Smart Grid framework Tables 4.1 and 4.2, and/or
 - 258 • Adopted by the American National Standards Institute (ANSI) or another well-established
259 international standards organization such as the International Organization for Standardization
260 (ISO), International Electrotechnical Commission (IEC), International Telecommunication Union
261 (ITU), Institute of Electrical and Electronics Engineers (IEEE), or Internet Engineering Task Force
262 (IETF).
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264 2. Communications Hardware Architecture – Communication with entities outside the Connected R/F
265 System that enables connected functionality (sections 4D through 4H) shall be enabled by any of the
266 following means, according to the manufacturer's preference:

¹ http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/PMO#Catalog_of_Standards_Processes

- 267 a. Built-in communication technology
268 b. Manufacturer-specific external communication module(s) and/or device(s)
269 c. Open standards-based communication port on the appliance combined with open standards-
270 based communications module
271 d. Open standards-based communication port(s) on the appliance in addition to a, b or c, above
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273 If option b or c is used, the communication module/device(s) must be easy for a consumer to install
274 and shipped with the appliance, provided to the consumer at the time of sale, or provided to the
275 consumer in a reasonable amount of time after the sale.
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277 **Note:** EPA has revised the language in Section B based on the recommendations made jointly by manufacturers
278 and utility stakeholders.
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280 In Sections B and C, EPA's intent is to continue to promote interoperability by requiring the use of open
281 communication standards, and open access by requiring the release of an API or interface specification. Based
282 on stakeholder recommendation, EPA has strengthened Section 4B1 to require for all communication layers
283 outside the Connected R/F System, the use of standards that are either included in the SGIP Catalogue of
284 Standards, in the NIST Smart Grid framework Tables 4.1 and 4.2, and/or adopted by ANSI or another well-
285 established international standards organization. EPA has included ANSI as the sole U.S. national SDO, while
286 also allowing the use of open-standards adopted by well established international SDOs. As such, EPA has not
287 included the Consumer Electronics Association (CEA) in this list as requested by stakeholders. However, EPA
288 notes that standards developed by ANSI accredited standards bodies, including CEA, may be used once adopted
289 by ANSI.
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291 As recommended by stakeholders, Section 4B2 recognizes three main options for communication between the
292 Connected R/F System and entities outside the system. Option (a) represents a base refrigerator/freezer with
293 communication technology (e.g., Wi-Fi) built into the appliance. Option (b) represents a scenario where the
294 communication module is physically external to the base refrigerator/freezer (e.g., attached via a physical
295 connector); communication between the base refrigerator/freezer and the module may be proprietary although
296 communication with device(s) external to the R/F system must use open protocol. With Option (c), the
297 refrigerator/freezer would have an open standard-based communication module port (e.g., ANSI/CEA-2045),
298 designed to be used with an open standard-based communication module. A compatible module could be
299 provided by the manufacturer or by a 3rd party such as a utility or service provider. In order to deliver consumers
300 with near-term value from the added connected functionality and to help ensure a level playing field among the
301 three options specified in Section 4B2, EPA is calling on connected devices to be sold with the communication
302 module. Modules may ship with the product, be provided along with the product at the time of sale or be supplied
303 in a reasonable amount of time after the connected product is purchased.
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305 EPA has also considered that manufacturers may opt to include an open-standards based communication port *in*
306 *addition* to using option (a), (b), or (c). For example, a refrigerator that has a built-in Wi-Fi communication module
307 may also have an open-standards based communication port. For cases where this additional open-standards
308 communication port is also used (option d), given the product already comes with one communication module, a
309 second compatible communication module is not required to be supplied by the appliance manufacturer.
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311 C. Open Access 312

313 To enable interconnection with the product, an interface specification, API or similar documentation shall
314 be made available to interested parties that at a minimum, allows transmission, reception and
315 interpretation of the following information:
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- 317 ▪ Energy Consumption Reporting specified in section 4D (must include accuracy, units and
318 measurement interval);
- 319 ▪ Remote Management specified in section 4E;
- 320 ▪ Operational Status, User Settings & Messages specified in section 4F (if transmitted via a
321 communication link);
- 322 ▪ Communications required to enable Delay Defrost Capability specified in section 4G; and

- Demand Response specified in section 4H.

