



ENERGY STAR

Laboratory Grade Refrigerators and Freezers and Ultra-Low-Temperature Freezers Stakeholder Webinar

November 8, 2012

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ENERGY STAR Program



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	Incorporating ULFs
4	Draft 1 Test Method
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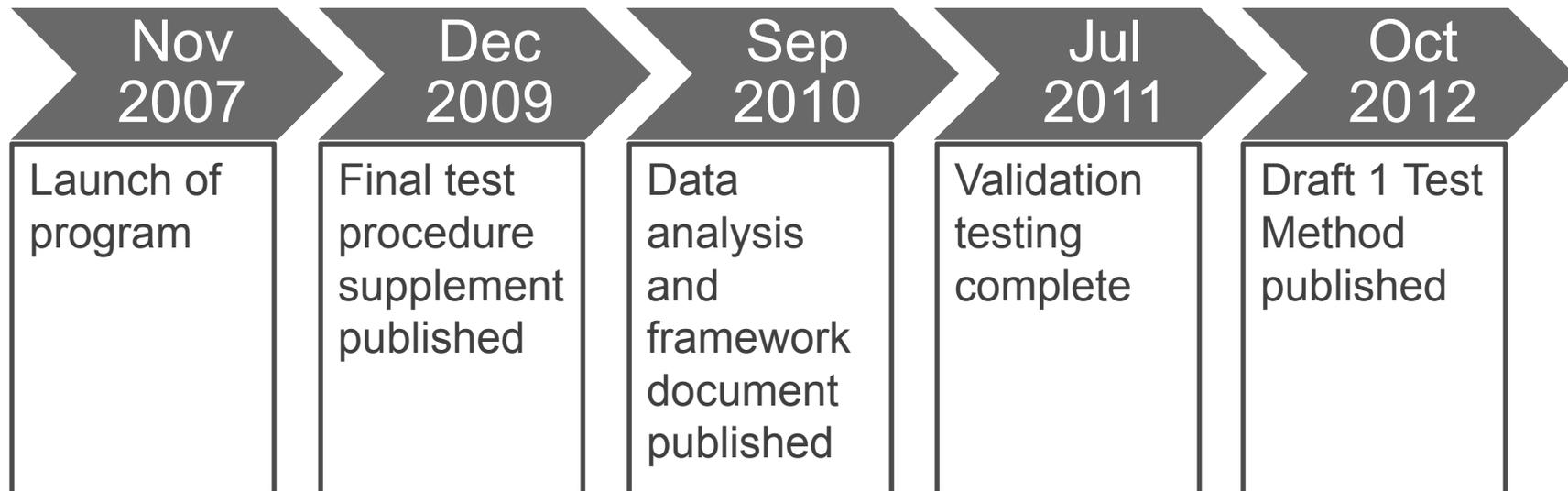
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ENERGY STAR Team

