door rail, glass, and frame heater power draw is more than 7.1 watts per square foot of door opening (for freezers) and 3.0 watts per square foot of door opening (for coolers), the antisweat heat controls shall reduce the energy use of the antisweat heater in a quantity corresponding to the relative humidity in the air outside the door or to the condensation on the inner glass pane.

APPENDIX A TO SUBPART R OF PART 431—UNIFORM TEST METHOD FOR THE MEASUREMENT OF ENERGY CONSUMPTION OF THE COMPONENTS OF ENVELOPES OF WALK-IN COOLERS AND WALK-IN FREEZERS

1.0 Scope

This appendix covers the test requirements used to measure the energy consumption of the components that make up the envelope of a walk-in cooler or walk-in freezer.

2.0 Definitions

The definitions contained in §431.302 are applicable to this appendix.

3.0 Additional Definitions

3.1 Automatic door opener/closer means a device or control system that ''automatically'' opens and closes doors without direct user contact, such as a motion sensor that senses when a forklift is approaching the entrance to a door and opens it, and then closes the door after the forklift has passed.

3.2 Core region means the part of the panel that is not the edge region.

3.3 Edge region means a region of the panel that is wide enough to encompass any framing members and edge effects. If the panel contains framing members (e.g. a wood frame) then the width of the edge region must be as wide as any framing member plus 2 in. ± 0.25 in. If the panel does not contain framing members then the width of the edge region must be 4 in ± 0.25 in. For walk-in panels that utilize vacuum insulated panels (VIP) for insulation, the width of the edge region must be the lesser of 4.5 in. ± 1 in. or the maximum width that does not cause the VIP to be pierced by the cutting device when the edge region is cut.

3.4 Surface area means the area of the surface of the walk-in component that would be external to the walk-in. For example, for panel, the surface area would be the area of the side of the panel that faces the outside of the walk-in. It would not include edges of the panel that are not exposed to the outside of the walk-in.

3.5 Rating conditions means, unless explicitly stated otherwise, all conditions shown in Table A.1. For installations where two or more walk-in envelope components share any surface(s), the ''external conditions'' of the shared surface(s) must reflect the internal conditions of the adjacent walk-in. For example, if a walk-in component divides a walk-in freezer from a walk-in cooler, then the internal conditions are the freezer rating conditions and the external conditions are the cooler rating conditions.

3.6 Percent time off (PTO) means the percent of time that an electrical device is assumed to be off.

TABLE A.1—TEMPERATURE CONDITIONS

Internal Temperatures (cooled space within the envelope)	
Cooler Dry Bulb Temperature	35 °F.
Freezer Dry Bulb Temperature	−10 °F.
External Temperatures (space external to the envelope)	
Freezer and Cooler Dry Bulb Temperatures	75 °F.
Subfloor Temperatures	
Freezer and Cooler Dry Bulb Temperatures	55 °F.

4.0 Calculation Instructions

4.1 Display Panels

(a) Calculate the U-factor of the display panel in accordance with section 5.3 of this appendix, Btu/h-ft^2-°F.

(b) Calculate the display panel surface area, as defined in section 3.4 of this appendix, A_{dp}, ft^2, with standard geometric formulas or engineering software.

(c) Calculate the temperature differential, ΔT_{dp}, °F, for the display panel, as follows:

$$\Delta T_{dp} = |T_{DB,ext,dp} - T_{DB,int,dp}| \qquad (4\text{-}1)$$

Where:

$T_{DB,ext,dp}$ = dry-bulb air external temperature, °F, as prescribed in Table A.1; and

$T_{DB,int,dp}$ = dry-bulb air temperature internal to the cooler or freezer, °F, as prescribed in Table A.1.

(d) Calculate the conduction load through the display panel, $Q_{cond\text{-}dp}$, Btu/h, as follows:

$$Q_{cond,dp} = A_{dp} \times \Delta T_{dp} \times U_{dp} \qquad (4\text{-}2)$$

Where:
A_{dp} = surface area of the walk-in display panel, ft^2;
ΔT_{dp}= temperature differential between refrigerated and adjacent zones, °F; and
U_{dp} = thermal transmittance, U-factor, of the display panel in accordance with section 5.3 of this appendix, Btu/h-ft^2- °F.