Note: EPA has clarified language in Section 4C to more clearly state that the interface specification or API documentation made available must, at minimum, enable open-access to the energy-related functionality specified in Sections 4D through 4H. EPA has added a bullet to cover the communications that may be required to enable Delay Defrost Capability (section 4G). It is not required this documentation expose additional functionality that is **not** covered in these sections.

D. Energy Consumption Reporting

In order to enable simple, actionable energy use feedback to consumers and consumer authorized energy use reporting to 3rd parties, the product shall be capable of transmitting energy consumption data via a communication link to energy management systems and other consumer authorized devices, services or applications. This data shall be representative of the product's interval energy consumption. It is recommended that data be reported in watt-hours for intervals of 15 minutes or less, however, representative data may also be reported in alternate units and intervals as specified in the product manufacturer's interface specification or API detailed in section 4C.

The product may also provide energy use feedback to the consumer on the product itself. On-product feedback, if provided, may be in units and format chosen by the manufacturer (e.g., \$/month).

E. Remote Management

The product shall be capable of receiving and responding to consumer authorized remote requests, via a communication link, similar to consumer controllable functions on the product. The product is not required to respond to remote requests that would compromise performance and/or product safety as determined by the product manufacturer.

F. Operational Status, User Settings & Messages

1. The product shall be capable of providing the following information to energy management systems and other consumer authorized devices, services or applications via a communication link:
 - Demand Response (DR) status (e.g., normal operation, delay appliance load, temporary appliance load reduction).
2. The product shall be capable of providing the following information on the product and/or to energy management systems and other consumer authorized devices, services or applications via communication link:
 - At least two types of messages relevant to the energy consumption of the product. For example, messages for refrigerators, refrigerator-freezers and freezers, might address: door left open notification, a notification that product lost power, a reminder to clean refrigerator coils, or report of energy consumption that is outside the product's normal range.

362 **Note:** The intent of consumption reporting is to enable simple, actionable energy use feedback to consumers
363 that could enable reduced energy consumption and cost savings. In this document EPA is proposing revised
364 language in Section 4D that recommends energy consumption be reported in watt-hours for intervals of 15
365 minutes or less, but allows reporting in alternate units and intervals as specified by the manufacturer. The
366 flexibility afforded by this language will allow stakeholders to determine how best to communicate product
367 energy consumption. While EPA recognizes potential advantages of standardized appliance energy use
368 reporting, there do not appear to be suitable standards yet in place. EPA is tracking the Green Button Initiative,
369 which standardizes delivery of premises energy consumption data for consumers and welcomes stakeholder
370 feedback on the applicability of this or other initiatives for standardization of appliance consumption reporting.

371 In Section 4D, EPA has also clarified that in addition to the requirement of transmitting data via a
372 communication link, the product may, as an option, also provide feedback to consumers on the product's
373 interface.

374 One utility stakeholder noted that at the present time, eligibility for some utility DR programs is dependent upon
375 the ability to verify that the end-device provides a certain response. The stakeholder suggested incorporating
376 language to make it clear to product manufacturers that this verification may be required for a utility to leverage
377 the product for DR purposes. Specifically, the stakeholder noted two types of information – energy
378 consumption information and DR status – that could be useful to a utility for verification purposes. It was
379 suggested that *with consumer approval* this data could be shared with a utility or other 3rd party. In
380 consideration of this feedback, EPA has combined the two sections that previously specified home energy
381 management (HEM) and DR functionality separately, to better reflect that these functionalities and the data
382 associated with them may not separate functions. In Section 4D, EPA also now notes that transmitted energy
383 consumption data can enable feedback to consumers as well as *consumer authorized* energy use reporting to
384 3rd parties.