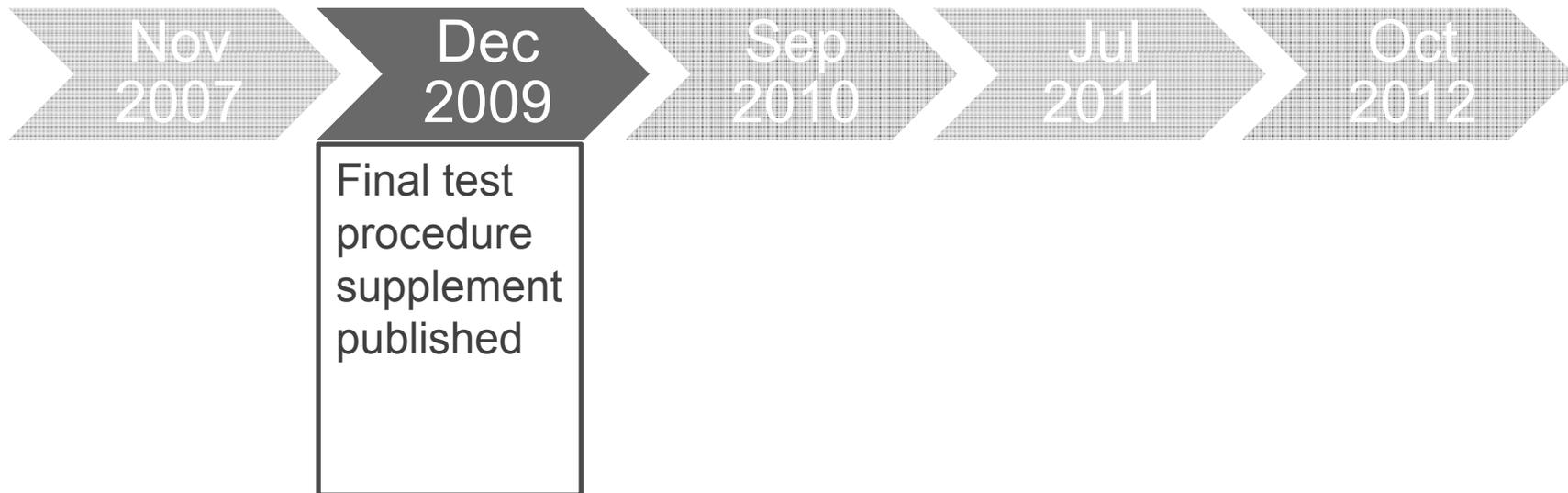


- EPA and DOE operating under Memorandum of Understanding (MOU) signed in 2009
- DOE is the lead for writing and updating ENERGY STAR test methods
- DOE team will provide overview and support of findings related to the test method

