ENERGY STAR® Program Requirements

Product Specification for Laboratory Grade Refrigerators and Freezers

Eligibility Criteria
Draft Version 1.1

Following is the Version 1.1 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 0 °C and 12 °C (32 °F and 53.6 °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 -40 °C and 0 °C (-40 °F and 32 °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.

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.

Note: In recognition of ongoing technology advancements in refrigeration products broadly, such as those earning the 2017 EPA ENERGY STAR Emerging Technology Award for Solid-State Refrigeration, EPA has updated Section 2.1 to clarify that products that operate without a compressor are within scope.

EPA has received sufficient efficiency data for ULT products, and has revised the scope to include these products in Version 1.1.

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 < 25	≤ 0.124 V + 2.0
25 ≤ V	≤ 0.121 V + 2.07
High Performance	
0 < V < 25	≤ 0.184 V + 3.5
25 ≤ V < 44	≤ 0.153 V + 4.28
44 ≤ V	≤ 0.125 V + 5.5

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

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	≤ 0.033 V + 2.0
15 ≤ V < 30	≤ 0.05 V + 1.75
30 ≤ V	≤ 0.188 V – 2.375
High Performance	
0 < V < 22	≤ 0.09 V + 10
22 ≤ V	≤ 0.426 V + 2.63

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
0.55

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 is proposing a Maximum Daily Energy Consumption (MDEC) requirement for ULTs using a volume normalized metric based on the ULT energy consumption calculation in the ENERGY STAR Test Method for Laboratory Grade Refrigerators, Freezers, and Ultra-Low Temperature Freezers. The kWh/day value calculated at -75 ºC using Equation 1 in the Test Method shall be divided by the product's volume (cubic feet), with the result not exceeding the value shown in Table 3 for all ULT products.

Example: An ULT with a volume of 18 cubic feet and calculated energy consumption of 15 kWh/day at -75ºC per Equation 1 would result in a normalized energy consumption value of 0.83, failing to meet the proposed ENERGY STAR ULT MDEC requirement.

To develop the requirement in Table 3, EPA used data gathered by MyGreenLabs, working together with ULT manufacturers, on 15 products currently on the market which were measured in proper laboratory settings using the ENERGY STAR Test Method. Given the nature of the ULT data set and its linear behavior, EPA has determined that a volume normalized energy metric is the simplest and most straightforward requirement to apply to ULTs. Further, a volume normalized approach for ULTs provides a desireable pass rate in products across all applicable volumes. EPA has received input from multiple stakeholders supporting this approach but welcomes additional feedback.

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.

4.3 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.

5 EFFECTIVE DATE

5.1.1 Effective Date: The ENERGY STAR Laboratory Grade Refrigerators and Freezers specification shall take effect on **December 21 2016**. 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.

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. EPA will consider the following in upcoming revisions.

i. Temperature Set Point for Freezers: EPA will investigate whether it is appropriate to set separate requirements in Version 2.0 for freezers designed to operate at -20 ºC, -30 ºC, and -40 ºC, as additional available data allows.

ii. Solid vs. Transparent Doors for Refrigerators: While EPA's current data set does not show a significant difference in energy efficiency of the two, based on stakeholder feedback EPA will revisit this potential area of differentiation in Version 2.0 as additional available data allows.