

**Draft 1 ENERGY STAR Supplement to ANSI/ASHRAE Standard 72-2005
For Laboratory Grade Refrigerators and Freezers
April 10, 2009**

Background

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.

On January 22, 2009, EPA held a meeting with equipment manufacturers, laboratory managers, and other interested parties to discuss suggestions for augmenting the current test procedure to better emulate laboratory grade performance. Based on these discussions, EPA is pleased to share this Draft 1 Supplement to ANSI/ASHRAE Standard 72-2005 for review and comment. Stakeholders are encouraged to submit comments to Rebecca Duff, ICF International, at rduff@icfi.com by **April 30, 2009**.

Please note that EPA is looking for comments on both the Draft 1 Supplement and the proposed timeline for testing equipment in support of the ENERGY STAR specification development process. Questions can be directed to Christopher Kent, EPA, at (202) 343-9046 or kent.christopher@epa.gov and Rebecca Duff at (202) 862-1266.

Presentations from the January 22 stakeholder meeting can be downloaded from the ENERGY STAR Web site at www.energystar.gov/NewSpecs.

ANSI/ASHRAE Standard 72-2005: Laboratory Grade Supplement

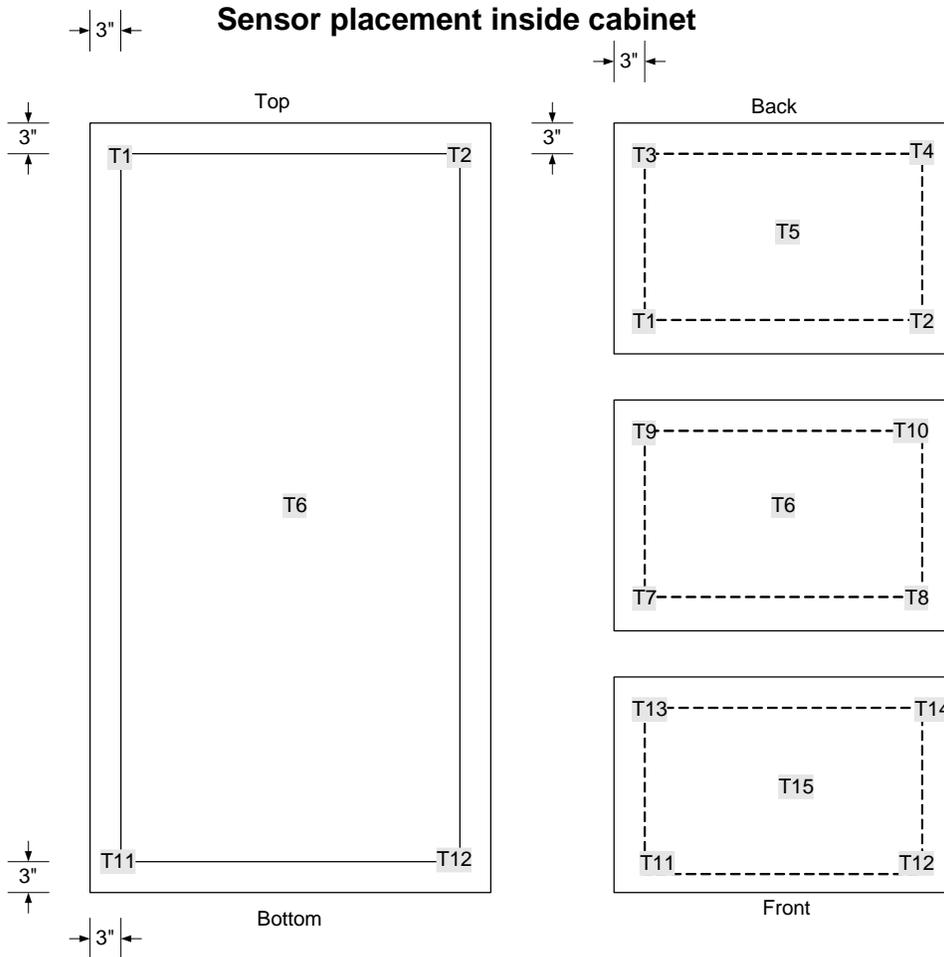
Sections 4 through 7 are provided in the table below along with the proposed condition for testing laboratory grade refrigerators and freezers. However, stakeholders are encouraged to provide feedback on any of the requirements outlined in Sections 1 – 3 (i.e., purpose, scope, and definitions) and 8 – 10 (i.e., calculations for remote refrigerators, recoded data, and references).