Timeline of Events

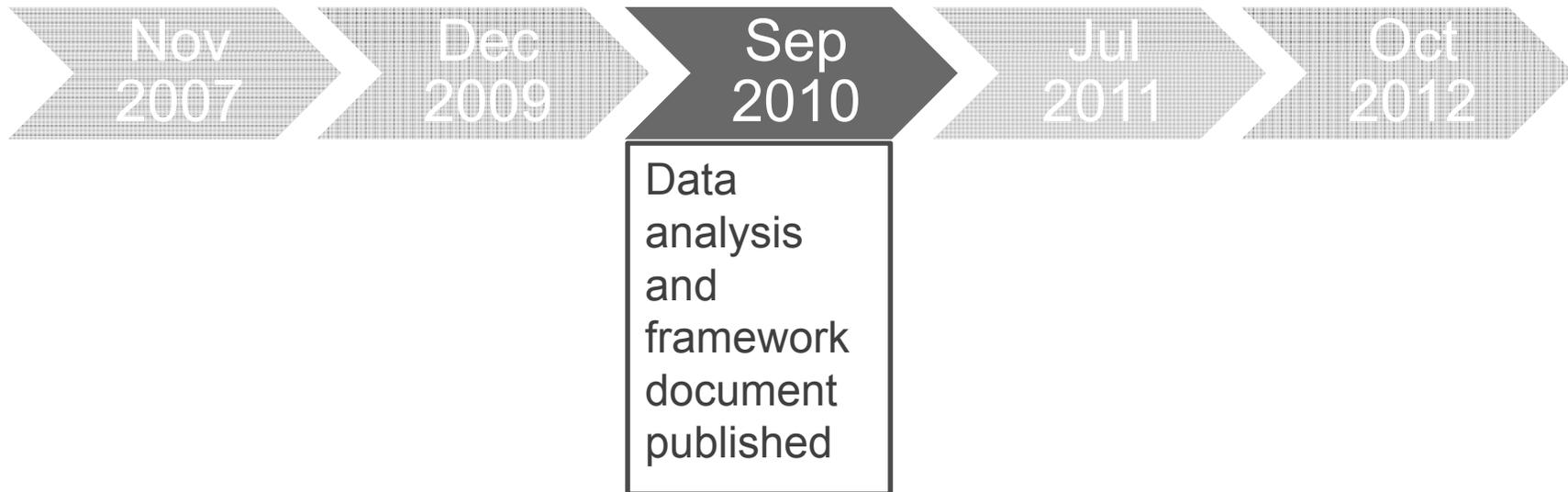


Timeline of Events



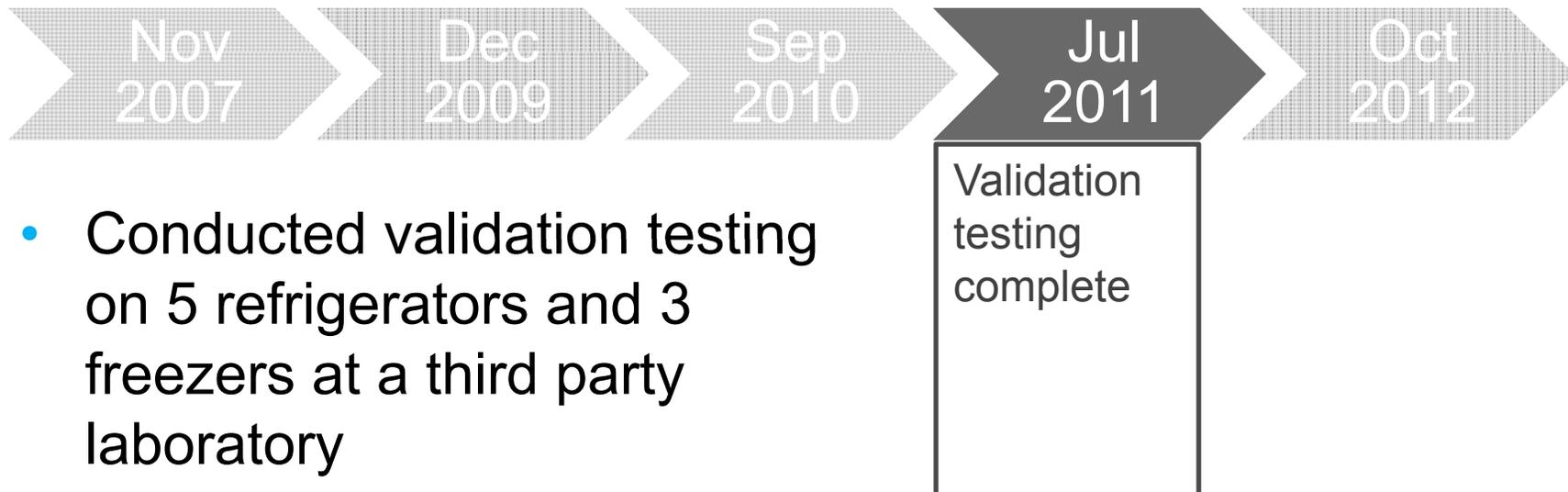
- Supplement to **ANSI/ASHRAE Standard 72-2005**
- Changes to:
 - Section 6: Apparatus
 - Section 7: Test Procedure

Timeline of Events

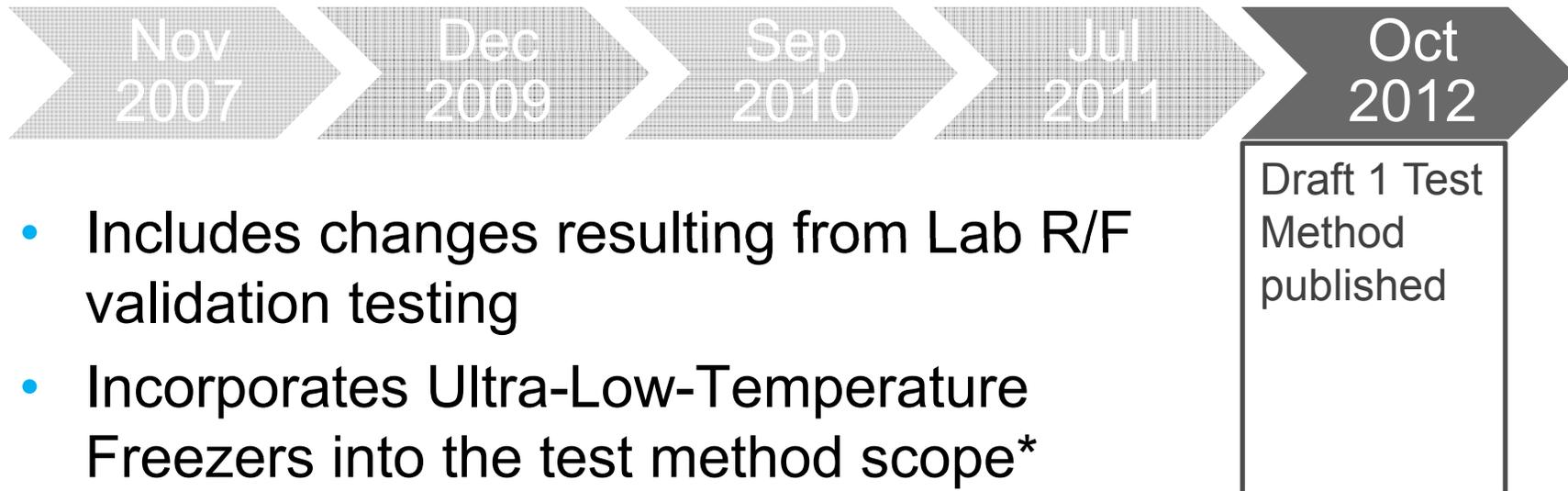


- Presents analysis of manufacturer-supplied test results
- Documents how EPA plans to use the data in the development of the specification

