ThermoFisher
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Energy Star: Commercial Refrigerator/Freezer & ULT Test Procedure

TFS Comments on Draft 1 Rev. Nov 2012

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Purpose:

The intent of the following document is to present comments and feedback on the Draft 1 Test Method prepared by Energy Star and the EPA concerning Laboratory Grade Refrigerators and Freezers and Ultra-Low-Temperature Freezers. In addition, several comments have been prepared regarding the Framework Discussions Slides presented September 22, 2010 by E-Star.

ThermoFisher hopes to assist in the preparation of a test procedure that adequately categorizes the variety of products to be tested based on the intended use of the given unit in the hands of the consumer. This means that refrigerators, freezers, and ULT's must be subdivided into categories based on the relative design and designed purpose of the given unit. This will be addressed in detail in the comments to follow.

EPA References / Contacts:

All documents referenced in this review can be found online at:

http://energystar.gov/products/specs/node/185

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Draft 1 Comments:

General Comments:

Table 1 indicates thermal performance criteria to be met for testing, but nowhere in the document are there energy standards documented which will indicate E-star certification. What are the goals of this test procedure? Section 6.6 describes "Energy Consumption" but has no table of criteria by which to judge performance.

If the purpose of the E-Star certification is to help educate or properly inform users/potential buyers of these refrigeration products then the procedure should reflect the typical conditions that a user will see when using the product. However, to do this, specifications on the purpose of each type of unit (storage intent, set point, environment, door type etc) may need to be addressed and/or subdivided. This will provide the user an understanding of the differences between the product options/designs and the impact these designs have on the performance/energy metrics important to the user.

Comments By Draft Line Number:

Section 2: Applicability

12-14: The applicability addressed clearly specifies that freezers have 1 of 4 set points, -20C, -30C, -70C, or -80C. We need to be clear on the applicability of the test procedure and account for future development and product use.

Verify Procedure applies for reciprocating compressor systems only (ie. sterling refrigeration systems are excluded)

Section 3: Definitions

51: Cycle, defrost cycle (not defined), running cycle, refrigeration cycle (not defined)

91: Semi-automatic Defrost = manual defrost

58/61: (Clarification) Freezer is said to house volatile reagents where refrigerators are for non-volatile reagents. Is this classification intended or a typographical mistake?

103: The definition of steady-state needs to be clarified. We would like EPA to share an example on how data will be analyzed to determine steady state (sample raw data, calculation, graph etc).

104: What is the definition of a refrigeration cycle in regard to this document as it is not defined in section 3. If "refrigeration cycle" here is synonymous with the defined "Cycle" in line 51, then either the "24hr period" or "refrigeration cycle" needs to be omitted from this line. As it reads, interpretation leads to differentiation between the two steady-state units of measure, and if refrigeration cycle is a "cycle" by the definition, then it is a 24hr period. The confusion comes from industry definition of a cycle as the sum of the a single instance of a compressor on and subsequent off time, not a 24 hr block which contains many instances of compressor on/off.

Section 4: Test Setup

142: What is the reasoning behind fluorescent lighting? Many newly developed testing facilities utilize LED lighting which allows for a tighter control on airflow and temperature dynamics within the test facilities. If the goal of this line/section is to ensure a certain amount of load (due to the lighting), allow for any type of lighting with the prescribed illumination characteristics but require a thermal load be added if the illumination source does not emit the same amount of energy into the room as the equivalent florescent setup. This will allow for multiple lighting scenarios all affecting the room conditions equally.

162: Typical TCs used for temperature measurement has a tolerance greater than +/- 0.8C. Suggested +/- 1C

165: Suggested that measurements are taken at 1 min intervals. Multiple times throughout the draft, 3 min intervals are indicated. Defining characteristics of thermal performance can be missed using a 3 min sampling rate.

Section 5: Pre-Test Configuration

174-191: If a unit comes in different options, such as with wire shelves, solid shelves, drawers, or a combination thereof, does each possibility get tested and E-star certified independently? Better define empty cabinet state that preserves the "vanila" or the design.

