ENERGY STAR® Laboratory Grade Refrigerator and Freezer Stakeholder Web Meeting

August 5, 2009

Meeting Notes

Laboratory grade refrigerator and freezer manufacturers and other stakeholders participated in a Web meeting hosted by the U.S. Environmental Protection Agency (EPA) on August 5, 2009. The purpose of the meeting was to discuss the Draft 2 Supplement to ANSI/ASHRAE Standard 72-2005 for measuring energy efficiency performance of laboratory equipment. The Draft 2 supplement and EPA's presentation will be posted to the ENERGY STAR Web site at: www.energystar.gov/newspecs.

Below is a summary of the discussion led by Christopher Kent, ENERGY STAR Program Manager, and Rebecca Duff, ICF International. A list of outstanding issues that require further review is also provided at the end of this document. Stakeholders with additional comments should submit feedback to Rebecca Duff at rduff@icfi.com **by Friday, August 21**. Questions can be directed to Mr. Kent at (202) 343-9046 or Rebecca Duff at (202) 862-1266.

Discussion Summary

Mr. Kent reviewed the purpose of the supplement document, the activities led by EPA to date, and the goals for the day's discussions. Mr. Kent and Ms. Duff then presented several outstanding issues that require additional input from stakeholders prior to finalizing. These issues, along with additional concerns and feedback offered by attendees, are described below:

Loading Conditions – Section 6.2

The Draft 1 proposes that the refrigerator or freezer be empty during testing. Manufacturers must also use un-weighted and bare thermocouples to collect data. Representative shelves should be installed during testing in the: (1) top allowable position; (2) geometric center; and (3) lowest allowable position. Thermocouples should be placed 1 inch above each shelf.

Issue: Representative shelving needs to be defined. Proposed options: as shipped/sold; standard wire shelves; different shelving for different product types. An additional comment was also made that thermocouples should be placed 3" off the wall.

- The standard practice for laboratory equipment testing is to use bare wire thermocouples. You get an immediate response to temperature change, which is very helpful to the end user and represents a worst case scenario.
- The uniformity test also requires a quicker response to temperature change.
- While thermal mass is helpful to the end user because it better emulates how the equipment will respond filled with product, it would be extremely difficult to pin down what a representative product should be as there is a wide range in laboratories.
- Manufacturers should test using the shelves that will be sold with the product. If the unit sells with more than 1 shelf option then the manufacturer should test using all options. All attendees agreed with this approach.
- ENERGY STAR Question: ANSI/ASHRAE Standard 72-2005 calls for thermocouple placement at the left front and rear, right front and rear, and front and rear at each shelf break. Do any stakeholders have concerns about this approach?
- There are many different cabinet and shelf sizes so you may have some inconsistency regarding where the thermocouple is placed in relation to the shelf.

- Thermocouples should be placed at the end of the shelf, perhaps 3' from the front of the shelf, to represent useable space. It doesn't make sense to pull temperature readings from an area in the cabinet that will not be populated by product.
- Total kWh/day, as prescribed in ANSI/ASHRAE Standard 72, uses representative volume as the process for calculating internal volume.
- The same thermocouples will be used to test temperature uniformity so placing the thermocouples in front of the shelves will capture airflow conditions.
- Do we use the wall to determine where the thermocouple is placed or the shelf (i.e., 3" off wall or 3" off front of the shelf)?
- Next Steps: Additional discussion is needed on this subject matter. *See outstanding issues section, below*.

Door Openings – Section 7.2

The Draft 1 proposes that each freezer door be opened at an angle of 75 degrees for 30 seconds, once per hour for eight consecutive hours. EPA received a suggestion that the period be revised to 15 seconds.

- Openings at the rate of 1 per hour make sense.
- 30 seconds is preferred and better emulates freezer usage. Freezers tend to have solid doors and are harder to find samples in the cabinet. Plus, manufacturers should stress the cabinet to show worst case scenario.
- Most customers ask for 1 minute but typically the operator isn't in the cabinet for more than 15 seconds.
- 15 seconds for an empty chamber may be a better representation of a fully loaded cabinet opened for 30 seconds.
- ENERGY STAR Question: Clarification was requested regarding the testing of sliding door units.
- The manufacturer should open the door as far as the door will allow during testing. This is how ANSI/ASHRAE Standard 72 defines testing these units.
- Perhaps the word "angle" should be dropped and manufacturers simply open the sliding door to 75%.
- A clarification also needs to be made that the doors should be opened in sequence.
- ENERGY STAR Question: One stakeholder asked whether inner doors should follow the same technique as outer door openings. EPA was under the impression that inner doors are typically only used in ultra low temperature freezer applications.
- That is correct, inner doors are used on ultra low temperature freezers (e.g., - 50 C+). If EPA is not including this product type in the scope then direction regarding inner doors is not needed.

