AHRI Standard 1251 (SI)

2014 Standard for Performance Rating of Walk-in Coolers and Freezers

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Note:

This standard supersedes AHRI Standard 1251 (SI)-2009
For I-P ratings, see ANSI/AHRI Standard 1250 (I-P)-2014.

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PERFORMANCE RATING OF WALK IN COOLERS AND FREEZERS

Section 1. Purpose

1.1 *Purpose*. The purpose of this standard is to establish, for walk-in coolers and freezers: definitions; test requirements; rating requirements; minimum data requirements for Published Ratings; operating requirements; marking and nameplate data and conformance conditions.

1.1.1 *Intent.* This standard is intended for the guidance of the industry, including manufacturers, designers, installers, contractors and users.

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 mechanical refrigeration equipment consisting of an integrated single package refrigeration unit, or separate Unit Cooler and condensing unit sections, where the condensing section can be located either outdoor or indoor. Controls may be integral, or can be provided by a separate party as long as performance is tested and certified with the listed mechanical equipment accordingly.

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

2.2.1 Enclosures used for telecommunications switch gear or other equipment requiring cooling
2.2.2 Enclosures designed for medical, scientific or research purposes
2.2.3 Performance testing and efficiency characterization of large parallel rack refrigeration systems (condensing unit)

Section 3. Definitions

All terms in this document will follow the standard industry definitions in the *ASHRAE Wikipedia* website (https://www.ashrae.org/resources--publications/free-resources/ashrae-terminology) unless otherwise defined in this section.

3.1 *Annual Walk-in Energy Factor (AWEF).* A ratio of the total heat, not including the heat generated by the operation of refrigeration systems, removed, in watt-hours, from a walk-in box during one year period of usage for refrigeration to the total energy input of refrigeration systems, in watt-hours, during the same period.

3.2 *Coefficient of Performance (COP).* A ratio of the Net Refrigeration Capacity in W to the power input values in W at any given set of Rating Conditions expressed in W/W.

3.3 *Forced-circulation Free-Delivery Unit Coolers (Unit Coolers).* A factory-made assembly, including means for forced air circulation and elements by which heat is transferred from air to refrigerant without any element external to the cooler imposing air resistance. These may also be referred to as Air Coolers, Cooling Units, Air Units or Evaporators.

3.4 *Gross Refrigeration Capacity.* The heat absorbed by the refrigerant, W. This is the sum of the Net Refrigeration Capacity and the heat equivalent of the energy required to operate the Unit Cooler. This includes both sensible and latent cooling.

3.5 *Load Factor.* A ratio of the Total Walk-in System Heat Load to the steady-state net refrigeration capacity.

3.6 *Load Period.* A twenty-four hour day.

3.6.1 *High Load Period.* The period of the day corresponding to frequent door openings, product loading events, and other design Load Factors. For the purposes of this standard, this period shall be 8 continuous hours.

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3.6.2 *Low Load Period.* The period of the day other than the High Load Period. For the purposes of this standard, this period shall be the remaining 16 continuous hours of the total Load Period.

3.7 *Net Refrigeration Capacity*. The refrigeration capacity available for space and product cooling, W. It is equal to the Gross Refrigeration Capacity less the heat equivalent of energy required to operate the Unit Cooler (e.g.: evaporator fans, defrost)

3.8 *Positive Displacement Condensing Unit.* A specific combination of refrigeration system components for a given refrigerant, consisting of one or more electric motor driven positive displacement compressors, condensers, and accessories as provided by the manufacturer.

3.9 *Published Rating.* A statement of the assigned values of those performance characteristics, under stated rating conditions, by which a unit may be chosen to fit its application. These values apply to all units of like nominal size and type (identification) produced by the same manufacturer. 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.

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

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

3.10 *Rated Fan Power*.

3.10.1 For single phase motors, total fan motor input power, W.

3.10.2 For polyphase motors, individual fan motor output power, W.

3.11 *Rating Conditions.* Any set of operating conditions under which a single level of performance results and which 1causes only that level of performance to occur.

3.11.1 *Standard Ratings Conditions.* Rating conditions used as the basis of comparison for performance characteristics.