Timeline of Events



Timeline of Events



*validation testing not yet performed

Draft 1 Test Method Applicability



	Laboratory Grade R/F	Ultra-Low-Temperature Freezers
Products in Scope	<ul style="list-style-type: none"> • General purpose lab refrigerators • Blood bank refrigerators • Pharmacy and chromatography refrigerators • General purpose laboratory freezers • -30⁰C Freezers • -20⁰C Freezers 	<ul style="list-style-type: none"> • Freezers that maintain storage temperatures between -70⁰C and -80⁰C
Validation Testing Complete?	Yes	No

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Validation Testing – Lab R/F



- Supplement used to inform the test plan
- Testing conducted at a third party laboratory from May to July 2011
- Tested a representative sample of the Lab R/F market

Units Under Test



UUT	Door Type	Method of Access	AHAM Vol., ft ³ (approx.)
Refrigerators			
1	Solid Hinged	Front	4
2	Solid Hinged	Front	4
3	Solid Hinged	Front	20
4	Glass Sliding	Front	40
5	Glass Hinged	Front	55
Freezers			
6	Solid Hinged	Above	15
7	Solid Hinged	Front	20
8	Solid Hinged	Front	20

Test Setup



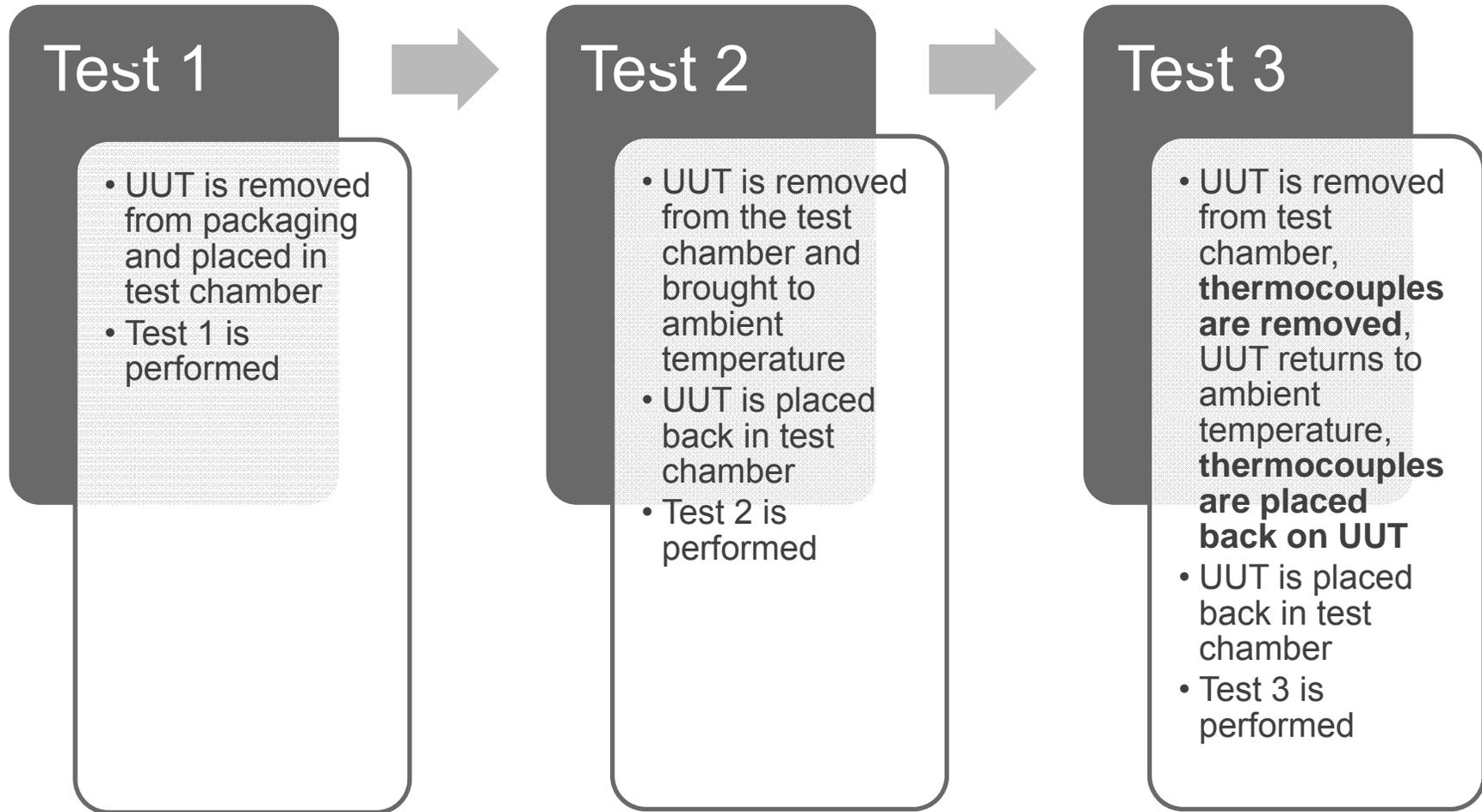
- Test Conditions
 - Dry Bulb: $24^{\circ}\text{C} \pm 1^{\circ}\text{C}$
 - Wet Bulb: $18^{\circ}\text{C} \pm 1^{\circ}\text{C}$
 - Air Currents: $\leq 0.5 \text{ m/s}$
 - Lighting: 800 lux
 - Radiant Heat: Unit faces only white gloss-finished surfaces having an average temperature not less than 21.1°C
- UUT filled with un-weighted bare thermocouples