(e) Select Energy Efficiency Ratio (EER), as follows:

(1) For coolers, use EER = 12.4 Btu/W-h

(2) For freezers, use EER = 6.3 Btu/W-h

(f) Calculate the total daily energy consumption, E_{dp}, kWh/day, as follows:

$$E_{dp} = \frac{Q_{cond,dp}}{EER} \times \frac{24\ h \times 1\ kW}{1\ day \times 1000\ W} \qquad (4\text{-}3)$$

Where:
$Q_{cond,\ dp}$ = the conduction load through the display panel, Btu/h; and EER = EER of walk-in (cooler or freezer), Btu/W-h.

4.2 Floor Panels

(a) Calculate the surface area, as defined in section 3.4 of this appendix, of the floor panel edge, as defined in section 3.3, $A_{fp\ edge}$, ft^2, with standard geometric formulas or engineering software as directed in section 5.1 of this appendix.

(b) Calculate the surface area, as defined in section 3.4 of this appendix, of the floor panel core, as defined in section 3.2, $A_{fp\ core}$, ft^2, with standard geometric formulas or engineering software as directed in section 5.1 of this appendix.

(c) Calculate the total area of the floor panel, A_{fp}, ft^2, as follows:

$$A_{fp} = A_{fp\ core} + A_{fp\ edge} \qquad (4\text{-}4)$$

Where:
$A_{fp\ core}$ = floor panel core area, ft^2; and
$A_{fp\ edge}$ = floor panel edge area, ft^2.

(d) Calculate the temperature differential of the floor panel, ΔT_{fp}, °F, as follows:

$$\Delta T_{fp} = \left| T_{ext,fp} - T_{DB,int,fp} \right| \qquad (4\text{-}5)$$

Where:
$T_{ext,\ fp}$ = subfloor temperature, °F, as prescribed in Table A.1; and
$T_{DB,int,\ fp}$ = dry-bulb air internal temperature, °F, as prescribed in Table A.1. If the panel spans both cooler and freezer temperatures, the freezer temperature must be used.

(e) Calculate the floor foam degradation factor, DF_{fp}, unitless, as follows:

$$DF_{fp} = \frac{R_{LTTR,fp}}{R_{O,fp}} \qquad (4\text{-}6)$$

Where:
$R_{LTTR,fp}$ = the long term thermal resistance R-value of the floor panel foam in accordance with section 5.2 of this appendix, h-ft^2- °F/Btu; and
$R_{o,fp}$ = the R-value of foam determined in accordance with ASTM C518 (incorporated

by reference; see section §431.303) for purposes of compliance with the appropriate energy conservation standard, h-ft^2- °F/Btu.

(f) Calculate the U-factor for panel core region modified by the long term thermal transmittance of foam, $U_{LT,fp\ core}$, Btu/h-ft^2-°F, as follows:

$$U_{LT,fp\ core} = \frac{U_{fp\ core}}{DF_{fp}} \qquad (4\text{-}7)$$

Where:

$U_{fp\ core}$ = the U-factor in accordance with section 5.1 of this appendix, Btu/h-ft^2- °F; and

DF_{fp} = floor foam degradation factor, unitless.

(g) Calculate the overall U-factor of the floor panel, U_{fp}, Btu/h-ft^2- °F, as follows:

$$U_{fp} = \frac{A_{fp\ edge} \times U_{fp\ edge} + A_{fp\ core} \times U_{LT,fp\ core}}{A_{fp}} \qquad (4\text{-}8)$$

Where:

$A_{fp\ edge}$ = area of floor panel edge, ft^2;

$U_{fp\ edge}$ = U-factor for panel edge area in accordance with section 5.1 of this appendix, Btu/h-ft^2- °F;

$A_{fp\ core}$ = area of floor panel core, ft^2;

$U_{LT,fp\ core}$ = U-factor for panel core region modified by the long term thermal transmittance of foam, Btu/h-ft^2- °F; and

A_{fp} = total area of the floor panel, ft^2.

(h) Calculate the conduction load through floor panels, $Q_{cond\text{-}fp}$, Btu/h,

$$Q_{cond-fp} = \Delta T_{fp} \times A_{fp} \times U_{fp} \qquad (4\text{-}9)$$

Where:

ΔT_{fp} = temperature differential across the floor panels, °F;

A_{fp} = total area of the floor panel, ft^2; and

U_{fp} = overall U-factor of the floor panel, Btu/h-ft^2- °F.