3.12 *Refrigeration Capacity*. The capacity associated with the increase in total enthalpy between the liquid refrigerant entering the expansion valve and superheated return gas multiplied by the mass flow rate of the refrigerant.

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

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

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

3.14 *Refrigerant Saturation Temperature.* Refrigerant temperature at the Unit Cooler inlet or outlet determined either by measuring the temperature at the outlet of the two-phase refrigerant flow, for a Liquid Overfeed Unit Cooler, or by measuring refrigerant pressure and determining the corresponding temperature from reference thermodynamic tables or equations for the refrigerant, ºC. For zeotropic refrigerants, the corresponding temperature to a measured pressure is the refrigerant Dew Point.

3.15 *Steady-state*. An operating state of a system, including its surroundings, in which the extent of change with time is within the required limits within this standard.

3.16 *Test Measurement.* The reading of a specific test instrument at a specific point in time. The Test Measurement may be averaged with other measurements of the same parameter at the same time to determine a Test Reading or averaged over the duration of the test to determine the value for the Test Run. Refer to Table C1 for Test Reading minimum time rate, number of Test Readings and minimum test duration.

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3.17 *Test Reading*. The recording of one full set of the Test Measurements required to assess the performance of the test unit.

3.18 *Total Walk-in System Heat Load*. Total heat load to the walk-in system including Walk-in Box Load and the heat load to the box contributed by the operation of the refrigeration system.

3.18.1 *Walk-in System High Load (WLH)*. Total Walk-in System Heat Load during a High Load Period.

3.18.1 *Walk-in System Low Load (WLL)*. Total Walk-in System Heat Load during a Low Load Period.

3.19 *Volatile Refrigerant.* A refrigerant which changes from liquid to vapor in the process of absorbing heat.

3.20 *Walk-in Box Load.* Heat load to the walk-in box resulting from conduction, infiltration and internal heat gains from equipment that is not related to the refrigeration system, such as lights and anti-sweat heaters, etc.

3.20.1 *High Box Load (BLH).* Walk-in Box Load during a High Load Period.

3.20.2 *Low Box Load (BLL).* Walk-in Box Load during a Low Load Period.

Section 4. Test Requirements

4.1 *Instruments.* All measuring instruments shall be selected to meet or exceed the accuracy criteria listed in Table 1 for each type of measurement. All temperature measurement shall be made in accordance with Table 2, Test Tolerance. Precision instruments and automated electronic data acquisition equipment shall be used to measure and record temperature, pressure and refrigerant flow rate test parameters. All measuring instruments and instrument systems (e.g. data acquisition coupled to temperature, pressure, or flow sensors) shall be calibrated by comparison to primary or secondary standards with calibrations traceable to National Institute of Standards and Technology (NIST) measurements, other recognized national laboratories, or derived from accepted values of natural physical constants. All test instruments shall be calibrated annually, whenever damaged, or when the accuracy is called into question.

Table 1. Instrumentation Accuracy

Measurement	Medium	Minimum Accuracy
Temperature, °C	Air dry-bulb	± 0.3
	Air wet-bulb	
	Refrigerant liquid	
	Refrigerant vapor	± 0.3
	Air Dew Point	± 0.3
	Others, °C	± 0.6
Relative humidity[1]	Air	± 3 % points rh
Pressure	Refrigerant	Pressure corresponding to ± 0.1 °C of saturation temperature
	Air	± 169 Pa
Flow	Refrigerant	1 % of reading
	Liquids	1 % of reading
Electrical	Motor kilowatts/amperes/voltage	1 % of reading
	Auxiliary kilowatt input (e.g. heater)	

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Table 1. Instrumentation Accuracy (cont.)		
Measurement	Medium	Minimum Accuracy
Speed	Motor / fan shaft	1 % of reading
Weight	Oil / refrigerant solution	0.5 % of reading
Specific Gravity	Brine	1 % of reading
Time	Hours / minutes / seconds	0.5 % of time interval

Note:
1. Relative humidity and air dew point measurements are intended to confirm the dry coil condition.