Approach



- Tested in controlled chamber to maintain test condition requirements
- Stabilized the units until they reached the Steady State condition, then measured energy consumption (in kWh) per day
- Conducted repeatability testing on 1 refrigerator and 1 freezer

Repeatability Testing



Key Takeaways



- Supplement was straightforward and easy to follow
- Testing provided results consistent with expectations
- Test repeatable
- Issues identified in the following areas
 - Location of thermocouples
 - Freezer set point temperature levels
 - Product quality

Issue 1: Location of Thermocouples



- Issue: Thermocouple placement not well defined in the supplement for units with multiple, adjacent baskets (i.e., chest freezers)
- Recommendation: Place thermocouples at the geometric center of each basket
 - Total number of thermocouples consistent with the number per non-adjacent shelf/basket
 - Placement of thermocouples consistent with placement for non-adjacent shelf/basket

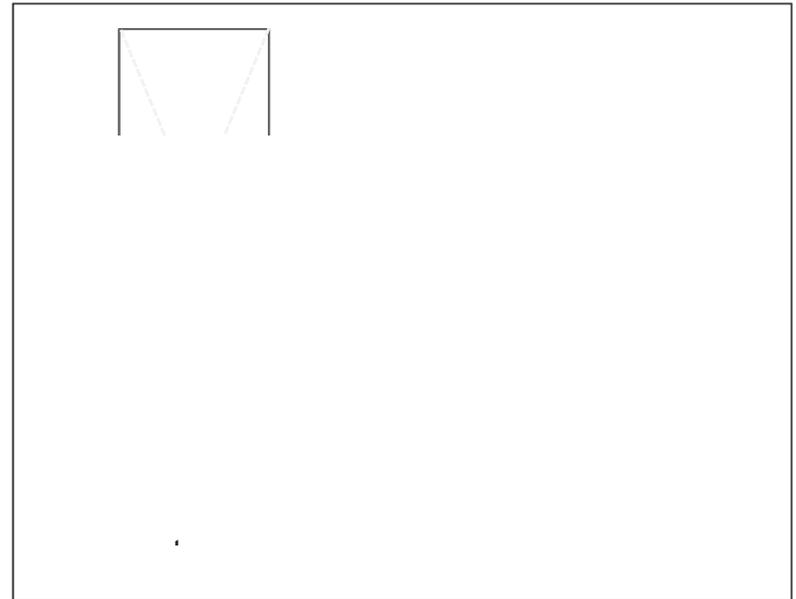
Issue 1: Location of Thermocouples



Unit Under Test (UUT) with Thermocouples Attached



Basket or Shelf Schematic



Issue 2: Freezer Temperature Levels



- Issue: Supplement specifies the set point temperature for **-30⁰C Freezers** and **-20⁰C Freezers** at -30⁰C and -20⁰C, respectively, but is not always clear which set point temperature to choose if units are not clearly defined
- Recommendation: Test at the following temperature settings:

