Draft 2 ENERGY STAR Supplement to ANSI/ASHRAE Standard 72-2005
For Laboratory Grade Refrigerators and Freezers
August 3, 2009

The U.S. Environmental Protection Agency (EPA) discussed the ANSI/ASHRAE Standard 72-2005, *Method of Testing Commercial Refrigerators and Freezers*, with several stakeholders to determine its applicability to laboratory applications. Preliminary feedback indicated that overall the test procedure is sound but revisions would need to be made to several test conditions to better represent laboratory grade applications and end user interests. The purpose of this supplement is to document the proposed changes to the test method presented in the standard in order to provide manufacturers with a meaningful and consistent method for measuring and comparing product energy efficiency and performance.

In April, a Draft 1 supplement to ANSI/ASHRAE Standard 72 was shared with stakeholders for review and comment. This Draft 2 version incorporates many of the comments and suggestions received on the Draft 1 document. Interested parties are encouraged to submit comments to Rebecca Duff, ICF International, at rduff@icfi.com **by August 17, 2009**.

Please note that the purpose of the table below is to document the proposed supplemental changes to the test method presented in ANSI/ASHRAE Standard 72-2005. EPA does not have the authority to revise the standard and therefore, sections that might not be applicable to certain laboratory grade refrigerators and freezers should simply be deemed not applicable. In this Draft 2 document, EPA has only included those sections where additional guidance specific to laboratory grade refrigerators and freezers is proposed.

Questions can be directed to Christopher Kent, EPA, at kent.christopher@epa.gov or (202) 343-9046 and Rebecca Duff at (202) 862-1266.

ANSI/ASHRAE 72-2005 Reference	Current Requirement	Supplement for Lab Grade
Section 6: Apparatus		
Section 6.2 Loading of Test Simulators and Filler Packages – 6.2.1 Test Simulators	Section 6.2.1 provides the guidelines for the test simulator. The simulator shall be a plastic container (such as polyethylene) of at least 473 mL (1 US liquid pint) volume, with a lid conforming to the dimensions shown in Figure 3 of the test standard. The container shall be filled with any natural or artificial sponge material that is saturated with a heat transfer solution consisting of a 50/50 +/- 2% mixture (by volume) of propylene glycol and distilled water. The temperature shall be measured within the simulator at the volumetric center point.	Chamber should be empty during testing. Un-weighted, bare thermocouples should be used to measure temperature. **Note:** The majority of stakeholders who commented on the Draft 1 support testing using an empty chamber. This represents the worst case scenario in regards to energy consumption.

Section 6.2: Loading of Test Simulators and Filler Packages – 6.2.2 Test Simulator Locations (Refrigerators with Shelves)	For each row of shelves in the refrigerated zone, there shall be two test simulators placed at each of the following locations: at the left end, at the right end, and at each shelf standard break between adjacent shelves. At each location, one test simulator shall be placed on the shelf surface at the front of the shelf and the other test simulator placed on the shelf surface at the rear edge of the shelf. For the bottom compartment display or storage area, there shall be two test simulators located at the left end, at the right end, and at the shelf standard break between adjacent shelves. At each location, both test simulators shall be placed to be in contact with the specified upper load-limit boundary, with one at the front and one at the back of the compartment.	Representative shelving should used during testing. Thermocouples should be placed on three planes located 1 inch above each shelf. Shelves should be placed in: the (1) top allowable position, (2) geometric center, (3) lowest allowable position. **Note:** The majority of stakeholders that commented on the Draft 1 support the use of representative shelving during testing. Representative shelving might be defined as: (1) shelving that is sold with the unit or (2) standard wire shelves. Stakeholders are encouraged to provide feedback on a definition for representative/standard shelving. EPA also received a comment that sensors should be placed 3" off the wall.
Section 6.2: Loading of Test Simulators and Filler Packages – 6.2.3 Simulator Locations (Refrigerators without Shelves)	Test simulators shall be located at the left end, at the right end, and at 915 to 1220 mm (36 to 48 in.) intervals across the width of the refrigerator. At each location, test simulators shall be placed in the front and the rear, and at the top and bottom, in contact with the manufacturer's specified load-limit boundaries.	NA – all laboratory grade refrigerators and freezers must be tested with representative shelving.
Section 6.2.4 – 6.2.5: Typical Locations and Filler Packages	Section 6.2.4 references figures within the test standard regarding typical multi-deck and single-deck refrigerators showing filler packaging and test simulator locations. Section 6.2.5 provides guidance regarding filler packages used as product mass.	NA – filler packages are not needed because test chamber is tested empty.
Section 7: Test Procedure		
Section 7.2: Door-Opening Requirements	Each door shall be in the fully open position for six seconds, six times per hour for eight consecutive hours. Each door shall be opened sequentially, one at a time. The eight-hour period of door openings shall	For Refrigerators: Each door shall be opened **at an angle of 75° for fifteen seconds, three times per hour,** for eight consecutive hours. For Freezers: Each door shall