385 G. Delay Defrost Capability

386 When interconnected with an energy management system or other consumer authorized device, service
387 or application via a communication link, products with automatic defrost shall have a delay defrost
388 capability active by default, where the consumer can input or the product itself shall identify, the time of
389 day, and the product shall automatically move the defrost function outside of a 4-hour deferral period.
390 The deferral period is seasonal and has been defined to align with both summer and winter peak energy
391 demand periods, as follows:

- 392 • 6am to 10am – November 1 through April 30
- 393 • 3pm to 7pm – May 1 through October 31

394 The product shall provide an option for the consumer and/or consumer authorized 3rd party to modify
395 scheduling and functional status of this capability in order to, for example: respond to a short term request
396 from the utility, align defrost avoidance periods with on-peak periods for their utility or enable/disable the
397 capability.

398 In the event of a power outage, after power is restored the product shall not require any interaction from
399 the consumer to maintain this defrost deferral feature with the same settings as prior to the power outage.

400 Exceptions:

- 401 • Once the consumer enrolls in a program that sends consumer-authorized signals to the R/F System,
402 the Delay Defrost capability, as defined in this section, shall be disabled. The product may include an
403 optional transition period of up to 24-hours after enrollment, during which the R/F System is not
404 required to provide either Delay Defrost capability or DR capability as defined in Section 4H.
- 405 • A refrigerator, refrigerator-freezer or freezer with manual defrost or partial automatic defrost is not
406 required to provide Delay Defrost Capability.

407 **Note:** EPA has heard concerns from stakeholders with regards to increasing incremental product costs specific to
408 two areas proposed in the R/F Draft 2 specification. In that draft, EPA's criteria would have required that products
409 include backup capability for the clock as well as include a user interface (UI) and display that allows users to set
410 the time. In response to feedback received on these proposals, EPA has revised the Delay Defrost criteria to
411 apply only to products that are interconnected. EPA expects that this change will reduce the incremental product
412 cost by encouraging time synchronization with external sources such that clock display, (time input) UI and
413 backup requirements are reduced. Consumer experience will also be enhanced in that there will be no need to set
414 or maintain the time. That is, EPA believes that interconnected products with time sync capability will be able to
415 automatically obtain and maintain time of day. Consumer settings will persist through outages and time of day
416 recovered through the network connection; no need for a super capacitor or battery backup.

417 In Draft 2, EPA proposed including a second 4-hour deferral period to address the winter peak. Appliance
418 manufacturers, however, expressed concern during the R/F webinar and through their written comments that
419 requiring products to defer defrost for more than one 4-hour period per 24-hours could have performance and
420 reliability implications for the R/F. In this proposal, EPA is proposing revised criteria with seasonal deferral period
421 scheduling such that the product responds to both winter and summer 4-hour peak periods while only deferring
422 defrost from one 4-hour period per 24-hour period. EPA believes any incremental cost associated with this
423 proposal will be mitigated by the product's network connectivity, but welcomes further feedback on associated
424 costs that should be considered.

425 Finally, EPA has heard concerns and requests for further clarification on how the delay defrost capability will
426 interact with the Section 4H Delay Appliance Load Capability. As previously noted, the appliance industry has
427 voiced concern with requiring a product to defer defrost for more than 4-hours per day. Given this concern and the
428 uncertainty that product performance can be maintained if defrost is deferred for more than 4 hours in a day, EPA
429 has revised criteria to provide an exception that specifies that the Delay Defrost Capability be disabled once the
430 consumer enrolls their R/F system to receive signals from a utility program or 3rd party program provider. EPA
431 requests feedback on the proposed language and welcomes alternative suggestions for how to best clarify the
432 interaction between these two capabilities.

433 H. Demand Response

434 A connected refrigerator, freezer or refrigerator-freezer shall have the capability to receive, interpret and
435 act upon consumer-authorized signals by automatically adjusting its operation depending on both the
436 signal's contents and settings from consumers. At a minimum, the product shall be capable of providing
437 the following:
438

- 439 1. *Delay Appliance Load Capability:* The capability of the product to respond to a signal by providing a
440 moderate load reduction for the duration of a delay period.
 - 441 a. Upon receipt of signal and in accordance with consumer settings, except as permitted below, the
442 product shall:
 - 443 i. Shift its defrost cycle(s) beyond the delay period, and
 - 444 ii. Either shift ice maker cycles beyond the delay period or reduce its average power draw
445 during the delay period by at least 13% relative to the average power draw drawn during an
446 average load over a 24-hour period as defined by the Baseline Test in the Test Method to
447 Validate Demand Response.
 - 448 b. Exceptions:
 - 449 i. The product is not required to respond to a delay appliance load request if the signal requests
450 the delay load period to begin while the product is defrosting.
 - 451 ii. The product is not required to provide the 4H1(a)(ii) response if the delay appliance load
452 signal requests the delay load period to begin while the product is in an ice-maker
453 harvest/refill cycle.