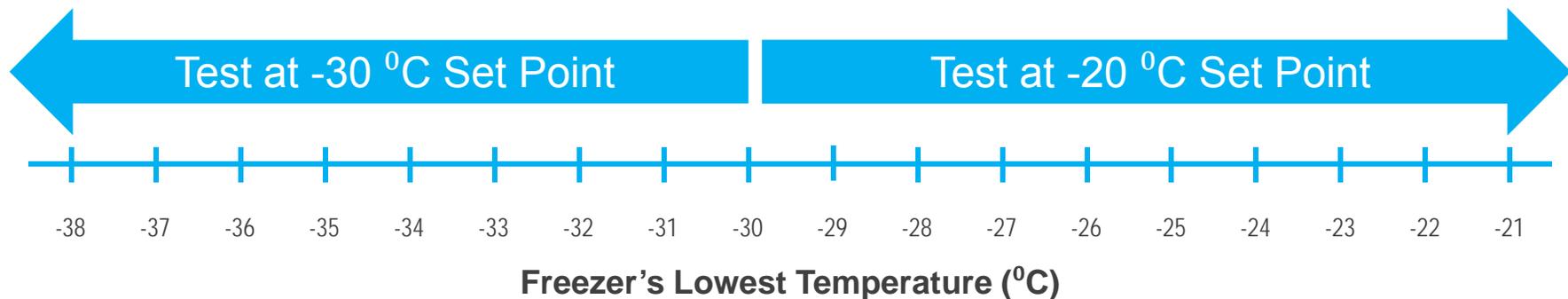


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Including ULFs in the Test Method Scope



- Freezers designed for laboratory applications that are capable of maintaining storage temperatures between -70°C and -80°C
- Originally excluded from the ENERGY STAR scope
- DOE is developing voluntary technical specifications for ULFs for the Commercial Building Energy Alliance (CBEA)

Unique Characteristics of ULFs



- ULFs have unique characteristics that may require modifications to the proposed test method
 - Cascade or Stirling refrigeration system instead of single-cycle vapor compression system
 - Cold-wall evaporator configuration instead of evaporator coil
 - May be used for long-term sample storage and not accessed as frequently

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References



The following test procedures were used as input to the Draft 1 Test Method:

- ANSI/ASHRAE Standard 72-2005
- ENERGY STAR supplement to ANSI/ASHRAE Standard 72-2005
- AHRI Standard 1200-2010
- AHAM HRF-1-2008

Definitions



- Steady State: The condition where the average temperature of all thermocouples changes less than 0.2°C (0.4°F) from one 24-hour period or refrigeration cycle to the next.

- Is this definition suitable for all products in scope?
- Can all products meet the proposed temperature tolerances?
- Is the time period presented appropriate?

Test Setup



- Ambient condition requirements for:
 - Dry Bulb
 - Dry Bulb Gradient
 - Lighting
 - Wet Bulb
 - Air Currents
 - Radiant Heat

- Are lighting and radiant heat requirements necessary for these products?

Door Opening Requirements



For Freezers: Each door shall be opened for

- For Freezers: Each door shall be opened for 15 seconds, 1 time per hour, for 8 consecutive hours
- If the freezer has inner doors:
 1. Open outer door
 2. Open inner door(s)
 3. Close inner door(s)
 4. Close outer door

Door Opening Requirements



- Should the test method include door openings?

Door Opening Requirements



- Should the test method include door openings?
- Are the door opening requirements appropriate for units with and without inner doors?

Door Opening Requirements



- Should the test method include door openings?
- Are the door opening requirements appropriate for units with and without inner doors?
- If door openings are not included, should test chamber ambient temperature conditions be different than what is presented in the Draft 1 Test Method?

Volume Measurements



- Tolerances: The unit volume is to be recorded to the nearest 0.1 L (0.01 ft³)
- Determination of Volume: The volume shall take into account the exact shapes of the walls including all depressions or projections

- Can Computer Aided Design (CAD) drawings be used to accurately estimate volume?
- Will manufacturers be able to submit CAD drawings to the Certification Body at the time of qualification?