	begin three hours after the start of a defrost period. For units with pass-through doors, only the doors on one side of the unit shall be opened during the test.	be opened **at an angle of 75° for thirty seconds, once per hour** for eight consecutive hours. **Note:** A suggestion was made to change the freezer requirement to 15 seconds. EPA is interested in a time period that best emulates laboratory usage. Stakeholders are encouraged to comment on this proposed change.
Section 7.3: Defrost	The test shall begin with a defrost period as shown in Figure 6 of the test standard. Test period is 24 hours.	Test period must be at least 24 hours with a minimum of 2 defrost cycles. For test periods longer than 24 hours, to capture two defrost cycles manufacturer should derive kWh/day by dividing total hour duration by 24. **Note:** EPA received limited feedback on this approach. This approach was proposed by meeting attendees in January. Stakeholders are encouraged to indicate whether additional clarification or guidance is needed, especially for units that may only have one defrost cycle under typical operation. Currently, this test procedure as written would require testing to continue until a second defrost cycle is encountered. It is expected that testing would not exceed 7 days under the current test conditions.
Section 7.7: Test Simulator Temperature Measurement	After steady state conditions, the ambient, the test simulator temperatures, and all other data shall be recorded at **three-minute intervals** beginning at the start of the defrost period, through the defrost period, and through the running cycle until the beginning of the next successive defrost period. After this test period, all test simulators shall continue to be recorded throughout the 24-hour refrigerant flow period to ensure that no changes occur that would change the test results.	**Note:** One stakeholder suggested 5-minute recording intervals to avoid issues with data overflow on validations. Currently the ENERGY STAR commercial refrigeration specification uses the pre-determined ANSI/ASHRAE 3-minute intervals. Stakeholders are encouraged to provide feedback on the appropriate amount of data needed to produce reasonably accurate performance results for laboratory equipment.

Temperature Uniformity Test

- Measurements taken during energy consumption test over a 3-hour period while door is closed at 3-minute intervals.
- Test period must not include defrost cycle.

Note: EPA received a comment that temperature uniformity was outside the scope of ENERGY STAR. At the beginning of this process several laboratory grade manufacturers requested that a test method for uniformity be developed to ensure that performance is maintained with reduced energy consumption. This is also an important guiding principle for developing ENERGY STAR specifications. The current ANSI/ASHRAE Standard 72-2005 does not address uniformity (i.e., the ability of the unit to keep temperature balanced throughout the chamber). This is an important consideration of customers when purchasing laboratory grade refrigerators and freezers. Laboratory managers want to be assured that product quality will not suffer as a result of reductions in energy use. By requiring uniformity to be conducted during the larger energy consumption test, customers can use both metrics to make purchasing decisions and know that they are linked.

Reporting Method

- **Option 1:** Manufacturers use the standard deviation formula below and multiply the result by 3 to get 3 standard deviations of the average of all interval standard deviations. Where:

N = number of data points
X = average of all data points
Xi = data for individual data point at any particular time

$$s_N = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \overline{x})^2}$$

- **Option 2:** Manufacturers report the minimum and maximum temperature during test period.

Note: EPA received mixed feedback regarding the best approach for reporting temperature uniformity results. Some stakeholders believe that Option 1 is a better, more accurate representation of uniformity while others believe that Option 2 represents the approach currently used by pharmaceutical industry and provides data that is more useable and relevant to the end user. One stakeholder suggested using Option 2 but requiring additional reporting, including:

- Average Temperature -the average of all test simulator temperatures recorded shall be calculated.
- Coldest Test Simulator Average – The test simulator with the coldest recorded average temperatures.
- Warmest Test Simulator Average - The test simulator with the warmest recorded average temperatures.
- Warmest Test Simulator – The maximum temperature of the test simulator with the warmest peak temperature.
- Coldest Test Simulator – The minimum temperature of the test simulator with the coldest peak temperature.

