ENERGY STAR Supplement to ANSI/ASHRAE Standard 72-2005
For Laboratory Grade Refrigerators and Freezers
December 30, 2009

The U.S. Environmental Protection Agency (EPA) developed this ENERGY STAR® supplement to ANSI/ASHRAE Standard 72-2005, *Method of Testing Commercial Refrigerators and Freezers*, to document the proposed changes to the test standard as it applies to laboratory grade refrigeration equipment. EPA developed this supplement with stakeholders in order to provide manufacturers with a meaningful and consistent method for measuring and comparing energy efficiency and performance data for this type of equipment and to ensure that the reporting results will be appropriate for laboratory grade end users' information needs.

This final ENERGY STAR supplement to ANSI/ASHRAE Standard 72-2005 incorporates several written stakeholder comments and suggestions submitted to EPA in subsequent drafts of the supplement, as well as feedback provided during stakeholder meetings.

Manufacturers are invited to begin testing and provide data to ENERGY STAR for evaluation. Interested parties are asked to submit data using the enclosed data collection form to ENERGY STAR at LabGradeRefrigeration@energystar.gov **by March 31, 2010**.

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

Questions can be directed to Christopher Kent, EPA, at kent.christopher@epa.gov or (202) 343-9046 and Bijit Kundu, ICF International, at bkundu@icfi.com or (202) 862-1157.

ANSI/ASHRAE 72-2005 Reference	Current Requirement	Supplement for Laboratory Grade Equipment
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.

ANSI/ASHRAE 72-2005 Reference	Current Requirement	Supplement for Laboratory Grade Equipment
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 be used during testing. Representative shelving is defined as that which is installed as sold to the end user. If tested unit offers more than one type of shelf or shelf configuration, manufacturers must test and report each option/configuration separately. If a unit also offers drawers or baskets then that configuration must also be tested separately. Thermocouples should be placed on three planes located 1 inch above each shelf or 1 inch above the bottom of a drawer or basket. Shelves should be placed in the: (1) top allowable position, (2) geometric center, and (3) lowest allowable position. Thermocouples should be placed in the geometric center and 3 inches from each corner of the shelf (5 sensors/shelf). For adjacent shelves within a unit, thermocouples shall be placed at each shelf standard break between adjacent shelves, consistent with ANSI/ASHRAE 72.
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.	If a unit is sold without shelving then the manufacturer may test it without shelves. If the unit is sold without shelves but then offers different shelf types for installation in the field, then manufacturer should test each of those options.
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		

ANSI/ASHRAE 72-2005 Reference	Current Requirement	Supplement for Laboratory Grade Equipment
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 Hinged Doors:** Opened at an angle not less than 75°. **For Sliding Doors:** Opened as far as they will go. **Note:** Language from the ANSI/ ASHRAE 72 test method regarding the testing of hinged and sliding doors is reiterated in this supplement, above.	For Refrigerators: Each door shall be opened **for fifteen seconds, three times per hour,** for eight consecutive hours. For Freezers: Each door shall be opened **for fifteen seconds, once per hour** for eight consecutive hours. Each door shall be opened using even time intervals.
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.	**Manual:** 24-hour test period with no defrost cycle. **Automatic Timed:** Test period must be at least 24 hours with a minimum of 2 defrost cycles. **Automatic Smart or On Demand:** Test period must be at least 24 hours with a minimum of 1 defrost cycle (including pull down). If test period extends beyond 24 hrs to capture a defrost cycle manufacturer should derive kWh/day by dividing total hour duration by 24.

ANSI/ASHRAE 72-2005 Reference	Current Requirement	Supplement for Laboratory Grade Equipment
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.	Testing for laboratory grade refrigerators and freezer will be recorded using the same approach as ANSI/ASHRAE 72. If steady state, as defined by ANSI/ASHRAE 72, is not met after a 5 hour period, manufacturers are asked to report the equipment's actual steady state condition. This information will be used to determine if the supplement should include alternate requirements for steady state for the conditions described in this test procedure. Note: ENERGY STAR understands that steady state conditions as defined by ANSI/ASHRAE 72 (i.e., average temperature of all test simulators changes less than 0.2 degrees C from one 24-hour period or refrigeration cycle to the next) may be difficult to meet with un-weighted, bare probes. In an effort to determine the steady state conditions for the test conditions outlined in this supplement, manufacturers are asked to submit input on steady state conditions based on testing results.

Temperature Uniformity Test

Measurements taken during energy consumption test over two 3-hour periods while door is closed at 3-minute intervals.

- Manufacturer must collect uniformity data during two 3-hour periods: one that includes a defrost cycle and one in steady state (i.e., no defrost cycle) **AND**
- Manufacturer must report stability for the central thermocouple on each shelf (average temperature and +/- range).

Reporting Method
Manufacturers should report both the standard deviation and minimum/maximum temperatures collected for each thermocouple during the test period:

Standard Deviation – 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

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

Min/Max Temperature – Manufacturers report the minimum and maximum temperature during test period.

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 manual, automatic-timed, and smart or on-demand defrost systems. Combination freezer-refrigerators are excluded at this time.

Set-Point Temperature Requirements

Product Type	Set-Point Temperature	Average of All Thermocouples During Entire Test Period
General Purpose Laboratory Refrigerators	4 degrees C	4 degrees ± 1 degree C
Blood Bank Refrigerators	4 degrees C	4 degrees ± 1 degree C
Pharmacy and Chromatography Refrigerators	4 degrees C	4 degrees ± 1 degree C
General Purpose Laboratory Freezers	-20 degrees C	-20 degrees ± 1 degree C
-30 Freezers	-30 degrees C	-30 degrees ± 1 degree C
-20 Freezers	-20 degrees C	-20 degrees ± 1 degree C

Note: ENERGY STAR understands that temperature measurements may be less stable in an empty cabinet, with un-weighted, bare probes, making the +/- 1 degree C requirement difficult to meet. In an effort to determine and define the testing tolerances for the test conditions outlined in this supplement, manufacturers are asked to submit input on testing tolerances based on testing results. Including temperature tolerances will eliminate poorly designed units that may perform well in regards to energy efficiency but also allow the temperatures to go above acceptable levels. EPA believes based on stakeholder discussions that this issue is also important to the laboratory community.

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. 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.