ENERGY STAR® Program Requirements

Product Specification for Laboratory Grade Refrigerators and Freezers

Eligibility Criteria
Final Draft, Version 2.0

Following is the Final Draft, 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 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.

Note: The EPA received a significant amount of additional stakeholder feedback requesting that the Agency revert to the peak variation in temperature ranges to no greater/less than 6°C in the definition as proposed in Draft 1 compared to the 4°C proposed in Draft 2. The majority of commenters urged EPA to maintain consistency with NSF 456-2021a which references the temperature differences as no greater/less than 6°C. As a result of this feedback and with a desire to maintain the range referenced by the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use (IHC) requirements to avoid market confusion, EPA is proposing to revert the temperature differences above to 6°C as proposed both in Draft 1 and that is used in the current Version 1 specification.

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.

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 < 20	≤ 0.01V + 0.95
20 ≤ V < 44	≤ 0.07V - 0.25
44 ≤ V	≤ 0.056V + 0.04
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: The EPA received stakeholder feedback arguing that the proposed MDEC requirements for solid door high performance refrigerators were too stringent in Draft 2. After re-reviewing the data focusing particularly on the medium volume segment, the EPA is proposing to adjust the volume bins in this category slightly and adjust the requirements in each volume bin to provide slightly greater availability of qualifying products in the middle volume range.

The Agency received similar feedback regarding transparent door high performance refrigerators, but additional analysis of that data does not support a revision to the requirements proposed in Draft 2 for this subcategory of products.

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

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).

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 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.

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 6: 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: 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 **June 30, 2025**. 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 late Q3 of 2024 with an effective date of June 30, 2025, roughly 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.