(i) Select Energy Efficiency Ratio (EER), as follows:

(1) For coolers, use EER = 12.4 Btu/W-h

(2) For freezers, use EER = 6.3 Btu/W-h

(j) Calculate the total daily energy consumption, E_{fp}, kWh/day, as follows:

$$E_{fp} = \frac{Q_{cond-fp}}{EER} \times \frac{24\ h \times 1\ kW}{1\ day \times 1000\ W} \qquad (4\text{-}10)$$

Where:

$Q_{cond\text{-}fp}$ = the conduction load through the floor panel, Btu/h; and EER = EER of walk-in (cooler or freezer), Btu/W-h.

4.3 Non-Floor Panels

(a) Calculate the surface area, as defined in section 3.4, of the non-floor panel edge, as defined in section 3.3, $A_{nf\ edge}$, ft^2, with standard geometric formulas or engineering software as directed in section 5.1 of this appendix.

(b) Calculate the surface area, as defined in section 3.4, of the non-floor panel core, as defined in section 3.2, $A_{nf\ core}$, ft^2 with standard geometric formulas or engineering software as directed in section 5.1 of this appendix.

(c) Calculate total non-floor panel area, A_{nf}, ft^2:

$$A_{nf} = A_{nf\ edge} + A_{nf\ core} \qquad (4\text{-}11)$$

Where:

$A_{nf\ edge}$ = non-floor panel edge area, ft²; and

$A_{nf\ core}$ = non-floor panel core area, ft².

(d) Calculate temperature differential, ΔT_{nf}, °F:

$$\Delta T_{nf,} = \left| T_{DB,ext,nf} - T_{DB,int,nf} \right| \qquad (4\text{-}12)$$

Where:

$T_{DB,ext,\ nf}$ = dry-bulb air external temperature, °F, as prescribed in Table A.1; and

$T_{DB,int,\ nf}$ = dry-bulb air internal temperature, °F, as prescribed in Table A.1. If the non-floor panel spans both cooler and freezer temperatures, then the freezer temperature must be used.

(e) Calculate the non-floor foam degradation factor, DF_{nf}, unitless, as follows:

$$DF_{nf} = \frac{R_{LTTR,nf,}}{R_{o,nf}} \qquad (4\text{-}13)$$

Where:

$R_{LTTR,nf}$ = the R-value of the non-floor panel foam in accordance with section 5.2 of this appendix, h- ft²- °F/Btu; and

$R_{o,nf}$ = the R-value of foam determined in accordance with ASTM C518 (incorporated by reference; see section § 431.303) for purposes of compliance with the appropriate energy conservation standard, h-ft²- °F/ Btu.

(f) Calculate the U-factor, $U_{LT,nf\ core}$, Btu/h-ft²- °F, as follows:

$$U_{LT,nf\ core} = \frac{U_{nf\ core}}{DF_{nf}} \qquad (4\text{-}14)$$

Where:

$U_{nf\ core}$ = the U-factor, in accordance with section 5.1 of this appendix, of non-floor panel, Btu/h- ft²- °F; and

DF_{nf} = the non-floor foam degradation factor, unitless.

(g) Calculate the overall U-factor of the non-floor panel, U_{nf}, Btu/h-ft²- °F, as follows:

$$U_{nf} = \frac{A_{nf\ edge} \times U_{nf\ edge} + A_{nf\ core} \times U_{LT,nf\ core}}{A_{nf}} \qquad (4\text{-}15)$$

Where:

$A_{nf\ edge}$ = area of non-floor panel edge, ft²;

$U_{nf\ edge}$ = U-factor for non-floor panel edge area in accordance with section 5.1 of this appendix, Btu/h-ft²- °F;

$A_{nf\ core}$ = area of non-floor panel core, ft²;

$U_{LT,nf\ core}$ = U-factor for non-floor panel core region modified by the long term thermal transmittance of foam, Btu/h-ft²- °F; and

A_{nf} = total area of the non- floor panel, ft².

(h) Calculate the conduction load through non-floor panels, $Q_{cond\text{-}nf}$, Btu/h,

$$Q_{cond-nf} = \Delta T_{nf} \times A_{nf} \times U_{nf} \qquad (4\text{-}16)$$

Where:

ΔT_{nf} = temperature differential across the non-floor panels, °F;
A_{nf} = total area of the non-floor panel, ft^2; and
U_{nf} = overall U-factor of the non-floor panel, Btu/h-ft^2- °F.

(i) Select Energy Efficiency Ratio (EER), as follows:

(1) For coolers, use EER = 12.4 Btu/W-h

(2) For freezers, use EER = 6.3 Btu/W-h

(j) Calculate the total daily energy consumption, E_{nf}, kWh/day, as follows:

$$E_{nf} = \frac{Q_{cond-nf}}{EER} \times \frac{24\ h \times 1\ kW}{1\ day \times 1000\ W} \qquad (4\text{-}17)$$

Where:

$Q_{cond\text{-}nf}$ = the conduction load through the non-floor panel, Btu/h; and
EER = EER of walk-in (cooler or freezer), Btu/W-h.

