ENERGY STAR® Program Requirements

Product Specification for Laboratory Grade Refrigerators and Freezers

Eligibility Criteria
Draft 2, Version 2.0

Following is the Draft 2, 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 a 2 °C and 8 °C (35.6 °F and 46.4 °F) operating range, 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 4 °C.

b) General Purpose: A laboratory grade refrigerator product that cannot support a maximum peak variation in temperature equal to or less than 4 °C.

Note: EPA amended the set point temperature range in Draft 1 to align with the NSF/ANSI 456-2021a Standard. Stakeholders provided feedback indicating that a variety of industry standards should be referenced. One concern was that the set point temperature range derived from NSF/ANSI 456-2021a is 1 ºC outside blood bank's 1 - 6 ºC range. Given the significant overlap between the specified range and the blood bank range, EPA notes that manufacturers of LGRs for blood banks have the option of certifying within a 2 and 6 ºC temperature set point range.

EPA is also proposing to tighten the peak variation for General Purpose and High Performance Laboratory Grade Refrigerators based on stakeholder feedback to ensure that expected temperature performance is maintained per end-user expectations.

2) Laboratory Grade Freezer (LGF): A refrigeration cabinet used for storing volatile reagents and biological specimens at set point temperatures between a -50 °C and -15 °C (-58 °F and 5 °F) operating range, 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: Several stakeholders commented on the terms used to describe set points and operating ranges. To reduce confusion in this area and to align with industry's interpretation of these terms, the Version 2.0 Lab Grade Specification will refer to set points as the actual temperature to be achieved by the model. The operating range is the boundary prescribed to the set point and peak variance.

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 for Refrigerators: 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: 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	
Solid Door	
0 < V < 25	≤ 0.01V + 0.85
25 ≤ V < 44	≤ 0.07V - 0.68
44 ≤ V	≤ 0.06V - 0.03
Transparent Door	
0 < V < 10	≤ 0.1V + 0.55
10 ≤ V < 44	≤ 0.06V + 1.08
44 ≤ V	≤ 0.14V - 2.48

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

Note: In response to the Draft 1 proposal stakeholders noted that some refrigerators may feature transparent (or glass) doors in place of solid doors and that there may be a need to account for the energy consumption of these different door types. EPA reviewed the dataset and agreed that there was a need to differentiate products by door type and has therefore added separate criteria for solid and transparent doors in Table 1. With the updated criteria, an average of 29% of High Performance Refrigerator products meet the criteria.

3.2.2 Allowances for NSF Certified High Performance Refrigerator Models: Models that are NSF certified may claim an additional allowance as indicated in Table 2 below. Allowance values should be added to the model's initial required MDEC value defined in equation in Table 1 above to determine ENERGY STAR certification eligibility.

Table 2: MDEC Allowance for NSF Certification of High Performance Refrigerators (kWh/day)	
Solid Door	2.4
Transparent Door	1.0

Note: EPA received feedback indicating that the proposed levels would limit the number and variation of models eligible for both ENERGY STAR and NSF/ANSI 456-2021a certification. This certification is required by certain purchasers who have specific needs for vaccine protection. EPA received data on those products that are NSF/ANSI 456-2021a certified and determined that an additional allowance is warranted for products attaining National Science Foundation (NSF) certification of High Performance Refrigerators and Freezers. These allowances allow these products to be differentiated against like products. There were no models within the General Purpose categories that are NSF certified, as well as no manual defrost, High Performance Freezer models with NSF certification and therefore, additional allowances were not proposed for those subcategories.

NSF model data existing within the High Performance Refrigerators and Freezers categories were isolated to evaluate their respective volume-bin pass rates with the new NSF certified allowances. After isolating the NSF model data, EPA found that 41% of High Performance Refrigerators and 33% of High Performance Freezers met the criteria with the new allowance.

3.2.3 Maximum Daily Energy Consumption Requirements for Freezers: 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 3: 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	
Manual Defrost	
0 < V < 15	≤ 0.08V + 1.0
15 ≤ V < 30	≤ 0.12V + 0.4
30 ≤ V	≤ 4.0
Automatic Defrost	
0 < V < 15	≤ 0.18V + 1.0
15 ≤ V < 30	≤ 0.28V - 0.5
30 ≤ V	≤ 8.0

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

Note: EPA received stakeholder feedback indicating that there may be a need to segment freezer products by their defrost type and potentially door type. After considering the data set, EPA agreed with this feedback for defrost type in freezers and has created separate criteria for manual defrost and automatic defrost products to compare those products against similar type products. For High Performance Freezers, roughly 25% meet the updated criteria.

After taking into consideration the additional data points identified by stakeholders (included as a new dataset utilized by the Agency), EPA believes that the above criteria offer customers a range of choice while continuing to differentiate the most energy efficient refrigerator and freezers on the market. EPA welcomes comment on the proposed criteria.

3.2.4 Allowance for NSF Certified High Performance Freezer Models: Models that are NSF certified may claim an allowance as indicated in Table 4 below. Allowance values should be added to the model's initial required MDEC value defined in equation in Table 3 above to determine ENERGY STAR certification eligibility.

Table 4: MDEC Allowance for NSF Certification of High Performance Freezers (kWh/day)	
Automatic Defrost	3.0

3.2.5 Maximum Daily Energy Consumption Requirements for ULTs: 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 5: MDEC Requirements (kWh/day/ft^3) for ENERGY STAR Certified Ultra-Low Temperature Freezers @ -75 ºC	
0 < V < 20	≤ 0.46
20 ≤ V	≤ 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 received preliminary feedback suggesting that there are ULT products smaller than 20 cubic feet that cannot meet existing ULT Version 1.1 requirements and warrant a less stringent threshold. EPA received data on 8 additional models and developed the above MDEC requirements and volume bins.

The Agency used the ENERGY STAR certified product list (which includes 46 unique models) and the eight additional, unique models to determine proposed levels for Ultra-Low Temperature Freezers and to propose a new volume bin in Table 3. This proposed level and new refrigerant requirements will recognize 50% of products across volumes between 0 and 20 cubic feet, and 28% of products with volumes greater than 20 cubic feet.

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, the 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.

4.2.4 A Representative Laboratory Grade Freezer Model that is capable of set point temperatures ≤ -20 °C must be tested at a -20 °C set point and are now required to report the manufacturer's intended set point (e.g., -20 °C, -30 °C, etc.).

Note: Stakeholders recommended that a standardized set point of -20 °C be mandated for Laboratory Grade Freezers as most models are able to achieve this temperature. As such, EPA is requiring that Laboratory Grade Freezer models be tested at this set point of -20 °C and the manufacturer's intended set point temperature be reported (e.g., -20 °C, -30 °C, etc.) during testing.

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 Q2 of 2024 with a TBD effective date sometime in Q1 2025, 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.