Defrost – Section 7.3

The Draft 1 proposes that the test period be at least 24 hours with a minimum of two defrost cycles. For test periods longer than 24 hours, the manufacturer should derive kWh/day by diving total hour duration by 24. Several stakeholders expressed concern that equipment designed to only go into one defrost cycle or manual defrost equipment won't be covered.

- One thing to consider is if you run the unit for longer than 24 hours, its efficiency will improve. We don't want to encourage manufacturers to run longer tests to improve their efficiency results.
- Some end users prefer manual defrost units because they provide the best uniformity. There are a lot of units available today that are not designed with automatic defrost.

- There are several units that do not have a defrost cycle. For example, some freezers include evaporative coils in the walls and do not have traditional defrost cycles.
- The ANSI/ASHRAE Standard 72 only applies to automatic and semi-automatic systems, requiring a clean coil at the end of testing (i.e., steady state).
- Some units have programmable defrost based on the time of day and frequent of defrost. This capability is set at the factory but the end user can change the parameters, if needed.
- If a refrigerator offers a smart technology, that negates the need for a defrost cycle, why should it be forced into a defrost cycle during the test period?
- There are three classifications for defrost: smart defrost; automatic (timed); and manual.
- EPA should allow product to be tested as designed and intended for the end user.
- Next Steps: Additional discussion is needed on this subject matter. *See outstanding issues section, below*.

Temperature Measurement – Section 7.7

The Draft 1 proposes that data 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. A suggestion was made to increase this polling to five minutes.

- Solution: Attendees agreed that a three minute interval was acceptable, especially since it appears that testing will be confined to a 24-hour period.

Temperature Uniformity Test (not currently included in ANSI/ASHRAE Standard 72-2005)

The Draft 1 proposes that measurements be taken during the energy consumption test over a 3-hour period while the door is closed at three minute intervals. In addition, the test period must not include a defrost cycle. There are two options for reporting the results of the uniformity test: (1) using standard deviation (formula provided) and multiplying the result by 3 to get 3 standard deviations or (2) providing the minimum and maximum temperature during testing.

- Uniformity is important because end users can purchase the wrong type of equipment but expect a certain level of uniformity and not get it. For example, commercial or residential units will not have the same level of uniformity as units designed specifically for use in the laboratory.
- Uniformity is extremely important to end users. End users may gravitate toward low energy consuming models but not without evaluating uniformity as well.
- The standard deviation approach tracks well to uniformity.
- In particular, the biotech industry will want to see that the temperature never exceeds 8 degrees C. Therefore, minimum and maximum values will be important to this sector.
- Standard deviation is the most statistically accurate and it is easily calculated using Excel formulas.
- Standard deviation provides over 99% confidence that the cabinet will not exceed the mean temperature +/- X degrees any time it is tested.
- The most understandable is usually the best approach for reporting data. Not everyone is comfortable with the idea of standard deviation. Although either approach would be fine.
- Solution: Manufacturers will be required to report both using standard deviation and min/max temperatures. End users can use whatever information is most useful for their purposes.
- The test period must include a defrost cycle so end users can get an idea of how it will operate in practice.
- This could be a problem particularly with smart defrost units. There would be inconsistency across products. The goal of this testing should be to compare products using the same test conditions.

- The defrost cycle is very short with impacts similar to that of a door opening.
- End users will want a uniformity test that includes a defrost cycle. There have been situations where reagent has been lost because of defrost cycles.
- ENERGY STAR Question: Perhaps one approach would be to also test uniformity over a 24-hour period to capture at least one defrost cycle, for those products that enter defrost during that period.
- Many customers are already mapping equipment over a 24-hour period.
- Next Steps: Additional discussion is needed on this subject matter. *See outstanding issues section, below*.