4.4 Display Doors

4.4.1 Conduction Through Display Doors

(a) Calculate the U-factor of the door in accordance with section 5.3 of this appendix, Btu/h-ft^2- °F

(b) Calculate the surface area, as defined in section 3.4 of this appendix, of the display door, A_{dd}, ft^2, with standard geometric formulas or engineering software.

(c) Calculate the temperature differential, ΔT_{dd}, °F, for the display door as follows:

$$\Delta T_{dd} = \left| T_{DB,ext,dd} - T_{DB,int,dd} \right| \qquad (4\text{-}18)$$

Where:

$T_{DB,ext,\ dd}$ = dry-bulb air temperature external to the display door, °F, as prescribed in Table A.1; and
$T_{DB,int,\ dd}$ = dry-bulb air temperature internal to the display door, °F, as prescribed in Table A.1.

(d) Calculate the conduction load through the display doors, $Q_{cond\text{-}dd}$, Btu/h, as follows:

$$Q_{cond,dd} = A_{dd} \times \Delta T_{dd} \times U_{dd} \qquad (4\text{-}19)$$

Where:

ΔT_{dd} = temperature differential between refrigerated and adjacent zones, °F;
A_{dd} = surface area walk-in display doors, ft^2; and
U_{dd} = thermal transmittance, U-factor of the door, in accordance with section 5.3 of this appendix, Btu/h-ft^2- °F.

4.4.2 Direct Energy Consumption of Electrical Component(s) of Display Doors

Electrical components associated with display doors could include, but are not limited to: heater wire (for anti-sweat or anti-freeze application); lights (including display door lighting systems); control system units; and sensors.

(a) Select the required value for percent time off (PTO) for each type of electricity consuming device, PTO_t (%)

(1) For lights without timers, control system or other demand-based control, PTO = 25 percent. For lighting with timers, control system or other demand-based control, PTO = 50 percent.

(2) For anti-sweat heaters on coolers (if included): Without timers, control system or other demand-based control, PTO = 0 percent. With timers, control system or other demand-based control, PTO = 75 percent. For anti-sweat heaters on freezers (if included):

Without timers, control system or other auto-shut-off systems, PTO = 0 percent. With timers, control system or other demand-based control, PTO = 50 percent.

(3) For all other electricity consuming devices: Without timers, control system, or other auto-shut-off systems, PTO = 0 percent. If it can be demonstrated that the device is controlled by a preinstalled timer, control system or other auto-shut-off system, PTO = 25 percent.

(b) Calculate the power usage for each type of electricity consuming device, $P_{dd\text{-}comp,u,t}$, kWh/day, as follows:

$$P_{dd-comp,u,t} = P_{rated,u,t} \times \left(1 - PTO_{u,t}\right) \times n_{u,t} \times \frac{24h}{day} \qquad (4\text{-}20)$$

Where:

u = the index for each of type of electricity-consuming device located on either (1) the interior facing side of the display door or within the inside portion of the display door, (2) the exterior facing side of the display door, or (3) any combination of (1) and (2). For purposes of this calculation, the interior index is represented by u = int and the exterior index is represented by u = ext. If the electrical component is both on the interior and exterior side of the display door then u = int. For anti-sweat heaters sited anywhere in the display door, 75 percent of the total power is be attributed to u = int and 25 percent of the total power is attributed to u = ext;

t = index for each type of electricity consuming device with identical rated power;

$P_{rated,u,t}$ = rated power of each component, of type t, kW;

$PTO_{u,t}$ = percent time off, for device of type t, %; and

$n_{u,t}$ = number of devices at the rated power of type t, unitless.

(c) Calculate the total electrical energy consumption for interior and exterior power, $P_{dd\text{-}tot,\ int}$ (kWh/day) and $P_{dd\text{-}tot,\ ext}$ (kWh/day), respectively, as follows:

$$P_{dd-tot,int} = \sum_{1}^{t} P_{dd-comp,int,t} \qquad (4\text{-}21)$$

$$P_{dd-tot,ext} = \sum_{1}^{t} P_{dd-comp,ext,t} \qquad (4\text{-}22)$$

Where:

t = index for each type of electricity consuming device with identical rated power;

$P_{dd\text{-}comp,int,\ t}$ = the energy usage for an electricity consuming device sited on the interior facing side of or in the display door, of type t, kWh/day; and

$P_{dd\text{-}comp,ext,\ t}$ = the energy usage for an electricity consuming device sited on the external facing side of the display door, of type t, kWh/day.