Table 2. Test Operating and Test Condition Tolerances for Steady-state Test

	Test Operating Tolerance [1]	Test Condition Tolerance [2]
Indoor dry-bulb, °C		
Entering temperature	± 2.0	± 0.3
Indoor wet-bulb, °C		
Entering temperature	± 2.0	± 0.3
Outdoor dry-bulb, °C		
Entering temperature	± 2.0	± 0.6
Outdoor wet-bulb, °C		
Entering temperature	± 2.0	± 0.6
Electrical voltage, % of reading.	± 2.0	
Electric voltage % of reading	± 0.6	

Notes:
1. Test Operating Tolerance is the maximum permissible range of any measurement. When expressed as a percentage, the maximum allowable variation is the specified percentage of the average value.
2. Test Condition Tolerance is the maximum permissible variation of the average value of the measurement from the specified test condition.

4.2 *Method of Test.* The test procedure for walk-in cooler and freezer systems that have matched Unit Coolers and condensing units, and the procedures of testing condensing units and Unit Coolers individually for are described in Appendix C of this standard.

4.3 *Test Conditions.* Walk-in systems, condensing units and Unit Coolers shall be tested under the standard rating conditions defined in Section 5.

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Section 5. Rating Requirements

5.1 *Standard Ratings*. Standard Ratings shall be established at the Standard Rating Conditions in the following listed tables and shall include its associated power input and Coefficient of Performance (COP). When tested with a specified motor, the associated compressor speed (external drive compressors only) shall also be included as part of the rating. The power required to operate all included accessories such as condenser fans, water pumps, controls, and similar accessories shall be accounted for in the power input and Coefficient of Performance. When external accessories such as water pumps, remote fans, and similar accessories are required for the operation of the unit but not included with the unit, the manufacturer shall clearly state that the rated power input and Coefficient of Performance do not account for additional power required by these external accessories. If a water-cooled condenser is used, the cooling water flow rate and pressure drop shall be specified as part of the rating. The condenser entering air wet bulb temperature only applies to evaporative condensers.

Table 3. Fixed Capacity Matched Refrigerator System, Condensing Unit Located Indoor

Test Title	Unit Cooler Air Entering Dry-bulb, ˚C	Unit Cooler Air Entering Relative Humidity, %	Condenser Air Entering Dry-bulb, ˚C	Condenser Air Entering Wet-bulb, ˚C	Compressor Operating Mode	Test Objective
Off Cycle Fan Power	2	<50	-	-	Compressor Off	Measure fan input wattage during compressor off cycle, $\dot{E}F_{comp,off}$
Refrigeration Capacity	2	<50	32	24[1]	Compressor On	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss}$, input power, $\dot{E}_{ss}$ and COP at Rating condition

Note:
1. Required only for evaporative condensing units.

Table 4. Fixed Capacity Matched Refrigerator System, Condensing Unit Located Outdoor

Test Title	Unit Cooler Air Entering Dry-bulb, ˚C	Unit Cooler Air Entering Relative Humidity, %	Condenser Air Entering Dry-bulb, ˚C	Condenser Air Entering Wet-bulb[1], ˚C	Compressor Operating Mode	Test Objective
Off Cycle Fan Power	2	<50	-	-	Compressor Off	Measure fan input wattage during compressor off cycle, $\dot{E}F_{comp,off}$
Refrigeration Capacity A	2	<50	35	24	Compressor On	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{SS,A}^{k=1}$, input power, $\dot{E}_{SS,A}^{k=1}$, and COP at Rating Condition

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Table 4. Fixed Capacity Matched Refrigerator System, Condensing Unit Located Outdoor (cont.)

Test Title	Unit Cooler Air Entering Dry-bulb, ˚C	Unit Cooler Air Entering Relative Humidity, %	Condenser Air Entering Dry-bulb, ˚C	Condenser Air Entering Wet-bulb, ˚C	Compressor Operating Mode	Test Objective
Refrigeration Capacity B	2	<50	15	12	Compressor On	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,A}^{k=2}$, and system input power, $\dot{E}_{ss,A}^{k=2}$, at moderate condition
Refrigeration Capacity C	2	<50	2	1	Compressor On	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,A}^{k=2}$, and system input power, $\dot{E}_{ss,A}^{k=2}$, at cold condition

Note:
1. Required only for evaporative condensing units.