- 454 c. Default settings –The product shall ship with default settings that enable a response in
455 accordance with 4H1(a) for at least 4 hours.
- 456 d. Consumer override – The consumer shall be able to override the product’s Delay Appliance Load
457 response before or during a delay period.
- 458 e. The product shall be able to provide at least one Delay Appliance Load response in a rolling 24-
459 hour period.
- 460
- 461 2. *Temporary Appliance Load Reduction Capability*: The capability of the product to respond to a signal
462 by providing an aggressive load reduction for a short time period, typically 10 minutes.
- 463 a. Upon receipt of signal and in accordance with consumer settings, except as permitted below, the
464 product shall restrict its average power draw during the load reduction period to no more than
465 50% of the average power draw during an average load over a 24-hour period as defined by the
466 Baseline Test in the Test Method to Validate Demand Response.
- 467 b. Exceptions – Under the following conditions, the product is not required to provide a response in
468 accordance with 4H2(a):
- 469 i. If a signal is received during a defrost cycle, that defrost cycle may finish. However, no
470 additional defrost cycle(s) shall occur during the time period, and/or
- 471 ii. If there is a consumer-initiated function such as a door opening or ice/water dispensing
472 during the load reduction period.
- 473 c. Default settings - The product shall ship with default settings that enable a response in
474 accordance with 4H2(a) for a time period of least 10 minutes.
- 475 d. Consumer override – The consumer shall be able to override the product’s Temporary Appliance
476 Load Reduction response before or during a load reduction period.
- 477 e. The product shall be able to provide at least one Temporary Appliance Load Reduction response
478 in a rolling 24-hour period.

479 **Note:** EPA has heard concerns from stakeholders over removal of the option for products with automatic ice
480 makers to respond to a Delay Appliance Load signal by deferring ice making. These concerns noted the 13%
481 reduction option was derived from the estimated average load reduction from ice making deferral. In this proposal,
482 EPA has included the option of delaying ice making when a product provides a Delay Appliance Load (DAL)
483 capability, recognizing that ice making is a function that has been identified by the appliance industry and other
484 stakeholders as being suitable for load shifting.

485
486 In response to a stakeholder comment, EPA has included exceptions to the R/F DAL criteria for products that are
487 making ice or defrosting at the start of a requested DAL period.

488
489 EPA has also revised the DAL and Temporary Appliance Load Reduction (TALR) criteria to specify reductions in
490 the average power draw instead of the average energy consumption. One stakeholder noted that the criteria
491 specified in the Draft 2 R/F document could be interpreted to mean the R/F was required to reduce its average
492 energy consumption during the delay period by at least 13% or 50% relative to the energy consumed during the
493 24-hour period defined in the DOE test procedure. The intent of the criteria is to reduce the average energy
494 consumption over a defined period of time by a minimum amount, relative to the energy consumed during the
495 same defined period of time as measured in the Baseline Test as included in the Test Method to Validate
496 Demand Response. Since sections 4H1(a) and 4H2(a) do not define a time period, EPA believes the criteria can
497 be more simply expressed in terms of average power draw but welcomes stakeholder feedback on this
498 clarification.