(d) Calculate the total electrical energy consumption, $P_{dd\text{-}tot}$, (kWh/day), as follows:

$$P_{dd-tot} = P_{dd-tot,int} + P_{dd-tot,ext} \qquad (4\text{-}23)$$

Where:

$P_{dd\text{-}tot,int}$ = the total interior electrical energy usage for the display door, kWh/day; and

$P_{dd\text{-}tot,ext}$ = the total exterior electrical energy usage for the display door, kWh/day.

4.4.3 Total Indirect Electricity Consumption Due to Electrical Devices

(a) Select Energy Efficiency Ratio (EER), as follows:

(1) For coolers, use EER = 12.4 Btu/Wh

(2) For freezers, use EER = 6.3 Btu/Wh

(b) Calculate the additional refrigeration energy consumption due to thermal output from electrical components sited inside the display door, $C_{dd\text{-}load}$, kWh/day, as follows:

$$C_{dd-load} = P_{dd-tot,int} \times \frac{3.412}{EER} \frac{Btu}{W-h} \qquad (4\text{-}24)$$

Where:

EER = EER of walk-in cooler or walk-in freezer, Btu/W-h; and

$P_{dd\text{-}tot,int}$ = The total internal electrical energy consumption due for the display door, kWh/day.

4.4.4 Total Display Door Energy Consumption

(a) Select Energy Efficiency Ratio (EER), as follows:

(1) For coolers, use EER = 12.4 Btu/W-h

(2) For freezers, use EER = 6.3 Btu/W-h

(b) Calculate the total daily energy consumption due to conduction thermal load, $E_{dd,\ thermal}$, kWh/day, as follows:

$$E_{dd,thermal} = \frac{Q_{cond,dd}}{EER} \times \frac{24\ h \times 1\ kW}{1\ day \times 1000\ W} \qquad (4\text{-}25)$$

Where:

$Q_{cond,\ dd}$ = the conduction load through the display door, Btu/h; and

EER = EER of walk-in (cooler or freezer), Btu/W-h.

(c) Calculate the total energy, $E_{dd,tot}$, kWh/day,

$$E_{dd,tot} = E_{dd,thermal} + P_{dd-tot} + C_{dd-load} \qquad (4\text{-}26)$$

Where:

$E_{dd,\ thermal}$ = the total daily energy consumption due to thermal load for the display door, kWh/day;

$P_{dd\text{-}tot}$ = the total electrical load, kWh/day; and

$C_{dd\text{-}load}$ = additional refrigeration load due to thermal output from electrical components contained within the display door, kWh/day.

4.5 Non-Display Doors

4.5.1 Conduction Through Non-Display Doors

(a) Calculate the surface area, as defined in section 3.4 of this appendix, of the non-display door, A_{nd}, ft^2, with standard geometric formulas or with engineering software.

(b) Calculate the temperature differential of the non-display door, ΔT_{nd}, °F, as follows:

$$\Delta T_{nd} = |T_{DB,ext,nd} - T_{DB,int,nd}| \qquad (4\text{-}27)$$

Where:

$T_{DB,ext,\ nd}$ = dry-bulb air external temperature, °F, as prescribed by Table A.1; and

$T_{DB,int,\ nd}$ = dry-bulb air internal temperature, °F, as prescribed by Table A.1. If the component spans both cooler and freezer spaces, the freezer temperature must be used.

(c) Calculate the conduction load through the non-display door: $Q_{cond\text{-}nd}$, Btu/h,

$$Q_{cond-nd} = \Delta T_{nd} \times A_{nd} \times U_{nd} \qquad (4\text{-}28)$$

Where:

ΔT_{nd} = temperature differential across the non-display door, °F;

U_{nd} = thermal transmittance, U-factor of the door, in accordance with section 5.3 of this appendix, Btu/h-ft^2- °F; and

A_{nd} = area of non-display door, ft^2.

4.5.2 Direct Energy Consumption of Electrical Components of Non-Display Doors

Electrical components associated with a walk-in non-display door comprise any components that are on the non-display door and that directly consume electrical energy. This includes, but is not limited to, heater wire (for anti-sweat or anti-freeze application), control system units, and sensors.