Table 5. Two Capacity Matched Refrigerator System, Condensing Unit Located Outdoor

Test Title	Unit Cooler Air Entering Dry-bulb, ˚C	Unit Cooler Air Entering Relative Humidity, %	Condenser Air Entering Dry-bulb, ˚C	Condenser Air Entering Wet-bulb[1], ˚C	Compressor Operating Mode	Test Objective
Off Cycle Fan Power	2	<50	-	-	Compressor Off	Measure fan input wattage during compressor off cycle, $\dot{E}F_{comp,off}$
Refrigeration Capacity A Low Speed	2	<50	35	24	Minimum Capacity	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,A}^{k=1}$, and input power, $\dot{E}_{ss,A}^{k=1}$, at Rating Condition and minimum compressor capacity
Refrigeration Capacity A High Speed	2	<50	35	24	Maximum Capacity	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,A}^{k=2}$, input power, $\dot{E}_{ss,A}^{k=2}$, and COP at Rating Condition and maximum compressor capacity

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Table 5. Two Capacity Matched Refrigerator System, Condensing Unit Located Outdoor (cont.)

Test Title	Unit Cooler Air Entering Dry-bulb, ˚C	Unit Cooler Air Entering Relative Humidity, %	Condenser Air Entering Dry-bulb, ˚C	Condenser Air Entering Wet-bulb[1], ˚ C	Compressor Operating Mode	Test Objective
Refrigeration Capacity B Low Speed	2	<50	15	12	Minimum Capacity	Determine Net Refrigeration Capacity of Unit Cooler ,$\dot{q}_{ss,B}^{k=1}$, and system input power, $\dot{E}_{ss,B}^{k=1}$, at moderate condition and minimum compressor capacity
Refrigeration Capacity B High Speed	2	<50	15	12	Maximum Capacity	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=2}$, and system input power, $E_{ss,B}^{k=2}$, at moderate condition and maximum compressor capacity
Refrigeration Capacity C Low Speed	2	<50	2	1	Minimum Capacity	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,C}^{k=1}$, and system input power, $\dot{E}_{ss,C}^{k=1}$, at cold condition and minimum compressor capacity
Refrigeration Capacity C High Speed	2	<50	2	1	Maximum Capacity	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,C}^{k=2}$, and system input power, $\dot{E}_{ss,C}^{k=2}$ at cold condition and maximum compressor capacity

Note:
1. Required only for evaporative condensing units.

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Table 6. Variable Capacity Matched Refrigerator System, Condensing Unit Located Outdoor

Test Title	Unit Cooler Air Entering Dry-bulb, ˚C	Unit Cooler Air Entering Relative Humidity, %	Condenser Air Entering Dry-bulb, ˚C	Condenser Air Entering Wet-bulb[2], ˚C	Compressor Operating Mode	Test Objective
Off Cycle Fan Power	2	<50	-	-	Compressor Off	Measure fan input wattage during compressor off cycle, $\dot{E}F_{comp,off}$
Refrigeration Capacity A Low Speed	2	<50	35	24	Minimum Capacity, k = 1	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,A}^{k=1}$, and system input power, $\dot{E}_{ss,A}^{k=1}$ at Rating Condition and minimum compressor capacity
Refrigeration Capacity A Variable Speed	2	<50	35	24	Intermediate Capacity[1], k = i	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,A}^{k=i}$, and system input power, $\dot{E}_{ss,A}^{k=i}$, at Rating Condition and intermediate compressor capacity
Refrigeration Capacity A High Speed	2	<50	35	24	Maximum Capacity, k = 2	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,A}^{k=2}$, system input power, $\dot{E}_{ss,A}^{k=2}$, and COP at Rating Condition and maximum compressor capacity
Refrigeration Capacity B Low Speed	2	<50	15	12	Minimum Capacity, k = 1	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=1}$, and system input power, $\dot{E}_{ss,B}^{k=1}$ at moderate condition and minimum compressor capacity
Refrigeration Capacity B Variable Speed	2	<50	15	12	Intermediate Capacity[1], k = i	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=i}$, and system input power, $\dot{E}_{ss,B}^{k=i}$, at moderate condition and intermediate compressor capacity

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Table 6. Variable Capacity Matched Refrigerator System, Condensing Unit Located Outdoor (cont.)

