Laboratory Grade Refrigerators and Freezers Test Procedure Discussion

ENERGY STAR® Labeled Products Program

Washington, DC

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Purpose of Test Procedure

- Provide a consistent, repeatable method to determine energy consumption
- Emulate real world operating conditions
- Supply end users with information to compare products based on energy efficiency and other performance factors

**ENERGY STAR specification cannot be developed until test method is agreed upon**
ASHRAE 72: Background

• ASHRAE 72-2005 test procedure developed for commercial food grade applications
  – Energy use results reported in kWh/day
  – Referenced in ENERGY STAR commercial refrigeration spec
  – Some manufacturers already using on lab grade units

• Stakeholder review/comments indicate that test method cannot be applied to lab grade units as is
  – What changes are needed to apply to lab grade?
Discussion Goals

• Review issues/concerns brought forward by stakeholders re: applicability of ASHRAE 72 to lab grade units
  – Identify any additional discussion items

• Discuss ways in which the test method could be augmented to better emulate lab grade operation

• Determine next steps to drafting an amendment for purposes of ENERGY STAR testing
  – Review proposed testing/data collection schedule
Topics for Discussion

- Product coverage
- Manual switches/accessories
- Required defrost cycles
- Number of door openings
- Temperature uniformity
- Product loading and shelf placement
- Others?
1. Lab Grade Taxonomy

- **Temperature Range**
  - +4°C, -20°C, -30°C, -40°C

- **Cabinet Size**
  - i.e.- Undercounter (<6cuft), 7-12cuft, 13-18cuft, 19-24cuft, 25-30cuft, 31-40cuft, 41-55cuft, 56-70cuft, 70+cuft
  - Combination models are different design/lab application than single cabinet compartment models

- **Manual Defrost vs. Automatic Defrost**
  - Some laboratory samples can’t tolerate temp changes during defrost cycles
  - Can exist in +4°C, -20°C, -30°C and -40°C as well as all different sizes

- **Specialty Models vs. Standard Refrigerators and Freezers**
  - Explosion-proof and flammable-proof models have different design/lab application requirements
  - Glass door and solid door models have different design/lab application requirements.
ENERGY STAR Coverage

- EPA would like test procedure coverage to be as robust as possible
- Data collection effort will determine which types are ripe for ENERGY STAR
  - ENERGY STAR does not work well for niche products
  - EPA will take functionality into account re: levels
- Are there any product types that cannot be tested by ASHRAE 72 because of niche application, etc?
2. Manual Switches/Accessories

- ASHRAE 72 is silent on this issue
- New Version 2.0 ENERGY STAR commercial refrigerator and freezer specification will require “all factory-installed accessories (lighting, perimeter heat, pan heater, etc.) in the “ON” position if they are manually-controlled”
Stakeholder Comments

• **Some accessories should be excluded in testing:**
  
  – Lighting is rarely used because of added heat and is enabled only when door is opened
  
  – Many freezers don’t include lights
  
  – Most manufacturers are already using efficient fluorescent lighting
Discussion Questions

• What types of switches/accessories are used in lab grade units?
  – Sold with unit or sold separately?

• Are most accessories automatic or manual?
  – Enabled upon shipment or user enabled/disabled?

• How much energy is used by these features?

• Test procedure clarification?
3. Required Defrost Cycle

AHSRAE Requirement:

- Test procedure must start with a defrost period
- See Figure 6, page 8 for test cycle diagram
Stakeholder Comments

• Not all lab grade units use automatic defrost
  – Majority of -20/-30°C units use manual defrost
  – Some units (e.g., ultra low freezers) may never go into a defrost cycle

• Defrost requirements may need to vary based on product type
Discussion Questions

• Which product types use automatic defrost and which use manual defrost cycles?
  – How often is defrost used in practice?
  – Does the end user have control over the defrost?

• What parameters need to be set for the different product types?

• Test procedure clarification?
4. Door Openings

ASHRAE Requirement:

• Each door is fully open for 6 seconds, six times per hour, 8 consecutive hours

• Each door opened sequentially, one at a time

• Door opening period begins 3 hours after the start of the defrost period
• Current ASHRAE requirements are not representative of lab grade usage pattern

• Number of openings will depend on product type
  – E.g., for ULT openings may not be applicable
Discussion Questions

• What number of door openings would best emulate real world use?
  – Is there an average number per hour that can be used?
  – How might this differ between product types?
• If there is no defrost period, when would testing commence?
• Test procedure clarification?
5. Temperature Uniformity

- **Temperature uniformity**: temperature balance throughout the chamber
  - Different than “tolerance” which is the deviation from the controller set point
- **ASHRAE does not currently address temperature uniformity**
Stakeholder Comments

- From several discussions, EPA understands that temperature uniformity is one of the most important elements of a purchasing decision
  - This element should be considered when testing lab grade unit energy efficiency performance

- However, customers don’t always set the uniformity by application in a consistent manner
  - Ordinary Needs/Basic Cabinet: ave. uniformity (≈4°C -10°C)
  - Sensitive Sample Customers
    - High degree uniformity (<≈4°C)
    - Validatable cabinet (accuracy, stability, uniformity)
6. Product Loading

ASHRAE Requirement

- Simulator is plastic container ≥ 473 mL with lid
  - Contents: natural OR artificial sponge material saturated with heat transfer solution of 50/50 distilled water & propylene glycol

- For each row, 2 simulators are placed at the left end, right end, and at each standard break between adjacent shelves
  - For each location, 1 is placed at front of shelf and the other at back of shelf
Loading/Shelf Placement

• Fillers are provided for remaining space
  – **Material**: water OR 50/50 mixture of distilled water & propylene glycol OR wood blocks with an overall density ≥ 30 lbs/ft³
  – Must occupy 70-90% of net useable volume & uniformly occupy space from front to rear (simulator and fillers)
  – Shelves should be loaded to simulate typical end use condition

• No requirements re: shelf placement
  – ASHRAE does offer an option to test unit without shelves

• See figure 4a, page 7 for simulator/filler locations
Stakeholder Comments

- Loading not representative of lab grade use
  - Typically units are tested empty, worst case scenario
  - Empty is not representative of real world performance
- Shelf placement impacts temperature uniformity
  - Should be standardized for purposes of testing
Discussion Questions

• Can uniformity be measured at the same time as energy consumption?
  – How would it be measured?

• Uniformity is becoming standardized in the pharmaceutical industry (e.g., +/- 2°C blood bank, +/- 3°C pharmaceutical, +/- 5°C ULT)
  – Can we use these targets for ENERGY STAR?

• Do we also need to set temperature tolerances?
Discussion Questions cont.

- Should lab grade units be tested full or empty?
- If tested full:
  - Are ASHRAE test simulators/filler package requirements (i.e. material) acceptable? If not what are some other options to best emulate lab product?
  - Where should they be placed for purposes of testing?
  - What additional requirements re: shelf placement are needed to ensure consistent and fair testing?
- Test procedure clarifications?
Thermo Fisher Slides
Additional Topics for Discussion
Proposed Schedule

• Draft amendment to test procedure: Feb. 13
• Comments due on draft amendment: March 6
• Final amendment released: April 3
• Testing and data collection: April 3 – June 26
  – Deadline to submit data to EPA: June 26
• Draft 1 specification released: July 17
• Comments due on Draft 1: August 14
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