AHRI Standard 1361 (SI)

2017 Standard for

Performance Rating of Computer and Data Processing Room Air Conditioners

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IMPORTANT

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Note:

This 2017 standard supersedes ANSI/AHRI Standard 1361 (SI)-2016.

For I-P ratings, see AHRI Standard 1360 (I-P)-2017.

AHRI CERTIFICATION PROGRAM PROVISIONS

The current scope of the Datacom Cooling (DCOM) Certification Programs can be found on AHRI website www.ahrinet.org. The scope of the Certification Programs should not be confused with the scope of the standard, as the standard also includes ratings for products that are not covered by a certification program.

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PERFORMANCE RATING OF COMPUTER AND DATA PROCESSING ROOM AIR CONDITIONERS

Section 1. Purpose

1.1 *Purpose.* The purpose of this standard is to establish for Computer and Data Processing Room Air Conditioners (CDPR): definitions; classification; test requirements; rating requirements; 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, users, and regulators.

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 Floor Mounted and Ceiling Mounted Computer and Data Processing Room Air Conditioners as defined in Section 3.

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

2.2.1 Rating and testing of individual assemblies, such as condensing units or coils, for separate use.

2.2.2 Unitary air-conditioners and unitary heat pumps as defined in AHRI Standard 210/240 and AHRI Standard 340/360.

2.2.3 Variable refrigerant flow multi-split air conditioners and heat pumps as defined in AHRI Standard 1230.

2.2.4 Single package vertical air conditioners and heat pumps rated using ANSI/AHRI Standard 390.

2.2.5 Packaged terminal air-conditioners and heat pumps rated using AHRI Standard 310/380.

Section 3. Definitions

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

3.1 *Application Configurations.* Variations of Standard Models shall be tested and rated as Standard Models. Refer to Tables C1 and C2.

3.2 *Ceiling Mounted Unit*. A type of CDPR designed and marketed to be installed above a dropped ceiling inside the building. These have one airflow direction through the unit (horizontal) and multiple airflow connections.

3.2.1 *Connections.*

3.2.1.1 *Discharge from Unit*.

3.2.1.1.1 *Ducted Discharge.* A unit which discharges air into attached field installed ductwork.

3.2.1.1.2 *Free Air Discharge.* A unit with a factory installed integral grill or a field installed factory grill or plenum which does not have field installed ductwork attached.

3.2.1.2 *Return to Unit*.

3.2.1.2.1 *Ducted Return.* A unit which returns air from attached field installed ductwork.

3.2.1.2.2 *Free Air Return.* A unit with a factory installed integral grill or a field installed factory grill or plenum which does not have field installed ductwork attached.

3.3 *Computer and Data Processing Room Air Conditioner (CDPR).* An air conditioning unit specifically designed and marketed for cooling Data Centers and Information Technology Equipment (ITE) year round. A CDPR consists of one or more factory-made assemblies, which include a direct expansion evaporator or chilled water cooling coil, an air-moving device(s) and air-filtering device(s). The air conditioner may include a compressor, condenser, humidifier or reheating function. The functions of a CDPR, either alone or in combination with a cooling plant, are to provide air filtration, air circulation, cooling, and humidity control (if the necessary options are included for humidity control).

3.4 *Computer Room Air Conditioner (CRAC).* A CDPR that utilizes dedicated compressors and refrigerant cooling coils rather than chilled-water coils.

3.4.1 *Air-cooled*. A CRAC whose refrigeration system has an air-cooled condenser heat exchanger.
3.4.2 *Glycol-cooled*. A CRAC whose refrigeration system has a glycol-cooled condenser heat exchanger.
3.4.3 *Water-cooled*. A CRAC whose refrigeration system has a water-cooled condenser heat exchanger.

3.5 *Computer Room Air Handler (CRAH).* A CDPR that utilizes chilled-water coils for cooling rather than dedicated compressors.

3.6 *Data Center.* A building, room(s), or portions thereof, serving an ITE load.

3.7 *Floor Mounted Unit.* A type of CDPR designed and marketed to be installed on a raised floor, floor stand, or a solid floor inside the building. These have two airflow configuration options: Direction and Connection. Each Floor Mounted CDPR can be a combination of one Direction and two Connections (one Discharge from Unit and one Return to Unit)

3.7.1 *Connections.*

3.7.1.1 *Discharge from Unit*.