Test Title	Unit Cooler Air Entering Dry-bulb, ˚C	Unit Cooler Air Entering Relative Humidity, %	Condenser Air Entering Dry-bulb, ˚C	Condenser Air Entering Wet-bulb[2], ˚C	Compressor Operating Mode	Test Objective
Refrigeration Capacity B High Speed	2	<50	15	12	Maximum Capacity, k = 2	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=i}$, and system input power, $\dot{E}_{ss,B}^{k=i}$, at moderate condition and maximum compressor capacity
Refrigeration Capacity C Low Speed	2	<50	2	1	Minimum Capacity, k = 1	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=i}$, and system input power, $\dot{E}_{ss,B}^{k=i}$, at cold condition and minimum compressor capacity
Refrigeration Capacity C Variable Speed	2	<50	2	1	Intermediate Capacity[1], k = i	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=i}$, and system input power, $\dot{E}_{ss,B}^{k=i}$, at cold condition and intermediate compressor capacity
Refrigeration Capacity C High Speed	2	<50	2	1	Maximum Capacity, k = 2	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=i}$, and system input power, $\dot{E}_{ss,B}^{k=i}$, at cold condition and maximum compressor capacity

Notes:

1. For the intermediate capacity test, the compressor capacity shall be set to 40% of its maximum capacity if possible. Otherwise, it shall be set to the capacity that is the closest to the 40% of its maximum capacity.
2. Required only for evaporative condensing units.

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Table 7. Fixed Capacity Matched Freezer System, Condensing Unit Located Indoor

Test Title	Unit Cooler Air Entering Dry-bulb, ˚C	Unit Cooler Air Entering Relative Humidity, %	Condenser Air Entering Dry-bulb, ˚C	Condenser Air Entering Wet-bulb[1], ˚ C	Compressor Operating Mode	Test Objective
Off Cycle Fan Power	-23	<50	-	-	Compressor Off	Measure fan input wattage during compressor off cycle, $\dot{EF}_{comp,off}$
Refrigeration Capacity	-23	<50	32	24	Compressor On	Determine Net Refrig-eration Capacity of Unit Cooler, $\dot{q}_{ss,A}$, system input power, $\dot{E}_{ss,A}$, and COP at Rating Condition
Defrost Frost Load	-23	Varying	32	24	System Dependent	Test according to Appendix C Section C11, $\dot{DF}$, $\dot{Q}_{DF}$.

Note:
1. Required only for evaporative condensing units.

Table 8. Fixed Capacity Matched Freezer System, Condensing Unit Located Outdoor

Test Title	Unit Cooler Air Entering Dry-Bulb, ˚C	Unit Cooler Air Entering Relative Humidity, %	Condenser Air Entering Dry-bulb, ˚C	Condenser Air Entering Wet-bulb[1], ˚ C	Compressor Operating Mode	Test Objective
Off Cycle Fan Power	-23	<50	-	-	Compressor Off	Measure fan input wattage during compressor off cycle, $\dot{EF}_{comp,off}$
Refrigeration Capacity A	-23	<50	35	24	Compressor On	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,A}$, system input power, $\dot{E}_{ss,A}$, and COP at Rating Condition
Refrigeration Capacity B	-23	<50	15	12	Compressor On	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,A}$, system input power, $\dot{E}_{ss,A}$, at moderate condition

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Table 8. Fixed Capacity Matched Freezer System, Condensing Unit Located Outdoor (cont.)

Test Title	Unit Cooler Air Entering Dry-Bulb, ˚C	Unit Cooler Air Entering Relative Humidity, %	Condenser Air Entering Dry-bulb, ˚C	Condenser Air Entering Wet-bulb[1], ˚ C	Compressor Operating Mode	Test Objective
Refrigeration Capacity C	-23	<50	2	1	Compressor On	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,A}$, system input power, $\dot{E}_{ss,A}$, at cold condition
Defrost Frost Load	-23	Varying	35	24	System Dependent	Test according to Appendix C Section C11, $\dot{DF}$, $\dot{Q}_{DF}$.