EPA will discuss this issue in greater detail during the stakeholder meeting scheduled for August 5, 2009. Stakeholders are encouraged to provide feedback during that meeting and in writing.

Additional Conditions

- All manually controlled accessories that come standard with the equipment must be installed and turned to the "ON" position during testing.
- Test procedure applicable to automatic and semi-automatic defrost systems only.

Note: Stakeholders support the requirement that manufacturers turn all manually controlled accessories to the "ON" position during testing. This is consistent with the ENERGY STAR commercial refrigeration specification and represents the worst case scenario.

EPA received a request to clarify the definition of a semi-automatic system. A semi-automatic system is defrosted by manually pushing a button/switch to begin cycle. Manually controlled defrost systems are not currently addressed by the test procedure. During the stakeholder meeting in January, it was decided that EPA should address automatic and semi-automatic units initially since they represent the majority of the general purpose, -20, and -30 products available. Stakeholders are encouraged to provide any additional thoughts regarding manual defrost units.

Set-Point Temperature Requirements

Product Type	**Integrated Average Temperature: *EPA Initial Proposal (Nov. 2007)***	**Integrated Average Temperature: *Alternate Proposal***
General Purpose Laboratory Refrigerators	4 degrees $\pm$ 2 degrees C	5 degrees $\pm$ 3 degrees C
Blood Bank Refrigerators	4 degrees $\pm$ 2 degrees C	5 degrees $\pm$ 3 degrees C
Pharmacy and Chromatography Refrigerators	4 degrees $\pm$ 2 degrees C	5 degrees $\pm$ 3 degrees C
General Purpose Laboratory Freezers	-20 degrees $\pm$ 2 degrees C	-20 degrees $\pm$ 5 degrees C
-30 Freezers	-30 degrees $\pm$ 2 degrees C	-30 degrees $\pm$ 5 degrees C
-20 Freezers	-20 degrees $\pm$ 2 degrees C	-20 degrees $\pm$ 5 degrees C

Note: Several stakeholders voiced support for the alternate set-point temperature requirements proposal provided above. However, a few stakeholders continue to have concerns that the requirements might be too tight for basic lab applications or that the temperatures as proposed may not support industry standards for product storage. EPA understands that the alternate proposal presented above mirrors that which is dictated by the pharmaceutical and bio tech industries. Furthermore, there is some indication that the Food and Drug Administration might extend these tighter requirements to universities that perform clinical drug trials and development.

One option would be to develop separate requirements based on application (e.g., university versus pharmaceutical/bio tech). However, compliance would be difficult to track since many of these products can be used in either university or pharmaceutical/bio tech applications. Again, EPA understands that customers may require slightly different parameters based on unique requirements related to product storage. However, the set point temperatures and tolerances presented above provide end users with a means to compare product performance under the same operating conditions. It is not EPA's intention to cover units designed for residential or commercial use and used in the laboratory environment. Equipment specifically designed for laboratory applications typically require tighter temperature requirements. The alternate proposal presented above seeks to align with these product types.

EPA also received a suggestion that references to "plasma" and "enzyme" freezers should be changed to -20 and -30 freezers.

Proposed Testing/Specification Development Timeline

- Draft 2 Supplement Released for Comment — August 3
- Comments on Draft 2 Supplement Due to EPA — August 17*
- Final Supplement Released — September 17
- Manufacturers Test and Report Results — September 17 – January 15
- Draft 1 Specification Released for Comment — February 11
- Stakeholder Meeting to Discuss Draft 1 — Late February
- Draft 1 Comments Due to EPA — Early March
- Draft 2 Specification Released for Comment — March/April
- Draft 2 Comments Due to EPA — Late April*

**Subsequent draft versions will be released, as needed, prior to finalization. Once final, the specification will become effective immediately.*

Reminder: As of January 1, 2010, laboratory grade refrigerators and freezers will no longer be eligible for ENERGY STAR qualification unless new requirements can be developed. Units qualified under the ENERGY STAR Version 1.0 Commercial Solid Door Refrigerator and Freezer specification will be removed from the ENERGY STAR qualified product list on January 1, 2010.

Note: The development of an ENERGY STAR specification for laboratory grade refrigerators and freezers is dependent on: a robust data set that presents significant differentiation among models and manufacturers; significant energy and carbon savings potential; and whether ENERGY STAR qualification is cost effective to the end user.