186: Some designs have different modes of normal operation. For example there are units that have both "High Performance" and "Energy Savings" modes incorporated as "normal" user options for operating the unit. Both settings may

meet the stabilization testing requirements and thermal performance criteria. Do both modes have to be tested to be certified by E-star or is the "Energy Savings" mode (as it a normal operating mode) suffice for certification/testing purposes.
What if "High performance" mode will qualify the unit for a regulated market and the "Energy Savings" mode would meet similar energy consumption for unregulated markets (other categories). We suggest using multiple ratings, so the customer can understand the impact of the energy consumption by cabinet temperature performance.

211: Manufacturers design units for different voltages and operating frequencies. Is there a reason for strict use of a power supply of 115 V? Is that same unit with a different operating voltage (220V @ 60 Hz) automatically certified after the 115V version is tested? What if a given unit isn't offered in the 115V option?

Voltage tolerance is for non-running or loaded state? Please clarify how this is defined (tolerance of +/-1V from nominal) Throughout the whole test? How is this verified? We suggest +/-3% from nominal voltage.

215-227: If the intent is to test units at the intended use of the customer then what is the purpose of a 3-shelf test system. Why not require testing to be done on the manufacturer prescribed configuration regardless of how many shelves or locations of the shelves. Each shelf or drawer for that matter, can still be required to utilize the 5 TC configuration and placement. Otherwise, the test will not simulate that which the user will see in practical use.

Again, if a unit comes with options that could improve energy efficiency in regard to shelving/baskets etc, are all options required to be tested independently? We suggest units be tested without the options unless the option is needed for the untended use or to meet untended performance criteria (ie Drawers for blood banks)

Also, TC placement should be 3" above and away from the plane (sides and bottom) of the shelf or drawer to eliminate influence of thermal transfer from the cold medium.

Bottom of the unit can be used as a shelf and should get a TC grid.

Section 6: Test Methodology for All Products

269-300: There are door opening specifications for refrigerators and freezers but no specifications for ULFs. As the rest of the document separates freezers and ULFs, a sub-category is required under door opening section. We recommend to use

steady state for ULFs to determine energy consumptions. Door opening energy data can also be reported as additional energy consumption data.

Door opening shall be performed in the most unfavorable normal operating condition.

Door opening frequency varies with application and door opening introduces variation in consistent test results. We suggest providing steady state and door opening energy consumption data to the customer so they can better understand the effect of the door openings on the energy consumptions and can make an educated purchasing decision in accordance to their typical usage pattern.

334-340: There are no objections to the use of CAD models for volume based measurements. However, tolerance within the CAD model must be specified to ensure accuracy.

353 (Section 6.6): How is the energy consumption measured? Watts transducer? Voltage and current meter (P = VI)? Procedure needs to be specified.

357: Use 1 min sampling rate as opposed to 3 min to ensure sufficient/accurate data collection.

363: Use 1 min sampling rate as opposed to 3 min to ensure sufficient/accurate data collection.

364: What is meant or intended by uniformity and stability? It is not defined in section 3.

366-367: What is the purpose of using the central thermocouple? Where is this value being used and what criteria is it being judged against? If the purpose of this section (line) is to ensure stable temperature in each section (shelf/drawer/etc) of the unit, the average of the 5 TCs in that given section (shelf/drawer/etc) should be reported along with the minimum and maximum measurement for the given section as well. This will ensure proper temperature fluctuation across the cabinet. However, there are no criteria mentioned for this.

369: How will adequate defrost be checked for automatic smart/on demand defrost units. We propose have only two defrost categories: assisted defrost and manual defrost. Manual defrost would be defined as any defrost system that requires manual interaction with the unit to initiate or terminate the defrosting of the unit.

Section 7: Reporting Method

394 (Table 1): Product type is subcategorized for refrigerators (general, blood bank and pharma/chromatography) however, the Avg_{TCs} requirement is the same for all of them. Are these values expected to change after consumer input? Agency standards such as AABB, AS must be considered as they are a definite contributor to the design and the performance of each type of unit. We propose adding a performance column and three categories for measuring performance.
1) "Regulated" category should be for units designed strictly for the regulated market (ie Blood banks)
2) "Validation" market for units designed around customer internal validation protocols or other published guidelines (ie. vaccine and enzyme storage, pharma industry etc)
3) "General" for all other lab application there cabinet temperature performance are more lax.