Note:
1. Required only for evaporative condensing units.

Table 9. Two Capacity Matched Freezer System, Condensing Unit Located Outdoor

Test Title	Unit Cooler Air Entering Dry-Bulb, ˚C	Unit Cooler Air Entering Relative Humidity, %	Condenser Air Entering Dry-bulb, ˚C	Condenser Air Entering Wet-bulb[1], ˚ C	Compressor Operating Mode	Test Objective
Off Cycle Fan Power	-23	<50	-	-	Compressor Off	Measure fan input wattage during compressor off cycle, $\dot{EF}_{comp,off}$
Refrigeration Capacity A Low Speed	-23	<50	35	24	Minimum Capacity	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=2}$, and system input power, $E_{ss,B}^{k=2}$, at Rating Condition and minimum compressor capacity

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Table 9. Two Capacity Matched Freezer System, Condensing Unit Located Outdoor (cont.)

Test Title	Unit Cooler Air Entering Dry-Bulb, ˚C	Unit Cooler Air Entering Relative Humidity, %	Condenser Air Entering Dry-bulb, ˚C	Condenser Air Entering Wet-bulb[1], ˚ C	Compressor Operating Mode	Test Objective
Refrigeration Capacity A High Speed	-23	<50	35	24	Maximum Capacity	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=2}$, and system input power, $E_{ss,B}^{k=2}$, and COP at Rating Condition and maximum compressor capacity
Refrigeration Capacity B Low Speed	-23	<50	15	12	Minimum Capacity	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=2}$, and system input power, $E_{ss,B}^{k=2}$, at moderate condition and mini-mum compressor capacity
Refrigeration Capacity B High Speed	-23	<50	15	12	Maximum Capacity	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=2}$, and system input power, $E_{ss,B}^{k=2}$, at moderate condition and maxi-mum compressor capacity
Refrigeration Capacity C Low Speed	-23	<50	2	1	Minimum Capacity	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=2}$, and system input power, $E_{ss,B}^{k=2}$, at cold condition and minimum com-pressor capacity
Refrigeration Capacity C High Speed	-23	<50	2	1	Maximum Capacity	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=2}$, and system input power, $E_{ss,B}^{k=2}$, at cold condition and maximum com-pressor capacity

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Table 9. Two Capacity Matched Freezer System, Condensing Unit Located Outdoor (cont.)

Test Title	Unit Cooler Air Entering Dry-Bulb, ˚C	Unit Cooler Air Entering Relative Humidity, %	Condenser Air Entering Dry-bulb, ˚C	Condenser Air Entering Wet-bulb[1], ˚ C	Compressor Operating Mode	Test Objective
Defrost Frost Load	-23	Varying	35	24	System Dependent	Test according to Appendix C Section C11, $\dot{DF}$, $\dot{Q}_{DF}$.

Note:
1. Required only for evaporative condensing units.

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Table 10. Variable Capacity Matched Freezer System, Condensing Unit Located Outdoor

Test Title	Unit Cooler Air Entering Dry-Bulb, ˚C	Unit Cooler Air Entering Relative Humidity, %	Condenser Air Entering Dry-bulb, ˚C	Condenser Air Entering Wet-bulb[2], ˚ C	Compressor Operating Mode	Test Objective
Off Cycle Fan Power	-23	<50	-	-	Compressor Off	Measure fan input wattage during compressor off cycle, $\dot{E}F_{comp,off}$
Refrigeration Capacity A Low Speed	-23	<50	35	24	Minimum Capacity	Determine Net Refriger-ation Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=2}$ and system input power, $\dot{E}_{ss,B}^{k=2}$, at Rating Condition and minimum compressor capacity
Refrigeration Capacity A Variable Speed	-23	<50	35	24	Intermediate Capacity[1]	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=2}$ and system input power, $\dot{E}_{ss,B}^{k=2}$, at Rating Condition and intermediate compressor capacity
Refrigeration Capacity A High Speed	-23	<50	35	24	Maximum Capacity	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=2}$ and system input power, $\dot{E}_{ss,B}^{k=2}$, and COP at Rating Condition and maximum compressor capacity
Refrigeration Capacity B Low Speed	-23	<50	15	12	Minimum Capacity	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=2}$ and system input power, $\dot{E}_{ss,B}^{k=2}$, at moderate condition and minimum compressor capacity
Refrigeration Capacity B Variable Speed	-23	<50	15	12	Intermediate Capacity[1]	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=2}$ and system input power, $\dot{E}_{ss,B}^{k=2}$, at moderate condition and intermediate compressor capacity

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Table 10. Variable Capacity Matched Freezer System, Condensing Unit Located Outdoor (cont.)