3.7.1.1.1 *Ducted Discharge.* A unit which discharges air into attached field installed ductwork.

3.7.1.1.2 *Free Air Discharge.* A unit with a factory installed integral grill or a field installed factory built plenum which does not have field installed ductwork attached.

3.7.1.1.3 *Raised Floor Plenum Discharge.* A unit which is sitting on and discharges air into an opening in a raised floor plenum.

3.7.1.2 *Return to Unit*.

3.7.1.2.1 *Ducted Return.* A unit which has and returns air into a field installed ductwork attached.

3.7.1.2.2 *Free Air Return.* A unit with a factory installed integral grill or a field installed factory built plenum which does not have field installed ductwork attached.

3.7.1.2.3 *Raised Floor Plenum Return.* A unit which is sitting on and takes in return air from an opening in a raised floor plenum.

3.7.2 *Direction*.

3.7.2.1 *Downflow*. Air passes vertically downward through cooling coil. Return air enters the top of the unit and discharge air leaves at the bottom of the unit.

3.7.2.2 *Horizontal-flow*. Air passes horizontally through cooling coil. Return air enters the rear of the unit and discharge air leaves at the front of the unit.

3.7.2.3 *Upflow*. Air passes vertically upward through cooling coil. Return air enters the bottom of the unit and discharge air leaves at the top of the unit.

3.8 *Fluid Economizer*. An option available with a CRAC or CRAH system in which a cold fluid is circulated by a pump through an indoor heat exchanger to provide cooling during lower outdoor ambient conditions, in order to reduce or eliminate compressor operation. The fluid could be chilled water, water/glycol solution, or refrigerant. An external fluid cooler such as a drycooler, cooling tower, or condenser is utilized for heat rejection. This is sometimes referred to as a free cooling coil, econ-o-coil, or economizer.

3.9 *Information Technology Equipment (ITE).* IT equipment includes IT racks and cabinets, computers, data storage, servers and network/communication equipment which generate heat.

3.10 *Integrated Net Sensible Coefficient of Performance (iNSenCOP)*. A value that provides a standardized evaluation of the annualized cooling energy efficiency of a unit operated across the specified range of outdoor ambient temperatures (see Table 2 and Informative Appendix D).

3.11 *Net Sensible Coefficient of Performance (NSenCOP).* A ratio of the Net Sensible Cooling Capacity in kilowatts to the total power input in kilowatts (excluding reheaters and humidifiers) at any given set of Rating Conditions.

3.12 *Net Sensible Cooling Capacity*. The rate, expressed in kW, at which the equipment removes sensible heat from the air passing through it under specified conditions of operation, including the fan energy dissipated into the conditioned space.

3.13 *Net Total Cooling Capacity*. The rate, expressed in kW, at which the equipment removes total heat from the air passing through it under specified conditions of operation, including the fan energy dissipated into the conditioned space.

3.14 *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 produced by the same manufacturer. As used herein, 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.

3.14.1 *Application Rating.* A rating based on tests of configured models at application Rating Conditions (other than Standard Rating Conditions).

3.14.2 *Standard Rating.* A 100% capacity rating based on tests of Standard Models performed at Standard Rating Conditions specified in Tables 2 and 3. Refer to Appendix C for a description of Standard Models.

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

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

3.16 *"Shall," "Should," "Recommended," or "It Is Recommended."* "Shall," "should," "recommended," or "it is recommended" shall be interpreted as follows:

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

3.16.2 *Should, Recommended, or It Is Recommended*. "Should," "recommended," or "it is recommended" is used to indicate provisions which are not mandatory but which are desirable as good practice.

3.17 *Standard Air.* Air weighing 1.2 kg/m^3 which approximates dry air at 21°C and at a barometric pressure of 101.3 kPa.

3.18 *Standard Airflow*. The volumetric flowrate of air corrected to standard air conditions expressed in standard cubic meter per hour (m^3/h of Standard Air).

3.19 *Standard Model.* A specific configuration for rating of the CDPR basic indoor cooling unit types as defined below and as shown in Appendix C.

