ENERGY STAR® Program Requirements

Product Specification for Laboratory Grade Refrigerators and Freezers

Eligibility Criteria
Draft 1, Version 2.0

Following is the Draft 1, Version 2.0 ENERGY STAR product specification for Laboratory Grade Refrigerators and Freezers. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

1 DEFINITIONS

A) Product Types:

1) Laboratory Grade Refrigerator (LGR): A refrigeration cabinet used for storing non-volatile reagents and biological specimens at set point temperatures between 2 °C and 8 °C (35.6 °F and 46.4 °F), typically marketed through laboratory equipment supply stores for laboratory or medical use.

a) High Performance: A laboratory grade refrigerator product that is designed to support a maximum peak variation in temperature no greater than 6 °C.

b) General Purpose: A laboratory grade refrigerator product that cannot support a maximum peak variation in temperature equal to or less than 6 °C.

2) Laboratory Grade Freezer (LGF): A refrigeration cabinet used for storing volatile reagents and biological specimens at set point temperatures between -50 °C and -15 °C (-58 °F and 5 °F), typically marketed through laboratory equipment supply stores for laboratory or medical use.

a) High Performance: A laboratory grade freezer product that is designed to support a maximum peak variation in temperature no greater than 10 °C.

b) General Purpose: A laboratory grade freezer product that cannot support a maximum peak variation in temperature equal to or less than 10 °C.

Note: EPA is revising the defined range of temperature set points for both laboratory grade refrigerators and freezers to align with the latest NSF/ANSI 456 – 2021a standard on safe vaccine storage.

In response to the data call, EPA received stakeholder feedback suggesting that the Agency remove peak variation in temperature as a defining feature of these product types in Version 2.0. EPA understands that the current NSF/ANSI 456 – 2021a standard no longer references peak variation in temperature and seeks stakeholder feedback on the rationale for this change.

ENERGY STAR has used this peak variation to distinguish between high performance laboratory grade products vs. general purpose laboratory grade products for multiple years and without further information as to why this would no longer be needed, has retained the peak variation in this Draft 1. Over 140 ENERGY STAR product families meet the existing peak variation. If peak variation is no longer suggested, what is the recommended method for differentiating general versus high performing products?

3) Ultra-Low-Temperature Laboratory Grade Freezer (ULT): A freezer designed for laboratory application that is capable of maintaining set point storage temperatures between -70 °C and -80 °C (-94 °F and -112 °F).

4) Combination Laboratory Grade Refrigerator/Freezer: A product composed of two or more refrigerated cabinets, one of which meets the definition of Laboratory Grade Refrigerator and another that meets the definition of Laboratory Grade Freezer.

5) Portable Laboratory Grade Refrigerator/Freezer: A refrigerated cabinet used for transporting perishable samples or products, and includes an integral battery or DC power cable to power the refrigeration process when disconnected from AC mains.

6) Walk-in Laboratory Grade Refrigerator: A larger laboratory grade refrigerator that is either built-in or composed of prefabricated sectional walk-in units.

7) Explosion Proof Refrigerator/Freezer: A product that is composed of a refrigerated cabinet that prevents arcing both inside and outside the cabinet and is typically used when flammable vapors are present, resulting in an explosive atmosphere during standard operation.

8) Incubators: A product used to control temperature and humidity often to support growing bacterial cultures or providing suitable conditions for chemical and biological reactions.

B) Defrost-related Terms

1) Automatic Defrost: A system in which the defrost cycle is automatically initiated and terminated, with resumption of normal refrigeration at the conclusion of the defrost operation. The defrost water is disposed of automatically.

2) Variable Defrost: A system in which successive defrost cycles are determined by an operating condition variable or variables other than compressor operating time. This includes any electrical or mechanical device performing this function.

3) Manual Defrost: A system in which the defrost cycle is initiated and terminated manually.

4) Semi-Automatic Defrost: A system in which the defrost cycle is manually initiated and automatically terminated, with automatic resumption of normal refrigeration at the conclusion of the defrost operation.

C) Additional Terms:

1) AHAM Volume (V): The interior volume of the refrigerator or freezer as calculated by ANSI/AHAM HRF-1-2008.

2) Cabinet Temperature: The average of all temperature measurements taken inside a product's cabinet at any given time.

3) Peak Variance: The difference between the maximum and minimum temperatures measured across all temperature measurement devices (TMD) over the course of a given measurement period.

4) Refrigeration Cycle: The period of time starting when a unit's refrigeration system turns on, through the time it turns off, and ending when the refrigeration system turns on again.

5) Stability: The difference between the maximum and minimum temperature measured by an individual TMD over the course of the entire test period.

6) Test: A 24-hour period over which measurements are taken and energy use evaluated under one set of conditions after the pull down period occurs as described in this test procedure.

7) Uniformity: The difference between the maximum and minimum temperature measured inside of a unit's cabinet at any given time.

8) Solid Door: Less than 75% of the front surface area of the door is glass.

9) Glass Door: Greater than, or equal to, 75% of the front surface area of the door is glass.

10) Solid Door Cabinet: A laboratory grade refrigerator or freezer in which all outer doors on all sides of the unit are solid doors. These doors may be sliding or hinged.

