ANSI/AHRI Standard 1321 (SI)

2011 Standard for

Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets for Use With Secondary Refrigerants

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PERFORMANCE RATING OF COMMERCIAL REFRIGERATED DISPLAY MERCHANDISERS AND STORAGE CABINETS FOR USE WITH SECONDARY REFRIGERANTS

Section 1. Purpose

1.1 *Purpose*. The purpose of this standard is to establish for Commercial Refrigerated Display Merchandisers and Storage Cabinets that use secondary refrigerants: definitions; test requirements; rating requirements; symbols and subscripts; minimum data requirements for Published Ratings; marking and nameplate data and conformance conditions.

1.1.1 *Intent*. This standard is intended for the guidance of the industry, including manufacturers, engineers, installers, contractors and users. The values reported using this standard allow comparison of energy consumption within each of the following product categories: Remote Commercial Refrigerated Display Merchandisers, Remote Commercial Refrigerated Storage Cabinets and Self-contained Commercial Refrigerated Display Merchandisers.

1.1.2 *Review and Amendment*. This standard is subject to review and amendment as technology advances.

Section 2. Scope

2.1 *Scope*. This standard applies to the following Commercial Refrigerated Display Merchandisers and Storage Cabinets, provided that the cases are equipped and designed to work with electrically driven, medium-temperature, single-phase secondary coolant systems:

2.1.1 Remote Commercial Refrigerated Display Merchandisers and Storage Cabinets
2.1.2 Open and Closed Commercial Refrigerated Display Merchandisers

2.2 *Exclusions.* This standard does not apply to the following:

2.2.1 Refrigerated vending machines
2.2.2 Ice makers
2.2.3 Soft serve extruders
2.2.4 Low-temperature applications
2.2.5 Secondary coolants involving a change of phase (e.g. ice slurries, CO_2)
2.2.6 Self-contained Commercial Refrigerated Display Merchandisers and storage cabinets

Section 3. Definitions

All terms in this document shall follow the standard industry definitions in the current edition of *ASHRAE Terminology of Heating, Ventilation, Air Conditioning and Refrigeration* unless otherwise defined in this section.

3.1 *Anti-condensate Energy Consumption (AEC).* The Total Daily Energy Consumption used in condensate removal on the outside of the Commercial Refrigerated Display Merchandiser or Storage Cabinet, which typically includes fan and condensate heater energy expressed in kW·h per day.

3.2 *Calculated Daily Energy Consumption (CDEC).* This is a value for Remote Commercial Refrigerated Display Merchandisers or Storage Cabinets based upon the requirements of this standard expressed in kW·h per day.

3.3 *Coefficient of Performance (COP).* A ratio of the cooling capacity in watts W to the power input value in watts W at any given set of Rating Conditions expressed in W/W.

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3.4 *Circulation Pump Energy Consumption (CPEC).* The energy consumed by the pump used to circulate secondary coolant expressed in kW·h per day.

3.5 *Circulation Pump Heat Input ($Q_{CP.}$)* The energy transferred to the secondary coolant as a result of the work done on the coolant by the circulation pump expressed in W.

3.6 *Commercial Refrigerated Display Merchandiser.* A cabinet cooled by a refrigerating system for displaying chilled and/or frozen food to be maintained within prescribed temperature limits.

3.6.1 *Closed Commercial Refrigerated Display Merchandiser*. A refrigerated display merchandiser where food is accessible for removal by opening or moving doors or panels.

3.6.2 *Open Commercial Refrigerated Display Merchandiser*. A refrigerated display merchandiser where food is accessible for removal without opening or moving doors or panels.

3.6.3 *Remote Commercial Refrigerated Display Merchandiser*. A refrigerated display merchandiser that has a remote condensing unit.

3.6.4 *Service Over the Counter (SOC).* A commercial refrigerator or freezer equipped with sliding or hinged doors in the back intended for use by sales personnel, and with glass or other transparent material in the front for displaying merchandise. The equipment has a height no greater than 167.6 centimeters and is intended to serve as a counter for transactions between sales personnel and customers.

3.7 *Commercial Refrigerated Storage Cabinet.* A closed cabinet cooled by a refrigerating system for storing chilled and/or frozen food to be maintained within prescribed temperature limits.

3.7.1 *Remote Commercial Refrigerated Storage Cabinet*. A refrigerated storage cabinet that has a remote condensing unit.

3.8 *Compressor Energy Consumption (CEC).* The energy consumed by the compressor expressed in kW·h per day.

3.9 *Condensate Evaporator Pan Energy Consumption (PEC).* The amount of heat energy required to change condensate from liquid to a vapor in the evaporator pan expressed in kW·h per day.

3.10 *Defrost Energy Consumption (DEC).* The energy consumed during defrost cycles expressed in kW·h per day.

3.11 *Dew Point.* Refrigerant vapor saturation temperature at a specified pressure expressed in °C.

3.11.1 *Adjusted Dew Point.* An adjusted temperature lower than actual Dew Point temperature expressed in °C, resulting from suction line pressure losses, equal to saturated suction temperature at the compressor.

3.12 *Fan Energy Consumption (FEC).* The energy consumed by fan motors expressed in kW·h per day.

3.13 *Integrated Average Temperature.* The average of all test package measurements taken during the test expressed in °C.

3.14 *Lighting Energy Consumption (LEC).* The energy consumed by lighted shelves and lighting internal to the refrigerated display merchandiser or storage cabinet expressed in kW·h per day.