(a) Select the required value for percent time off for each type of electricity consuming device, PTO_t (%)

(1) For lighting without timers, control system or other demand-based control, PTO = 25 percent. For lighting with timers, control system or other demand-based control, PTO = 50 percent.

(2) For anti-sweat heaters on coolers (if included): Without timers, control system or other demand-based control, PTO = 0 percent. With timers, control system or other demand-based control, PTO = 75 percent. For anti-sweat heaters on freezers (if included): Without timers, control system or other auto-shut-off systems, PTO = 0 percent. With timers, control system or other demand-based control, PTO = 50 percent.

(3) For all other electricity consuming devices: Without timers, control system, or other auto-shut-off systems, PTO = 0 percent. If it can be demonstrated that the device is controlled by a preinstalled timer, control system or other auto-shut-off system, PTO = 25 percent.

(b) Calculate the power usage for each type of electricity consuming device, $P_{nd\text{-}comp,u,t}$, kWh/day, as follows:

$$\mathbf{P_{nd-comp,u,t} = P_{rated,u,t} \times \left(1 - PTO_{u,t}\right) \times n_{u,t} \times \frac{24h}{day}} \qquad (4\text{-}29)$$

Where:

u = the index for each of type of electricity-consuming device located on either (1) the interior facing side of the display door or within the inside portion of the display door, (2) the exterior facing side of the display door, or (3) any combination of (1) and (2). For purposes of this calculation, the interior index is represented by u = int and the exterior index is represented by u = ext. If the electrical component is both on the interior and exterior side of the display door then u = int. For anti-sweat heaters sited anywhere in the display door, 75 percent of the total power is be attributed to u=int and 25 percent of the total power is attributed to u=ext;

t = index for each type of electricity consuming device with identical rated power;

$P_{rated,u,t}$ = rated power of each component, of type t, kW;

$PTO_{u,t}$ = percent time off, for device of type t, %; and

$n_{u,t}$ = number of devices at the rated power of type t, unitless.

(c) Calculate the total electrical energy consumption for interior and exterior power, $P_{nd\text{-}tot,\ int}$ (kWh/day) and $P_{nd\text{-}tot,\ ext}$ (kWh/day), respectively, as follows:

$$P_{nd-tot,int} = \sum_1^t P_{nd-comp,int,t} \qquad (4\text{-}30)$$

$$P_{nd-tot,ext} = \sum_1^t P_{nd-comp,ext,t} \qquad (4\text{-}31)$$

Where:

t = index for each type of electricity consuming device with identical rated power;

$P_{nd\text{-}comp,int,\ t}$ = the energy usage for an electricity consuming device sited on the internal facing side or internal to the non-display door, of type t, kWh/day; and

$P_{nd\text{-}comp,ext,\ t}$ = the energy usage for an electricity consuming device sited on the external facing side of the non-display door, of type t, kWh/day. For anti-sweat heaters,

(d) Calculate the total electrical energy consumption, $P_{nd\text{-}tot}$, kWh/day, as follows:

$$P_{nd-tot} = P_{nd-tot,int} + P_{nd-tot,ext} \qquad (4\text{-}32)$$

Where:

$P_{nd\text{-}tot,int}$ = the total interior electrical energy usage for the non-display door, of type t, kWh/day; and

$P_{nd\text{-}tot,ext}$ = the total exterior electrical energy usage for the non-display door, of type t, kWh/day.

4.5.3 Total Indirect Electricity Consumption Due to Electrical Devices

(a) Select Energy Efficiency Ratio (EER), as follows:

(1) For coolers, use EER = 12.4 Btu/Wh

(2) For freezers, use EER = 6.3 Btu/Wh

(b) Calculate the additional refrigeration energy consumption due to thermal output from electrical components associated with the non-display door, $C_{nd\text{-}load}$, kWh/day, as follows:

$$C_{nd-load} = P_{nd-tot,int} \times \frac{3.412}{EER}\frac{Btu}{W-h} \qquad (4\text{-}33)$$

Where:

EER = EER of walk-in cooler or freezer, Btu/W-h; and

$P_{nd\text{-}tot,int}$ = the total interior electrical energy consumption for the non-display door, kWh/day.