11) Glass Door Cabinet: A laboratory grade refrigerator or freezer in which all outer doors on at least one side of the unit are glass doors. These doors may be sliding or hinged.

12) Mixed Solid/Glass Door Cabinet: A laboratory grade refrigerator or freezer in which all outer doors on at least one side of the unit are a combination of solid and glass doors. A unit which has all glass doors on one side and a combination of solid and glass doors on another is considered a mixed solid/glass door cabinet.

D) Referenced Standards Organizations:

1) AHAM: Association of Home Appliance Manufacturers

2) ANSI: American National Standards Institute

E) Product Family: A group of product models that are (1) made by the same manufacturer, (2) have the same measured interior volume, (3) the same number of external doors and (3) of the same basic engineering design. Product models within a family can differ in the following characteristics:

1) Configurability Characteristics: Characteristics such as internal ports and access holes, drawer and shelf configuration, and other optional accessories.

2) Aesthetic Characteristics: Characteristics such as external finish, color, or door opening orientation (left-opening versus right-opening).

2 SCOPE

2.1 Included Products

2.1.1 Products that meet the definitions LGR, LGF, and ULT above are eligible for ENERGY STAR certification. This may include refrigerators and freezers that operate without a compressor.

2.2 Excluded Products

2.2.1 Products that are covered under other ENERGY STAR product specifications are not eligible for qualification under this specification. The list of specifications currently in effect can be found at www.energystar.gov/specifications.

2.2.2 The following products are not eligible for certification under this specification:

i. Products that meet the definitions 1.A.4 through 1.A.7 above; and

ii. Products which meet the incubator definition above, are marketed as incubators, or are capable of temperature control above 15 °C.

3 CERTIFICATION CRITERIA

3.1 Significant Digits and Rounding

3.1.1 All calculations shall be carried out with actual measured (unrounded) values. Only the final result of a calculation shall be rounded.

3.1.2 Unless otherwise specified in this specification, compliance with specification limits shall be evaluated exact values without any benefit from rounding.

3.1.3 Directly measured or calculated values that are submitted for reporting on the ENERGY STAR website shall be rounded to the nearest significant digit as expressed in the corresponding specification limit.

3.2 Energy Efficiency Requirements

3.2.1 Maximum Daily Energy Consumption Requirements: The maximum daily energy consumption (MDEC), in kilowatt-hours per 24 hour period (or kilowatt-hours per 24 hour period per cubic foot for ULTs), shall be less than or equal to that specified below:

Table 1: Maximum Daily Energy Consumption (MDEC) Requirements (kWh/day) for ENERGY STAR Certified Laboratory Grade Refrigerators

Product Volume (in cubic feet)	Refrigerator
General Purpose	
0 < V < 15	≤ 0.03V + 0.80
15 ≤ V < 50	≤ 0.05V + 0.45
50 ≤ V	≤ 0.03V + 1.70
High Performance	
0 < V < 10	≤ 0.1V + 0.5
10 ≤ V < 25	≤ 0.05V + 1.0
25 ≤ V < 44	≤ 0.06V + 0.7
44 ≤ V	≤ 0.08V + 0.3

Note: V = AHAM volume, as defined in Section 1, in cubic feet (ft^3).

Note: EPA is proposing revised volume break points and MDEC levels in Table 1 for high performance and general purpose laboratory grade refrigerators and freezers in Version 2.0. To develop the proposed levels for laboratory grade refrigerators and freezers, EPA used the ENERGY STAR certified product list. This dataset for refrigerators included 105 unique models from 22 brands and for freezers 50 unique models and 14 brands. EPA's invitation to submit additional data did not result in new models.

In the case of the high performance refrigerators and freezers, the Agency believes that this data set captures the majority of the market. This is because the ENERGY STAR specification has been in place for 6 years and rebates for ENERGY STAR certified models drove certification during COVID. If stakeholders believe additional data should be considered, EPA welcomes partners to share it.

At EPA's proposed levels, 29 total refrigerator products and 11 freezer models would be eligible for the ENERGY STAR. EPA's analysis confirmed that at the proposed levels, there would be eligible models across all major size ranges recognizing customer needs for different sized models. The analysis also estimates that for high performance refrigerators the savings range from roughly 200 kWh/year to 1,000 kWh/year depending on the size bin. For high performance freezers the savings range from roughly 600 kWh/year to as high as 1,800 kWh/year.

Certification to ENERGY STAR for general purpose refrigerators and freezers has been limited in comparison to that of high performance units. Further, EPA believes based on discussion with manufacturers that the hardware and design of general purpose refrigerators and freezers is very similar, if not identical in some cases, to those certified as ENERGY STAR commercial refrigerators. In light of this, EPA is proposing to align the lab grade criteria with that of the commercial refrigerator criteria. This proposal results in an easing of the lab grade criteria for freezers. EPA does seek stakeholder feedback regarding the reason for the low certification of general purpose refrigerators and freezers. Has the market shifted away from general purpose models marketed for use in lab settings? Were the Version 1 levels a hindrance to participation for this subtype? Is there value for customers in maintaining the general purpose refrigerator and freezer categories?