General Feedback



- Does anyone have any other feedback on the test method they would like to discuss now?

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Written Stakeholder Comments



- Please submit all written comments to LabGradeRefrigeration@energystar.gov by November 15th

Next Steps



Milestone	Date
Publish Draft 1 Test Method	October 5, 2012
Present Stakeholder Webinar	November 8, 2012
Written Stakeholder Comments Due	November 15, 2012
Complete ULF Validation Testing	April 2013
Publish Draft 2 Test Method	May 2013

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Appendix

REFERENCE SLIDES

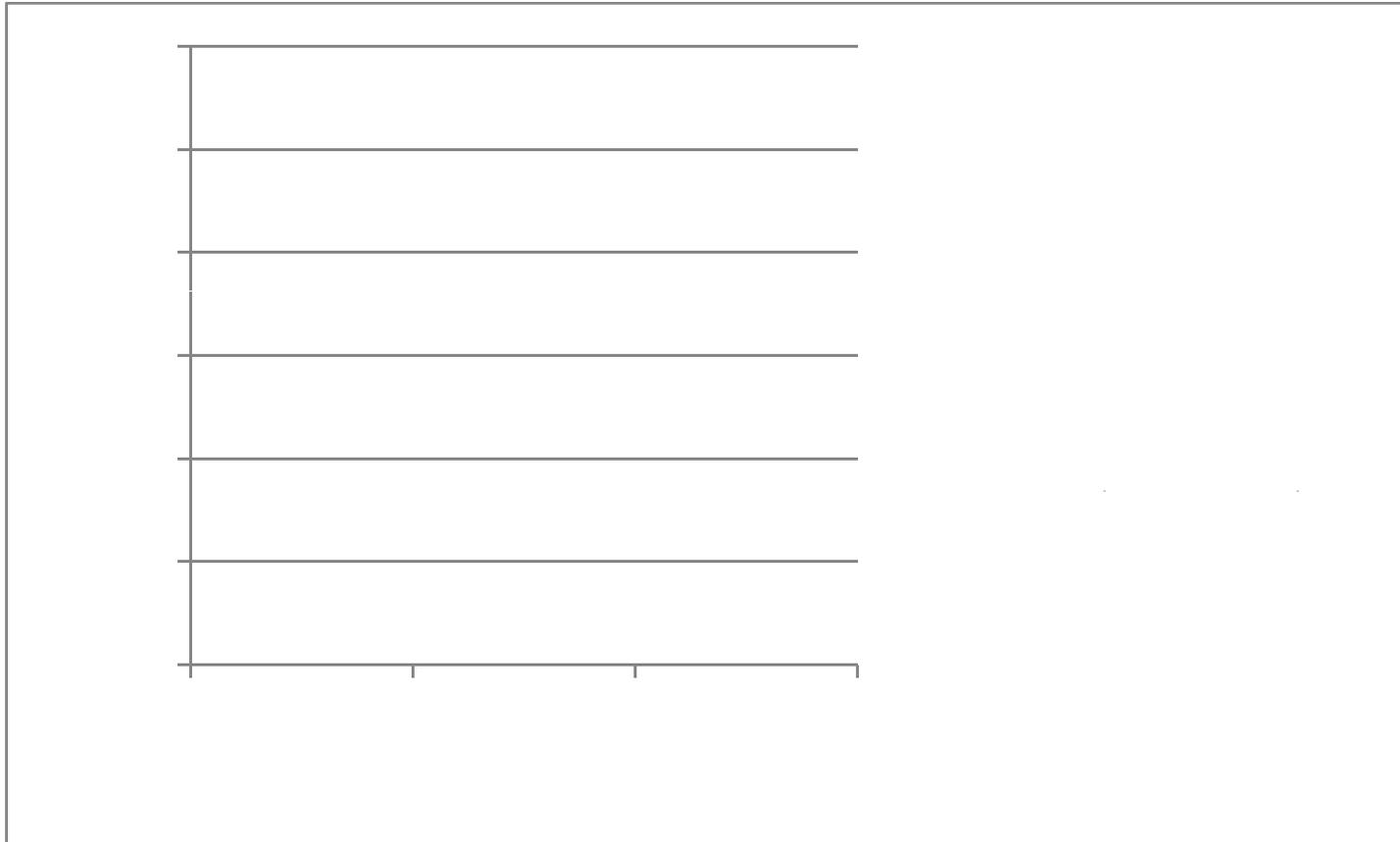
Comparison to CRE Qualification Criteria: Refrigerator



