

Energy Star,

Thank you for the opportunity to submit comments on the Energy Star Lab Grade Refrigerator & Freezer & ULT freezer testing protocol. I was unable to attend the webinar but I have looked over the presentation slides posted on the web and have the following comments:

- 1) I think it is wonderful that ULT freezer have been added to this effort! In doing so, I want to point out that, to the best of my knowledge, the only lab grade freezer that is missing from this Energy Star effort is the -40^oC freezers.
 - a. I am only aware of two manufacturers of -40C units (Baker/Dometic and Thermo), but there may be others I am not aware of.
 - b. My understanding of -40^oC units, is that they are essentially the same as ULT freezers except they only have one compressor instead of two. But in both cases of the Baker/Dometic and Thermo units, an ULT freezer chassis are used for the -40^oC units.
 - c. Since -40^oC units use the same chassis of ULT freezers and work is being done by Energy Star to design test for ULT freezers, I think it would be easy to add the -40^oC units to this effort
 - d. Also, since -40^oC units use ULT freezer chassis which have great insulation and gaskets, these units are already on their way to being energy efficient and likely are more efficient than many lab grade -20^oC and -30^oC units.
- 2) The Steady State condition in my opinion is TOO STRINGENT.
 - a. While some labs may need units that can meet this steady state condition, in many other labs this is not the case at all.
 - b. If I am understanding things correctly, this steady state condition requirement would prevent more energy efficient units from being considered because have greater temperature fluctuations than what is allowed by this steady state condition. If this is the case, then this definitely needs to be changed to allow for more fluctuation in temperature.
 - c. This also brings up the issue that perhaps we need two categories of Energy Star Lab Grade units. Those that are high performance units and those that are energy efficient units (where increased fluctuations from temperature set-point are permitted).
- 3) The only place where radiant heat requirement may be important in my opinion is with Chromatography refrigerators where equipment is commonly placed in the refrigerators which may reject heat into the refrigerator units (it would be great if we could reject this heat outside of the refrigerator rather than inside). I am uncertain how much heat is typically rejected by chromatography equipment. I certainly am concerned about these chromatography refrigerator units, especially considering that the one that just arrived on our campus is the biggest energy consumer we have metered yet.
- 4) Yes, door openings should be included, at least in some capacity, for the following reasons:
 - a. It will highlight the difference in energy consumption between chest and uprights. Presently manufacturers report only closed numbers to their customers. As a result, the consumption of chest freezers may appear to be the same or similar as upright freezers , when this may not be the case at all when door openings are added.
 - b. While some labs may infrequently open the doors to their freezers, at CU-Boulder this is not the case at all; the majority of freezer doors (even on ULT freezers) are opened multiple times a day.
 - c. If adding door openings to the test protocol is going to make it too complicated or costly to move the Energy Star process forward, then I suggest that instead a study

- be done that determine how much more efficient in general chest units are than upright units when door openings are included.
- d. Also, in regards to the inner doors, I think it is important to include a study where it is determined what the energy savings are that result from having inner doors in place. I am concerned that if all inner doors are opened as part of the protocol , it will not show the energy saving benefits of having these inner doors in place. Thus I think a study should be included that looks at the energy savings that results from opening one inner door versus all inner doors. This could be part of the freezer test protocol, or like I mention above, if this will make the protocol too complicated or costly to move forward then it could just be a study done to determine the benefits of inside doors.
- 5) Thermal mass should be included in freezers during testing, especially if door openings are going to be used as part of the testing protocol.
 - a. Presently consumption numbers by manufacturers are determined in general while the freezers are empty, however this does not reflect how freezers are used in labs.
 - b. For ULT freezers, the racks for the freezer could be provided by the manufacturer for 2 inch boxes and a water block that partially fills the box (25%-50%) could be placed in each box for the testing.
 - c. Bottles with water could perhaps be used in freezers (other than ULT freezers) and refrigerators
 - d. If adding thermal mass to freezers as part of the testing protocol is going to hinder this process moving forward, then let's not include it. But I do believe it would be best to have it included as part of the process.
 - 6) In addition to volume measurements, for ULT freezer especially it would also be beneficial to report the number of 2 inch freezer boxes that will fit in the freezer when using the freezer racks that will come from the manufacturer with that freezer or could be purchased to come with that freezer.
 - 7) I think the idea of using thermocouples that are submerged in water should be considered as part of this testing protocol so the conditions experienced by the majority of sample types can be simulated. Also, I know manufacturers have used many thermocouples when testing their freezer. Fewer thermocouples may work just fine for this testing protocol procedure.
 - a. IMPORTANTLY, if comments have not been received by Allen Doyle on this testing protocol, I ask that you please reach out to him to get his comments. He has done in field testing of units and has experience with items such as probe (thermocouple) placement, number of probes needed, and much more that should be included in this collection of comments.

Kathy

Kathryn A. Ramirez-Aguilar, Ph.D.
CU Green Labs Program Manager
Facilities Management/Environmental Center
University of Colorado at Boulder
303-859-2068
kramirez@colorado.edu