Test Title	Unit Cooler Air Entering Dry-Bulb, ˚C	Unit Cooler Air Entering Relative Humidity, %	Condenser Air Entering Dry-bulb, ˚C	Condenser Air Entering Wet-bulb[2], ˚ C	Compressor Operating Mode	Test Objective
Refrigeration Capacity B High Speed	-23	<50	15	12	Maximum Capacity	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=2}$ and system input power, $\dot{E}_{ss,B}^{k=2}$, at moderate condition and maximum compressor capacity
Refrigeration Capacity C Low Speed	-23	<50	2	1	Minimum Capacity	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=2}$ and system input power, $\dot{E}_{ss,B}^{k=2}$, at cold condition and minimum compressor capacity
Refrigeration Capacity C Variable Speed	-23	<50	2	1	Intermediate Capacity[1]	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=2}$ and system input power, $\dot{E}_{ss,B}^{k=2}$, at cold condition and intermediate compressor capacity
Refrigeration Capacity C High Speed	-23	<50	2	1	Maximum Capacity	Determine Net Refrigeration Capacity of Unit Cooler, $\dot{q}_{ss,B}^{k=2}$ and system input power, $\dot{E}_{ss,B}^{k=2}$, at cold condition and maximum compressor capacity
Defrost Frost Load	-23	Varying	35	24	System Dependent	Test according to Appendix C Section C11, $\dot{DF}$, $\dot{Q}_{DF}$.

Notes:

1. For the intermediate capacity test, the compressor capacity shall be set to 50% of its maximum capacity if possible. Otherwise, it shall be set to the capacity that is the closest to the 50% of its maximum capacity.
2. Required only for evaporative condensing units.

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Table 11. Fixed Capacity Refrigerator Condensing Unit, Condensing Unit Located Indoor[1]

Test Title	Suction Dewpoint, ˚C	Return Gas[2], ˚C	Condenser Air Entering Dry-bulb, ˚C	Condenser Air Entering Wet-bulb[3], ˚C	Compressor Operating Mode	Test Objective
Refrigeration Capacity at compressor on	-5	5	32	24	Compressor On	Determine Gross Refrigeration Capacity and input power of condensing unit at Rating Condition

Notes:
1. Subcooling to be set according to equipment specification and reported as part of standard rating
2. Measured at the condensing unit inlet location.
3. Required only for evaporative condensing units

Table 12. Fixed Capacity Refrigerator Condensing Unit, Condensing Unit Located Outdoor[1]

Test Title	Suction Dewpoint, ˚C	Return Gas[2], ˚C	Condenser Air Entering Dry-bulb, ˚C	Condenser Air Entering Wet-bulb[3], ˚C	Compressor Operating Mode	Test Objective
Refrigeration Capacity Ambient Condition A	-5	5	35	24	Compressor On	Determine Gross Refrigeration Capacity, $\dot{Q}_{gross,i}$, and input power, $\dot{E}_{CU,on}$, of condensing unit at Rating Condition
Refrigeration Capacity Ambient Condition B	-5	5	15	12	Compressor On	Determine Gross Refrigeration Capacity, $\dot{Q}_{gross,i}$, and input power, $\dot{E}_{CU,on}$, of condensing unit at moderate condition
Refrigeration Capacity Ambient Condition C	-5	5	2	1	Compressor On	Determine Gross Refrigeration Capacity, $\dot{Q}_{gross,i}$, and input power, $\dot{E}_{CU,on}$, of condensing unit at cold condition

Notes:
1. Subcooling shall be set according to equipment specification and reported as part of standard rating.
2. Measured at the condensing unit inlet location.
3. Required only for evaporative condensing units.

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