ENERGY STAR® Program Requirements

Product Specification for Laboratory Grade Refrigerators and Freezers

Eligibility Criteria
Draft 1 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.

Note: The proposed definitions below are consistent with definitions found in existing ENERGY STAR documents including the finalized Test Method for Laboratory Grade Refrigerators, Freezers, and Ultra-low-temperature Freezers as well as the Version 2.0 Program Requirements for Commercial Refrigerators and Freezers. EPA welcomes feedback on all proposed definitions, but intends to harmonize with existing industry accepted terminology whenever possible.

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 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 (4) 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).

Note: EPA has received mixed stakeholder feedback on the effects of port/access hole and drawer/shelf configuration and their impact on energy consumption. Limited data from past data assembly efforts has not demonstrated measureable differences, but EPA welcomes additional product test data to validate that these configurability characteristics do indeed lead to meaningful differences in test results. EPA is proposing that the highest energy-consuming unit in a product family will serve as the Representative Model for testing purposes, which is covered in more detail in Section 4.2 below.

2 SCOPE

2.1 Included Products

2.1.1 Products that meet the definitions 1.A.1 through 1.A.3 above are eligible for ENERGY STAR certification.

Note: At this time, EPA is proposing to include three product categories: lab grade refrigerators, lab grade freezers, and ultra-low freezers (defined above in 1.A. 1 - 3). At this time, however, EPA does not have any energy efficiency data related to Ultra-Lows to propose ENERGY STAR requirements, despite numerous attempts to secure such data. Unless EPA receives performance data on these units, we will not be able to set efficiency criteria in in subsequent drafts and will consider removing them from scope, until sufficient data is made available

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;

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: EPA has received stakeholder feedback to exclude the product categories in Section 2.2.2 above, primarily due to low representation in the market, or due to special circumstances in particular applications that result in energy consumption that is not comparable to other products which appear similar l (e.g. blood/plasma units). EPA welcomes feedback on the inclusion of any of these product categories in this specification if they can be properly addressed with sufficient supporting data.

EPA is also requesting feedback on the maximum temperature proposed (15°C) to exclude products that perform incubator-like functions rather than refrigeration as their primary function.

Finally, one stakeholder noted that chromatography products should either be excluded from scope or that they require their own category due to their higher BTU removal capacities. EPA's limited dataset does not currently support this assertion, but EPA welcomes additional data on chromatography products to determine whether they do require additional attention.

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: EPA conducted data assemblies in 2009 and 2010 to gather product data on laboratory grade refrigerators and freezers. This data, along with stakeholder feedback, formed the basis of the Framework Document published in September 2010. Following that development, the U.S. Department of Energy (DOE) took the lead on the validation of the existing draft test method and the re-development and finalization of the ENERGY STAR Test Method for Laboratory Grade Refrigerators and Freezers and Ultra-low-temperature Freezers. DOE completed the final version of this test method in July 2014.

In the 2010 Framework Document, EPA gave an overview of the data collected to date, which included energy performance data for 32 units from three participating manufacturers (using the previous test method). Based on the limited data received to date and our experience in working with commercial food refrigeration units, the following characteristics seem to be the most appropriate for binning and comparing products:

- Primary function and/or temperature set points

- Interior volume

- Defrost Strategy

- Door types and number of inner and outer doors

The attached data plots, from 2010, show that it seems appropriate to bin models by set point and interior volume, such that refrigerators, freezers (and presumably ULTs) would be categorized separately recognizing that measured interior volume has an impact on the total energy input. This is consistent with how EPA sets performance criteria for commercial food grade refrigeration equipment.

Lab grade equipment typically features a defrost feature, which removes any condensed water vapor from the refrigeration coils. As is also noted in the data plots, the defrost strategy (automatic versus manual or continuous) also appears to have an impact on the energy consumption of the models and thus needs to added as a defining characteristic.

Finally, while the 2010 data did not show that door type (solid vs. glass) was a significant distinguishing energy performance attribute, several stakeholders asserted that it was despite the available data. More recently, during the test method development, some stakeholders noted that the number and types of inner doors affects energy use.

Given the long period between the Framework Document and this Draft 1 specification, EPA is looking to collect additional product data for all of the product classes covered within the proposed scope: i.e., laboratory grade refrigerators, freezers, and ultra-low-temperature freezers. EPA wants to ensure the dataset is reflective of the current market and that EPA captures any improvements in the products' efficiency over the last four years.

Until additional data is received, EPA will defer defining the exact parameters of the energy requirements. Once we receive this additional product data, EPA will propose performance requirements for categories where there is sufficient data to create them in the Draft 2 specification. EPA will strive to create performance requirements that differentiate products in a fair and consistent manner, and that also avoid unnecessary complexity. EPA is requesting additional product data, gathered using the finalized ENERGY STAR Test Method for Laboratory Grade Refrigerators, Freezers, and Ultra-low-temperature to help finalize these categorizations and develop specific energy requirements for each category.

EPA also welcomes additional feedback and/or data that show the extent to which specific use cases would necessitate separate categorization for level setting purposes, beyond the exclusions already discussed in Section 2.2.

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:

i. TBD

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.

Note: EPA is proposing to require that manufacturers test the highest energy-consuming unit within a product family to serve as the Representative Model. This approach will ensure that any variations allowed within the product family definition above (e.g. inner door, port size, shelf configuration) are captured by the worst-case energy scenario within a given family of products. If the highest energy-consuming unit meets the ENERGY STAR requirement, all other configurations within that product family also earn ENERGY STAR certification.

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: EPA's ENERGY STAR specification development is a data driven process. EPA is only able to propose performance criteria when a robust data set has been collected. To this end, EPA is providing a longer than typical timeline to provide stakeholders with additional time to test models. Please note that these models need not be third party certified for the specification development process but once the criteria are finalized, any models seeking to be labeled must be third party certified by an EPA recognized certification body.

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.