3.15 *Product Temperature*. Commercial Refrigerated Display Merchandisers or Storage Cabinets shall be tested with one or more of the following Integrated Average Temperatures:

3.15.1 *Medium Temperature Applications.* Commercial Refrigerated Display Merchandisers and Storage Cabinets **i**ntended for Medium Temperature Applications, shall have an Integrated Average Temperature of 3.3°C ± 1.1°C.

3.15.2 *Application Product Temperature*. This test allows Integrated Average Temperatures other than Section 3.15.1.

3.16 *Published Rating.* A statement of the assigned values of those performance characteristics, under stated Rating

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Conditions, by which a unit may be chosen for its application. The term Published Rating includes the rating of all performance characteristics shown on the unit or published in specifications, advertising or other literature controlled by the manufacturer, at stated Rating Conditions.

3.16.1 *Application Rating*. A rating based on tests performed at application Rating Conditions (other than Standard Rating Conditions).

3.16.2 *Standard Rating*. A rating based on tests performed at Standard Rating Conditions.

3.17 *Rating Conditions*. Any set of operating conditions under which a single level of performance results and which causes only that level of performance to occur.

3.17.1 *Standard Rating Conditions.* Rating Conditions used as the basis of comparison for performance characteristics.

3.18 *Secondary Coolant.* Fluid used for the transmission of heat without a complete or partial change of phase within the cabinet. This standard applies to single-phase applications where the fluid is 35% propylene glycol or a fluid with similar viscosity and heat transfer properties.

3.19 *"Shall" or "Should"*. "Shall" or "should" shall be interpreted as follows:

3.19.1 *Shall*. Where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with the standard is claimed.

3.19.2 *Should.* "Should" is used to indicate provisions which are not mandatory but which are desirable as good practice.

3.20 *Total Display Area (TDA).* The sum of the projected area(s) for visible product expressed in m^2.

3.21 *Volume.* Two methods are defined for determining refrigerated volume.

3.21.1 *AHAM Volume Method.* The interior volume of a refrigerator as calculated by AHAM HRF-1.

3.21.2 *Load Line Volume Method*. The gross interior volume of the refrigerator contained within the load limit lines. This gross volume shall be calculated without display devices installed.

Section 4. Test Requirements

4.1 *Test Requirements.* The tests required for this standard shall be conducted in accordance with ANSI/ASHRAE Standard 72.

4.1.1 *Dry-Bulb Temperature***.** The average test-room dry-bulb temperature shall be 24.0ºC ± 1.0ºC, when measured in accordance with ANSI/ASHRAE Standard 72.

4.1.2 *Wet-Bulb Temperature*. The average test-room wet-bulb temperature shall be 18.0ºC ± 1.0ºC, when measured in accordance with ANSI/ASHRAE Standard 72.

Section 5. Rating Requirements

5.1 *General*. This section identifies the necessary data required to calculate the CDEC for Remote Commercial Refrigerated Display Merchandisers and Storage Cabinets for use with secondary refrigerants.

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5.2 *CDEC for Remote Commercial Refrigerated Display Merchandisers and Storage Cabinets*. The total electrical load shall be measured and adjusted to determine CDEC. The electrical load categories shall include compressors, evaporator fan motors, lighting, surface anti-condensate load including fans and heaters, defrost heaters, condensate evaporator pans, secondary coolant circulation pumps and any other suitable electrical loads when they are part of the unit. If measured electrical loads are not available, the following calculations shall be done to determine the CDEC.

$$CDEC = CEC + FEC + LEC + AEC + DEC + PEC + CPEC \quad (1)$$

Remote Commercial Refrigerated Display Merchandisers and Storage Cabinets shall report the individual loads in the calculation of CDEC. Shown below are formulae for the required individual loads.

5.2.1 *Calculation of CEC.* The COP values in Table 1 shall be used to calculate CEC for a 24 hour period.

Note: The COP values in Table 1 are based on an evaporator temperature and the Commercial Refrigerated Display Merchandiser or Storage Cabinet classification. Commercial Refrigerated Display Merchandisers and Storage Cabinets for Medium Temperature Secondary Applications shall use a temperature that is 4.0°C lower than the Commercial Refrigerated Display Merchandiser or Storage Cabinet secondary coolant cabinet inlet temperature.

$$CEC = [(Q_{rt} + Q_{CP}) \cdot (t - t_{dt})] / (COP \cdot 1000) \quad (2)$$

5.2.2 *Calculation of FEC.* The FEC shall be measured data for all fan motors or calculated data using the motor efficiency:

$$FEC = (P_f \cdot t_f) / (1000) \quad (3)$$

Where:

$P_f = (P_{fi} \cdot n)$ (measured)
$P_f = (P_{fo} \cdot n) / (\eta_m)$ (calculated)

5.2.3 *Calculation of LEC.*

$$LEC = (P_{li} \cdot t_l) / (1000) \quad (4)$$

5.2.4 *Calculation of AEC.*

$$AEC = (P_{ai} \cdot t_a) / (1000) \quad (5)$$

5.2.5 *Calculation of DEC.*

$$DEC = (P_d \cdot t_d) / (1000) \quad (6)$$

5.2.6 *Calculation of PEC.*

$$PEC = (P_c \cdot t_c) / (1000) \quad (7)$$

5.2.7 *Calculation of CPEC.*

5.2.7.1 *Off-Cycle Defrost.*

For cabinets with secondary coolant pressure drop values equal to or less than 45 kPa, use the formula

$$CPEC = M \bullet K_1 \bullet (t\text{-}t_{dt})/1000 \quad (8)$$

Where:

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