CRE Qualification Criteria available at:

http://www.energystar.gov/index.cfm?c=commer_refrig.pr_crit_commercial_refrigerators

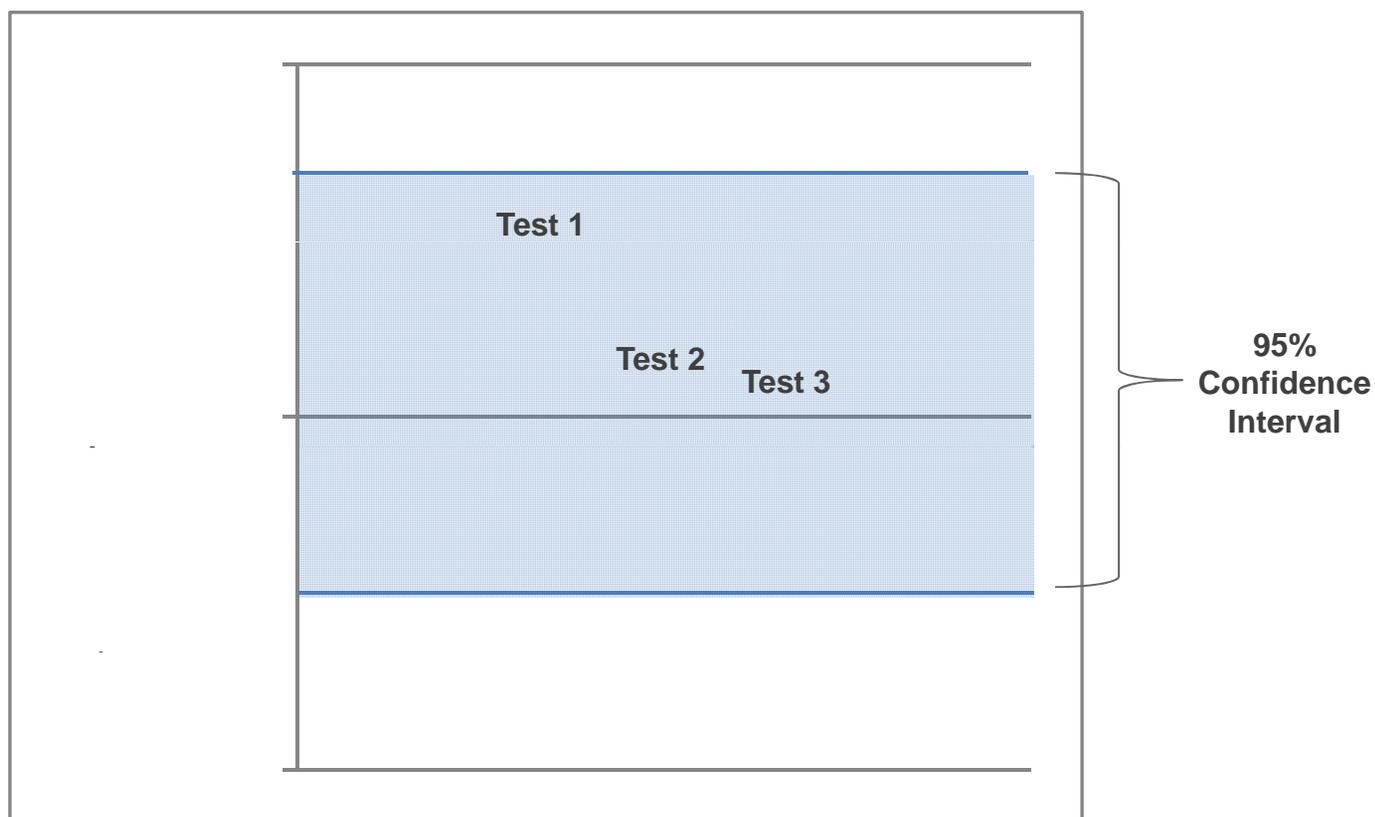
Comparison to CRE Qualification Criteria: Freezer



CRE Qualification Criteria available at:

http://www.energystar.gov/index.cfm?c=commer_refrig.pr_crit_commercial_refrigerators

Repeatability Testing: Refrigerator



Repeatability Testing: Freezer