Chromatography units should be removed from pharmacy category as it is designed to support heat generating equipment inside and will require more energy to maintain tight cabinet performance requirements.

396-403: Again, it is suggested to use the manufacturer's designed set point.

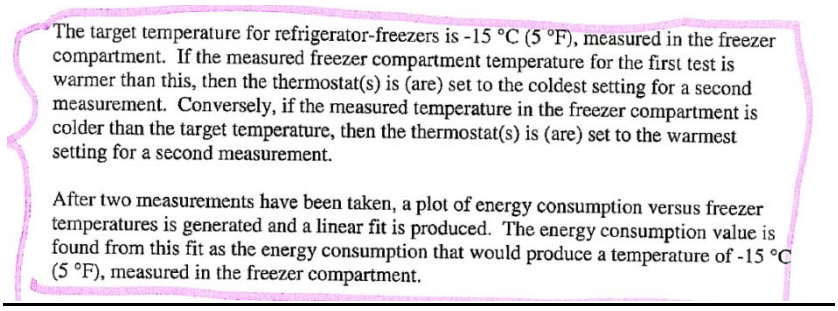
What does intended use mean? Is this intended use from the user standpoint? Manufacturer? The question is posed because some users, for example, run ULFs at temperature set points not recommended by the manufacturer.

If end use is going to be determined on what will be stored, then Table 1 needs further breakdown based on intended storage for freezer application (similar to that of refrigerators—blood bank, general, etc). However, it is again recommended that the unit be tested at the manufacturer recommended conditions. It is the user's prerogative as to what set point they use in their facility and what they put in the unit.

404-405: How is the weighted average of the energy results calculated? There is no procedure for this energy calculation. If the intent (from lines 396-403) is to use storage intended use, then why a weighted average would be used in the case of ULF? Further explanation for this reasoning is required. (Refer to previous comment regarding testing set point.)

We would recommend using AHAM test method to determine energy consumption at the category set point. This will remove any ambiguity about the test result and is already a mature measuring method. Of course this needs to be amended with the Lab grade categories set points.

In summary, measuring two energy numbers: one has a colder cabinet temperature than set point, and another is warmer than set point. Then generate a plot of the energy consumption vs. cabinet temperature, and calculate the energy number at set point through the linear curve fitting.



The target temperature for refrigerator-freezers is -15 °C (5 °F), measured in the freezer compartment. If the measured freezer compartment temperature for the first test is warmer than this, then the thermostat(s) is (are) set to the coldest setting for a second measurement. Conversely, if the measured temperature in the freezer compartment is colder than the target temperature, then the thermostat(s) is (are) set to the warmest setting for a second measurement.

After two measurements have been taken, a plot of energy consumption versus freezer temperatures is generated and a linear fit is produced. The energy consumption value is found from this fit as the energy consumption that would produce a temperature of -15 °C (5 °F), measured in the freezer compartment.

Further Clarifications needed:

1) Steady state condition
2) Performance criteria for door opening (unit has to recover from door opening and how will that be verified)
3) Where are table 1 values applicable (w/ or w/o door opening)

Nov 8 Webinar feedback

Issue: Door openings.

Questions:

In-out?

Performance or energy purpose?

TFS Recommendation: Leave in but report both: steady state Energy and Door opening energy

Issue: Volume measurement

CAD models ok?

Chris and Alan (USDaavis) other proposal: Use micro vials, plates, 2” vials and 2” boxes to measure volume capacity

TFS Recommendation: CAD files okay, but we need to use consistent method of measurement AHAM Volume

Issue: How to test units that do not have a clear identification of the recommended operating temperature

Test at lowest and highest and interpolate.

TFS Recommendation: Test at one of the lowest achieved predefined categories operating temperature.

Issue: Temperature performance measurement

Are open TC best representation for measuring performance?

Alan proposed to also report a weighted TC to show effect of temperature fluctuation on samples.

Also proposed loaded freezer

TFS Recommendation: Use open air as there's no representative/standardized medium to for testing loaded units