ANSI/ASHRAE 72-2005 Reference	Current Requirement	Supplement for Lab Grade
Section 4: Test Conditions	Sections 4.1 – 4.3 provide requirements for ambient conditions, power supply, and refrigerant or secondary coolant.	No changes.
Section 5: Instruments	Instruments shall be calibrated traceable to the National Institute of Standards and Technology (NIST) standards annually. Sections 5.1 – 5.5 provide requirements for equipment calibration and temperature, pressure, liquid quantity, and other measuring instruments.	No changes.

Section 6: Apparatus		
Section 6.1 Test Room Conditions	Sections 6.1.1 – 6.1.3 provide requirements for accessories, ambient temperatures, and illumination.	No changes.
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.
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.	<p>Option 1: All shelves should be removed during testing.</p> <p>Thermocouples should be placed on three planes using 5-5-5 placement: (1) 3” from top in same plane; (2) geometric center; and (3) 3” from bottom in same plane. See Sensor Placement Figure provided below.</p> <p>Option 2: Representative shelving is used during testing (e.g., standard wire shelves).</p> <p>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.</p> <p>Note: Stakeholders are encouraged to provide feedback on whether EPA should pursue Option 1 or 2.</p>

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.	Thermocouples should be placed on three planes using 5-5-5 placement: (1) 3” from top in same plane; (2) geometric center; and (3) 3” from bottom in same plane. See Sensor Placement Figure provided below.
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.	Filler packages are not needed because test chamber is tested empty.
Section 6.3: Refrigerating Apparatus	Sections 6.3.1 – 6.3.4 provide requirements for connecting remote refrigerators (pressure and temperature locations, sight glass locations, on/off cycles, and suction pressure adjustment).	NA
Section 7: Test Procedure		
Section 7.1: General Principles	Sections 7.1.1 – 7.1.3 provide requirements for steady state and ambient conditions.	No changes.
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 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.	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 doors shall be opened at an angle of 75° for thirty seconds, once per hour for eight consecutive hours.
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.

Section 7.4: Stabilization Period	Provides requirements for stabilization once ambient conditions have been reached. Refrigerator shall be pre-cooled and operated until steady state conditions occur. Once the temperatures have stabilized so that steady-state conditions exist, the refrigerator shall continue to operate for a period of not less than 12 hours without any adjustment to the controls.	No changes.
Section 7.5: Liquid Flow Measurement	Provides requirements for total liquid flow and time/cycles.	NA
Section 7.6: Remote Refrigerator Other Measurements	Provides requirements for direct expansion coils and secondary coolant coils (remote refrigerators).	NA
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.	No changes.
Section 7.8: Defrost Adequacy Assurance	Verification that any defrost setting and arrangement is adequate to melt all frost and ice from coils and flues and drain it out of the refrigerator. Additional testing may be required if after a subsequent two additional running cycles, or 24 hours whichever comes first, shows ice accumulation.	No changes.
Section 7.9: Remote Refrigerators – Additional Data	Electrical energy for the refrigerator electrical circuits shall be measured separately.	NA



Note: The figure above represents Option 1, testing refrigerators/freezers without shelves.

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.

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

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

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

Note: Stakeholders are encouraged to provide feedback on which option best supports data quality and end user needs.

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.

Set-Point Temperature Requirements

Product Type	Integrated Average Temperature: <i>EPA Initial Proposal (Nov. 2007)</i>	Integrated Average Temperature: <i>Alternate Proposal</i>
General Purpose Laboratory Refrigerators	4 degrees ± 2 degrees C	5 degrees ± 3 degrees C
Blood Bank Refrigerators	4 degrees ± 2 degrees C	5 degrees ± 3 degrees C
Pharmacy and Chromatography Refrigerators	4 degrees ± 2 degrees C	5 degrees ± 3 degrees C
General Purpose Laboratory Freezers	-20 degrees ± 2 degrees C	-20 degrees ± 5 degrees C
Plasma Freezers	-30 degrees ± 2 degrees C	-30 degrees ± 5 degrees C
Enzyme Freezers	-20 degrees ± 2 degrees C	-20 degrees ± 5 degrees C

Note: Stakeholders are encouraged to provide feedback on the appropriate temperature conditions.

Proposed Testing/Specification Development Timeline

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| • Comments Due on Draft 1 Supplement | April 30 |
| • Final Draft Supplement Released | May 14 |
| • Comments due on Final Draft Supplement | June 5 |
| • Final Supplement Released | June 19 |
| • Manufacturers Test and Report Results | June 19 – Sept 25 |
| • Draft 1 Specification Released for Comment | October 16 |
| • Stakeholder Meeting to Discuss Draft 1 | October 28 |
| • Draft 1 Comments Due to EPA | November 13 |
| • Draft 2 Specification Released for Comment | December 11 |
| • Draft 2 Comments Due to EPA | January 8* |

**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.