4.5.4 Total Non-Display Door Energy Consumption

(a) Select Energy Efficiency Ratio (EER), as follows:

(1) For coolers, use EER = 12.4 Btu/W-h

(2) For freezers, use EER = 6.3 Btu/W-h

(b) Calculate the total daily energy consumption due to thermal load, $E_{nd,\ thermal}$, kWh/day, as follows:

$$E_{nd,thermal} = \frac{Q_{cond-nd}}{EER} \times \frac{24\ h \times 1\ kW}{1\ day \times 1000\ W} \qquad (4\text{-}34)$$

Where:

$Q_{cond\text{-}nd}$ = the conduction load through the non-display door, Btu/hr; and

EER = EER of walk-in (cooler or freezer), Btu/W-h.

(c) Calculate the total energy, $E_{nd,tot}$, kWh/day, as follows:

$$E_{nd,tot} = E_{nd,thermal} + P_{nd-tot} + C_{load} \qquad (4\text{-}35)$$

Where:

$E_{nd,\ thermal}$ = the total daily energy consumption due to thermal load for the non-display door, kWh/day;

$P_{nd\text{-}tot}$ = the total electrical energy consumption, kWh/day; and

$C_{nd\text{-}load}$ = additional refrigeration load due to thermal output from electrical components contained on the inside face of the non-display door, kWh/day.

5.0 Test Methods and Measurements

5.1 Measuring Floor and Non-floor Panel U-factors

Follow the test procedure in ASTM C1363, (incorporated by reference; see §431.303), exactly, with these exceptions:

(1) Test Sample Geometry Requirements

(i) Two (2) panels, 8 ft. ± 1 ft. long and 4 ft. ± 1 ft. wide must be used.

(ii) The panel edges must be joined using the manufacturer's panel interface joining system (e.g., camlocks, standard gasketing, etc.).

(iii) The Panel Edge Test Region, see figure 1, must be cut using the following dimensions:

1. If the panel contains framing members (e.g. a wood frame), then the width of edge (W) must be as wide as any framing member plus 2 in. ± 0.25 in. For example, if the face of the panel contains 1.5 in. thick framing members around the edge of the panel, then width of edge (W) = 3.5 in. ± 0.25 in and the Panel Edge Test Region would be 7 in. ± 0.5 in. wide.

2. If the panel does not contain framing members, then the width of edge (W) must be 4 in ± 0. 25 in.

3. Walk-in panels that utilize vacuum insulated panels (VIP) for insulation, width of edge (W) = the lesser of 4.5 in. ± 1 in. or the maximum width that does not cause the VIP to be pierced by the cutting device when the edge region is cut.

(iv) Panel Core Test Region of length Y and height Z, see Figure 1, must also be cut from one of the two panels such that panel length = Y + X, panel height = Z +X where X=2W.

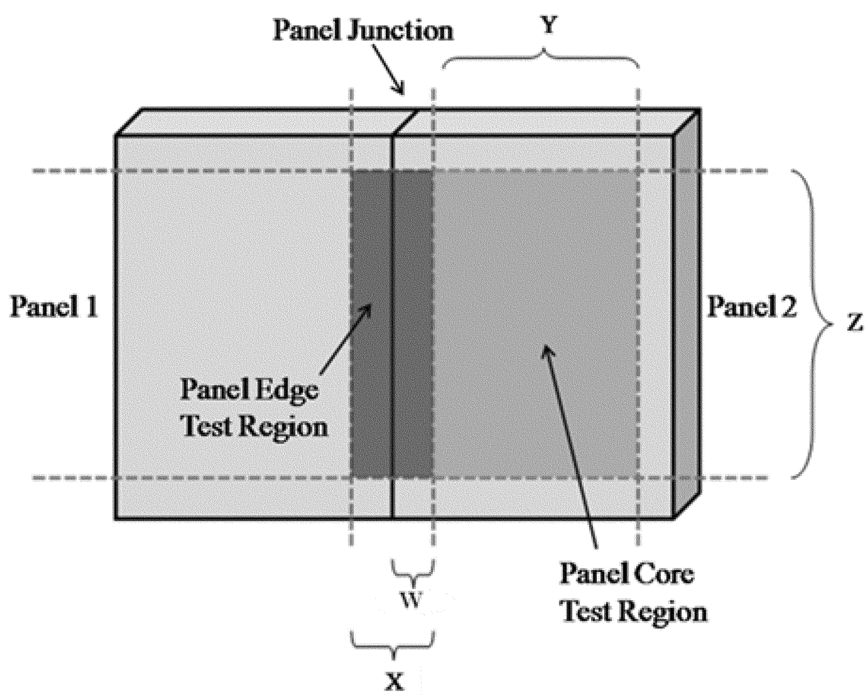

Figure 1 ASTM C1363 Test Regions (Note: diagram not drawn to scale)

(2) Testing Conditions

(i) The air temperature on the ''hot side'', as denoted in ASTM C1363, of the non-floor panel should be maintained at 75 °F ± 1 °F.

