ENERGY STAR® Program Requirements

Product Specification for Laboratory Grade Refrigerators and Freezers

Eligibility Criteria
Draft 2 Version 1.0

Following is the Version 1.0 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 0 °C and 12 °C (32 °F and 53.6 °F), typically marketed through laboratory equipment supply stores for laboratory or medical use.

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.

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 1.A.1 through 1.A.2 above are eligible for ENERGY STAR certification.

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.3 through 1.A.7 above;

ii. Products designed specifically to store blood and plasma samples; and

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

Note: **Note**: After the call for data in December 2014/January 2015, EPA did receive very limited product data on a few ULT models and would like to thank those stakeholders who provided the data for their contributions. Unfortunately, EPA still did not receive enough data to be able to differentiate ULT products in the market, and therefore is proposing to remove them from scope of the Version 1.0 specification. EPA welcomes additional data on ULT products to help build a more robust data set that can form the foundation for including ULTs in scope of the next revision of this specification.

3 QUALIFICATION 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

Note: Per stakeholder request and due to a limited amount of product data, EPA conducted an additional data assembly effort in the first half of 2015. EPA did not receive any additional usable data on non ULT products. As a result, EPA is proposing the Maximum Daily Energy Consumption (MDEC) criteria below based on the existing ENERGY STAR dataset, for products that are still sold on the market.

To come to the proposed MDEC requirements below, EPA considered several product characteristics, including door type, volume, and defrost strategy. Door type was a non-factor in freezers, as all freezers in the data set are solid door products. For refrigerators, products with transparent doors showed better energy performance than those with solid doors. Therefore, EPA is not proposing less rigorous levels for transparent door products. As previously determined, energy consumption typically rises as product volume increases, which is supported by available product data. The data showed that there was a significant separation of freezer products based on whether they use manual or automatic defrost, which is reflected in the proposed MDEC requirements below. This separation was not clearly defined when reviewing the refrigerator data, and therefore, EPA is not proposing refrigerator criteria based on defrost strategy. Overall, the Draft 2 proposed efficiency levels would enable representation across a range of refrigerator and freezer volumes and defrost strategies, while maintaining a straightforward approach based on the performance data received.

EPA is aware that the ENERGY STAR dataset is aged, and that the following areas of efficiency innovation are on the market and available for adoption by lab grade refrigeration manufacturers: auto-off lighting combined with the use of LED lights; energy efficient low-E glass used in glass door refrigerators; more efficient cooling compressors; more advanced microprocessor temperature control and defrost sensors; more efficient high-capacity air circulation systems, as well as hot gas defrost solutions; and low global warming potential, energy efficient alternative refrigerant options. Stakeholders are encouraged to comment on the proposed efficiency levels and provide additional details regarding these and other energy-efficient technologies. Through this new ENERGY STAR program for lab grade refrigerators/freezers, EPA intends to highlight for buyers products that are employing some of these innovations now and incentivize broad use of these and other efficiency approaches in future specification revisions.

3.2.1 Maximum Daily Energy Consumption Requirements: The maximum daily energy consumption (MDEC), in kilowatt-hours per 24 hour period, 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
$0 < V < 24$	$\leq 0.183\ V + 2.0$
$24 \leq V < 48$	$\leq 0.108\ V + 3.8$
$48 \leq V$	$\leq 0.11\ V + 3.72$

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**
Manual Defrost	
0 < V < 15	≤ 0.02 V + 1.6
15 ≤ V < 30	≤ 0.09 V + 0.55
30 ≤ V	≤ 0.188 V – 2.375
Automatic Defrost	
0 < V < 22	≤ 0.318 V + 4.0
22 ≤ V	≤ 0.463 V + 0.815

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

4 TESTING

4.1 Test Methods

4.1.1 Test methods identified in Table 1 shall be used to determine qualification for ENERGY STAR.

Table 1: Test Methods for ENERGY STAR Qualification

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 qualification 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 qualification 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 Qualification

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 Version 1.0 ENERGY STAR Laboratory Grade Refrigerators and Freezers specification shall take effect on **TBD**. To qualify 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: The Version 1.0 specification will take effect upon finalization, anticipated in Q1 2016.

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.