Table 2: Maximum Daily Energy Consumption (MDEC) Requirements (kWh/day) for ENERGY STAR Certified Laboratory Grade Freezers

Product Volume (in cubic feet)	Freezer
General Purpose	
0 < V < 15	≤ 0.21V + 0.9
15 ≤ V < 30	≤ 0.12V + 2.25
30 ≤ V < 50	≤ 0.26V – 2.14
50 ≤ V	≤ 0.14V + 4.0
High Performance	
0 < V < 15	≤ 0.1V + 1.0
15 ≤ V < 30	≤ 0.28V – 1.8
30 ≤ V	≤ 0.33V - 3.19

Note: V = AHAM volume, as defined in Section 1, in cubic feet (ft^3).

Table 3: Maximum Daily Energy Consumption (MDEC) Requirements (kWh/day/ft^3) for ENERGY STAR Certified Ultra-Low Temperature Freezers @ -75 ºC
0.35

Note: MDEC for ULTs is based on volume normalized energy consumption at -75 ºC as calculated in Equation 1 (ULT Energy Consumption Calculation) in the ENERGY STAR Test Method for Laboratory Grade Refrigerators, Freezers, and Ultra-Low Temperature Freezers.

Note: EPA has also used the ENERGY STAR certified product (which includes 46 unique models) data to determine proposed levels for Ultra-Low Temperature Freezers and proposes a new volume normalized MDEC level in Table 3. This proposed level will recognize 11 products across volume ranges between 15 and 33 cubic feet. Model savings at the proposed levels are roughly 740 kWh/year for a product of an average sized volume.

EPA received preliminary feedback suggesting that there are ULT products smaller than 15 cubic feet that cannot meet existing ULT Version 1.1 requirements and warrant a less stringent threshold. EPA requests data to support this request.

EPA also received feedback suggesting that consumers would benefit from having the energy measurements made at -70 ºC and -80 ºC during testing made public as individual customers choose to operate their ULT products at different set points within that range. As such, EPA proposes to collect that data during certification and display that information in the Qualified Product List for Version 2.0.

3.3 Additional Reporting Requirements

3.3.1 Report the type of refrigerant used in the laboratory grade refrigerator and/or freezer, for example: R-290, R600a, or R-134a.

Note: For numerous product categories, the ENERGY STAR program highlights refrigerant type in the consumer-facing ENERGY STAR Product Finder. Both ENERGY STAR utility partners and consumers have requested increased transparency around refrigerants used in products and their related global warming potentials (GWP) to understand their impact on the climate.

4 TESTING

4.1 Test Methods

4.1.1 Test method identified in Table 4 shall be used to determine certification to ENERGY STAR.

Table 4: Test Methods for ENERGY STAR Certification

Product Type	Test Method
All	ENERGY STAR Test Method for Laboratory Grade Refrigerators, Freezers, and Ultra-Low Temperature Freezers

4.2 Number of Units Required for Testing

4.2.1 Representative Models shall be selected for testing per the following requirements:

i. For certification of an individual product model, the Representative Model shall be equivalent to that which is intended to be marketed and labeled as ENERGY STAR.

ii. For certification of a Product Family, highest energy consuming unit within that Product Family can be tested and serve as the Representative Model. Any subsequent testing failures (e.g., as part of verification testing) of any model in the family will have implications for all models in the family.

4.2.2 A single unit of each Representative Model shall be selected for testing.

4.2.3 A Representative Model that is capable of being both air cooled and liquid cooled must be tested in its air cooled configuration for ENERGY STAR certification. If a product can only operate in a liquid cooled configuration, only then it is allowed to be tested as liquid cooled.

Note: EPA has clarified in Section 4.2.3 that all products that can be either air or liquid cooled shall be tested in their air cooled configuration for ENERGY STAR certification purposes. If the product can only be operating in a liquid cooled configuration, then it may be tested that way and reported in the QPX as a liquid cooled only product.

If a product can support both air cooled and liquid cooled modes of operation in the field, its use in an air cooled or liquid cooled configuration upon installation is up to the customer, as the tested air cooled configuration is assumed to be the least efficient scenario for representing that product's energy consumption.

4.3 International Market Certification

4.3.1 Products shall be tested for certification at the relevant input voltage/frequency combination for each market in which they will be sold and promoted as ENERGY STAR.

Note: Partner must ensure that all configurations certified as ENERGY STAR continue to meet the certification criteria through subsequent firmware, software, or other changes to the certified product.

5 EFFECTIVE DATE

5.1.1 Effective Date: The Version 2 ENERGY STAR Laboratory Grade Refrigerators and Freezers specification shall take effect on **TBD**. To certify for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on the model's date of manufacture. The date of manufacture is specific to each unit and is the date on which a unit is considered to be completely assembled.

Note: EPA intends to finalize the Version 2 specification in Q4 of 2023 or Q1 of 2024 with a TBD effective date sometime in Q3 or Q4 2024, nine months following the finalization of the specification.

5.1.2 Future Specification Revisions: EPA reserves the right to change this 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 stakeholder 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.