1. Exception: When testing floor panels, the air temperature should be maintained at 55 °F ± 1 °F.

(ii) The temperature on the ''cold side'', as denoted in ASTM C1363, of the panel should be maintained at 35 °F ± 1 °F for the panels used for walk-in coolers and −10 °F ± 1 °F for panels used for walk-in freezers.

(iii) The air velocity must be maintained as natural convection conditions as described in ASTM C1363. The test must be completed using the masked method and with surround panel in place as described in ASTM C1363.

(3) Required Test Measurements

(i) Non-floor Panels

1. Panel Edge Region U-factor: $U_{nf,\ edge}$

2. Panel Core Region U-factor: $U_{nf,\ core}$

(ii) Floor Panels

1. Floor Panel Edge Region U-factor: $U_{fp,\ edge}$

2. Floor Panel Core Region U-factor: $U_{fp,\ core}$

5.2 Measuring Long Term Thermal Resistance (LTTR) of Insulating Foam

Follow the test procedure in Annex C of DIN EN 13164 or Annex C of DIN EN 13165 (as applicable), (incorporated by reference; see § 431.303), exactly, with these exceptions:

(1) Temperatures During Thermal Resistance Measurement

(i) For freezers: 20 °F ± 1 °F must be used.

(ii) For coolers: 55 °F ± 1 °F must be used.

(2) Sample Panel Preparation

(i) A 800mm × 800mm square (× thickness of the panel) section cut from the geometric center of the panel that is being tested must be used as the sample for completing DIN EN 13165.

(ii) A 500mm × 500mm square (× thickness of the panel) section cut from the geometric center of the panel that is being tested must be used as the sample for completing DIN EN 13164.

(3) Required Test Measurements

(i) Non-floor Panels

1. Long Term Thermal Resistance: $R_{LTTR,nf}$

(ii) Floor Panels

1. Long Term Thermal Resistance: $R_{LTTR,fp}$

5.3 U-factor of Doors and Display Panels

(a) Follow the procedure in NFRC 100, (incorporated by reference; see § 431.303), exactly, with these exceptions:

(1) The average convective heat transfer coefficient on both interior and exterior surfaces of the door should be based on the coefficients described in section 4.3 of NFRC 100.

(2) Internal conditions:

(i) Air temperature of 35 °F (1.7 °C) for cooler doors and −10 °F (−23.3 °C) for freezer doors

(ii) Mean inside radiant temperature must be the same as shown in section 5.3(a)(2)(i), above.

(3) External conditions

(i) Air temperature of 75 °F (23.9 °C)

(ii) Mean outside radiant temperature must be the same as section 5.3(a)(3)(i), above.

(4) Direct solar irradiance = 0 W/m² (Btu/h-ft²).

(b) Required Test Measurements

(i) Display Doors and Display Panels

1. Thermal Transmittance: U_{dd}

(ii) Non-Display Door

1. Thermal Transmittance: U_{nd}

[76 FR 21606, Apr. 15, 2011, as amended at 76 FR 31796, June 2, 2011; 76 FR 33632, June 9, 2011]

Subpart S—Metal Halide Lamp Ballasts and Fixtures

SOURCE: 74 FR 12075, Mar. 23, 2009, unless otherwise noted.

§ 431.321 Purpose and scope.

This subpart contains energy conservation requirements for metal halide lamp ballasts and fixtures, pursuant to Part A of Title III of the Energy Policy and Conservation Act, as amended, 42 U.S.C. 6291–6309.

[75 FR 10966, Mar. 9, 2010]

§ 431.322 Definitions concerning metal halide lamp ballasts and fixtures.

AC control signal means an alternating current (AC) signal that is supplied to the ballast using additional wiring for the purpose of controlling the ballast and putting the ballast in standby mode.

Active mode means the condition in which an energy-using product:

(1) Is connected to a main power source;

(2) Has been activated; and

(3) Provides one or more main functions.

Ballast means a device used with an electric discharge lamp to obtain necessary circuit conditions (voltage, current, and waveform) for starting and operating.

Ballast efficiency means, in the case of a high intensity discharge fixture, the efficiency of a lamp and ballast combination, expressed as a percentage, and calculated in accordance with the following formula: Efficiency = P_{out}/P_{in} where:

(1) P_{out} equals the measured operating lamp wattage;