499
500 In response to stakeholder concerns, EPA has removed the language from both DAL and TALR Default Settings
501 criteria that allow consumer adjustability of the delay time period. EPA notes that the removal of this language
502 does not impact the ability for appliance manufacturers to offer this functionality, if they deem it appropriate.
503

504 I. Information to Consumers

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506 If additional modules, devices, services and/or infrastructure are part of the configuration required to
507 activate the product's communications capabilities, prominent labels or other forms of consumer
508 notifications with instructions shall be displayed at the point of purchase and in the product literature.
509 These shall provide specific information on what consumers must do to activate these capabilities (e.g.
510 "This product has Wi-Fi capability and requires Internet connectivity and a wireless router to enable
511 interconnection with an Energy Management System, and/or with other external devices, systems or
512 applications.").
513

514 **Note:** EPA has added services in addition to modules, devices and infrastructure, as elements that might be part
515 of the configuration required to activate the product's communication capabilities. EPA has also updated the
516 example to highlight that products may use Wi-Fi and require Internet connectivity and a wireless route to
517 communicate with external devices.

518
519 **5) Test Requirements:**

- 520 A. One of the following sampling plans shall be used to test energy performance for qualification to
521 ENERGY STAR:
- 522 1. A representative unit shall be selected for testing based on the definition for Basic Model provided in
523 Section 1 above; or
- 524 2. Units shall be selected for testing per the sampling requirements defined in 10 CFR § 429.14.
- 525 B. When testing energy consumption of residential refrigerators, the following test methods shall be used to
526 determine ENERGY STAR qualification:
527

528 **Table 3: Test Methods for ENERGY STAR Qualification**

ENERGY STAR Requirement	Test Method Reference
Energy Consumption (kWh/year)	10 CFR 430, Subpart B Appendix A – Residential Refrigerators

- 529 C. When determining energy performance for purposes of ENERGY STAR certification, the principles of
530 interpretation, contained in 10 CFR 430.23 (a) (10), should be applied to the test procedure.
- 531 D. Compliance with Connected functionality, as specified in Section 4, shall be through examination of
532 product and/or product documentation. In addition, demand response functionality shall be verified using
533 the ENERGY STAR Program Requirements Product Specification for Residential Refrigerators Test
534 Method to Validate Demand Response (Rev. Feb-2012) in order to be eligible for the connected
535 allowance.

536 **Note:** EPA has revised section 5B to cite the latest DOE test procedure for residential refrigerators (Appendix A).

- 537 **6) Effective Date:** The ENERGY STAR Residential Refrigerator and Freezer specification shall take effect on
538 **March 1, 2014**. To qualify for ENERGY STAR, a product model shall meet the ENERGY STAR specification
539 in effect on the model's date of manufacture. The date of manufacture is specific to each unit and is the date
540 (e.g., month and year) on which a unit is considered to be completely assembled.

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Note: EPA is proposing a revised effective date of March 1, 2014, for the Version 5.0 specification. In light of the extended timeline for completing the Version 5.0 revision and the new U.S. Department of Energy (DOE) test procedure and 2014 Federal standards for residential refrigerators and refrigerator-freezers, EPA is proposing a revised effective date of March 1, 2014, for the Version 5.0 specification. This timing avoids the need for two ENERGY STAR specification changes for residential refrigerators in the next two years and aligns with the availability of DOE's amended test procedure that manufacturers have told EPA they plan to use for new models introduced in 2014.

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In finalizing the Version 5.0 specification in Fall 2012, EPA is providing supplemental advance notice to prepare for the March 1, 2014, effective date, and has timed the specification change to mitigate burden on the industry since it falls outside the peak refrigerator selling season. The implication of this date, in terms of a transition, is that a model's ENERGY STAR certification would remain valid until March 1, 2014, as long as it is certified to the current Version 4.1 specification by January 1, 2014.

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While avoiding two, closely timed specification changes has clear advantages, EPA recognizes the trade-offs associated with further delay. Originally anticipated to go into effect in January of 2013, this revision to the R/F specification was initiated in the face of disproportionately high ENERGY STAR availability among the most energy intensive refrigerator configurations. Overall market share of ENERGY STAR refrigerators was close to 55% percent in 2011, and continued growth is expected. Maintaining ENERGY STAR's role as an effective differentiator of highly efficient products in the market is a priority for the Agency. An effective date of March, 1 2014, addresses the need for greater differentiation during the critical, peak refrigerator buying season (summer months).

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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 ENERGY STAR qualification is not automatically granted for the life of a product model.