Set Point Temperatures

The Draft 1 proposes integrated average temperatures and tolerances based on the product type: general purpose refrigerators and freezers, blood bank refrigerators, pharmacy/chromatography refrigerators, -20 freezers, and -30 freezers.

- Integrated average temperature and tolerances may not be the same for each product across the board.
- Set point temperatures can be set but we should leave the tolerances to the manufacturer to determine.
- The set point temperatures for general purpose, blood bank, and pharmacy/chromatography should be 4 degrees C, not 5 degrees C.
- There is some confusion as to what integrated average temperature represents. It's basically a dump of all data points collected during testing and averaged. It is not the same as uniformity or how tight the swing is around the set point at any point in time.
- If you provide large tolerances (e.g., 5 degrees) then you could find energy consumption differences of 30-40%. For example, if the requirement is 4 degrees +/- 5 degrees then the manufacturer could run the equipment at an average temperature of 9 degrees and achieve a lower kWh/day result. This is misleading to the customer and opens the manufacturer up to challenges.
- Canada is currently using a +/- 1 degree C for commercial refrigeration. Units are capable of meeting these tighter requirements because we are talking about an average of hundreds of data points. Perhaps there is a better term than integrated average temperature.
- Next Steps: Additional discussion is needed on this subject matter. *See outstanding issues section, below*

Outstanding Issues for Further Review

Stakeholders are encouraged to provide specific feedback on the following outstanding issues.

1. Thermocouple Placement: Ideas shared during the meeting: (1) place 3 inches off each wall; (2) place 1 inch from edge of shelf; (3) place 3 inches in front of the shelf in addition to inches determined off the surrounding walls; and (4) place 3 inches from each corner. Are there other proposals? The key issue for discussion is whether manufacturers measure useable volume or internal volume. This will largely determine where the thermocouples will be placed for both energy consumption and uniformity. The current ANSI/ASHRAE requirement is to use internal volume.
2. Defrost: Attendees suggested determining required defrost based on product type: manual, automatic/timed, automatic/smart. Manual will not be required to go into a defrost cycle and timed automatic could be required to use factory settings, as shipped. Smart automatic would be allowed to go into defrost based on the needs of the machine. This would allow the testing to be confined to a 24-hour period. What other parameters would need to be determined to define the testing of these different product types? What are some of the challenges with taking this approach?

3. Temperature Uniformity: Should the test method require a defrost cycle? If so, should the test period be expanded from 3 hours to 24 hours to capture at least one defrost cycle and align with the energy consumption test? What are the challenges for including, or not including, a defrost cycle?
4. Integrated Average Temperature: Defined as the average of all data points collected during the 24-hour test period. This is a different metric than set point temperature. Given this definition, do manufacturers agree that the proposed +/- 1 degree C tolerance is feasible? Is there a better term for this metric?

Additional Stakeholder Comments Not Covered:

5. Are there laboratory grade refrigerators or freezers that are designed and/or sold without shelves? If so, how should these products be address in the test method supplement?
6. A question was asked about how to test combination units (i.e., refrigerator/freezer).

   How prevalent are these product types in the marketplace? The test method should be the same regardless of product type so the question is whether or not we include these products for initial testing to determine whether an ENERGY STAR specification makes sense.
7. EPA should require certification for electrical safety by a third party (e.g. UL, ETL, CSA).

   Is this a concern among laboratory grade refrigerator and freezer manufacturers?
8. EPA should require that units meet UL Standard 471 for Commercial Refrigerators and Freezers.

   It appears that this standard only applies to commercial grade units, not laboratory grade units. EPA's intention is to only cover units designed for laboratory use and therefore, is inclined not to include this requirement.

   Are there other standards that should be referenced to more clearly draw the line between commercial, residential, and laboratory grade refrigerators and freezers?
9. Several times during the discussion, stakeholders mentioned units with drawers. It's important to note that ANSI/ASHRAE Standard 72-2005 does not cover units with drawers. The ASHRAE Technical Committee is working on adding specific conditions for units with drawers. Therefore, initial testing will be focused on door type units only.

Timeline

Stakeholders will be given another week to review the discussion notes and provide additional comments. A slightly revised timeline is provided below:

- Draft 2 Supplement Released for Comment — August 3
- Comments on Draft 2 Supplement Due to EPA — August 21
- Final Supplement Released — September 21
- Manufacturers Test and Report Results — September 21 – 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

***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.