3.19.1 *Ceiling Mounted Unit–ducted.* A Ceiling Mounted Unit with Ducted Discharge and Ducted Return. Ceiling Mounted Units with the option for ducted or non-ducted installation shall be rated as Ceiling Mounted Unit–ducted.

3.19.2 *Ceiling Mounted Unit–nonducted.* A Ceiling Mounted Unit with Free Air Discharge and Free Air Return. Ceiling Mounted Units with the option for ducted or non-ducted installation shall be rated as Ceiling Mounted Unit–ducted.

3.19.3 *Downflow Unit.* A Floor Mounted Downflow Raised Floor Plenum Discharge Unit with discharge air into a raised floor plenum and Free Air Return.

3.19.4 *Horizontal-flow Unit*. A Floor Mounted Horizontal-flow Free Air Discharge Unit with both Free Air Discharge and Free Air Return.

3.19.5 *Upflow Unit–ducted*. A Floor Mounted Upflow Ducted Discharge Unit with Ducted Discharge air and Free Air Return and does not have a factory-installed integral supply air grill or factory-installed supply air plenum.

3.19.6 *Upflow Unit–nonducted*. A Floor Mounted Upflow Free Air Discharge Unit with factory installed integral grill(s) or factory-installed supply air plenum and with both Free Air Discharge and Free Air Return. Floor Mounted Units with the option for ducted or non-ducted installation with a free discharge plenum shall be rated as ducted.

3.20 *Total Humidification Capacity*. The unit's total humidification output operating at Standard Rating Conditions (see Table 2). The mechanical cooling system is disabled to establish this rating.

Section 4. Classification

4.1 CDPR units within the scope of this standard shall be classified as shown in Table 1.

Table 1. Classification of Computer and Data Processing Room Air Conditioners

Designation	AHRI Type[1,2]	Arrangement – Indoor (ID)	Arrangement – Outdoor (OD)
Air-cooled Indoor Package with Remote Condenser	CSP-A[3] CSP-A-FC[3]	EVAP ID FAN COMP REHEAT[4] HUMIDIFIER[4]	COND FAN COND REFRIGERANT PUMP[4,5]
Air-cooled Indoor Package with Remote Condensing Unit	CRCU-A[3] CRCU-A-FC[3]	EVAP ID FAN REHEAT[4] HUMIDIFIER[4]	COND FAN COND COMP REFRIGERANT PUMP[4,5]
Air-cooled Indoor Package Self-Contained	CSPS-A[3] CSPS-A-FC[3]	EVAP ID FAN COND FAN COND COMP REHEAT[4] HUMIDIFIER[4] REFRIGERANT PUMP[4,5]	
Fluid-cooled Indoor Package (attached to customer fluid heat rejection)	CSP-W[3] CSP-W-FC[3]	EVAP ID FAN COMP[6] FLUID COND[6] REHEAT[4] HUMIDIFIER[4]	CUSTOMER COOLING TOWER OR DRY COOLER[7]
Indoor Fan Coil	CFC-C	COIL ID FAN REHEAT[4] HUMIDIFIER[4]	CUSTOMER CHILLER

Notes:

1. A suffix of "-O" following any of the above classifications indicates equipment not intended for use with field-installed duct systems.
2. A suffix of "-A" indicates air-cooled condenser, "-W" indicates water-cooled or glycol-cooled condenser, "-C" indicates indoor chilled-water coil, and “-FC” indicates free cooling coil (may be additional).
3. For a ducted indoor condenser/condensing unit, append “-DD” and outdoor arrangement moves from outdoor side to indoor side.
4. Optional component.
5. Refrigerant economizer pump may be indoors or outdoors and is only included in “-FC” units.
6. Component may be remote.
7. For "-W" products, outdoor arrangement can move from outdoor side to indoor side.

Section 5. Test Requirements

5.1 *Test Requirements.* All tests shall be conducted in accordance with ANSI/ASHRAE Standard 127 with revisions shown below. In addition, the test method for measuring total cooling capacity, sensible cooling capacity and electric energy use shall be based on ANSI/ASHRAE Standard 37, except as revised below or as revised by ANSI/ASHRAE Standard 127. Test measurements shall be within tolerances defined in ANSI/ASHRAE Standard 37 Table 2b.

5.1.1 *Horizontal-flow Free Air Discharge Unit.* For these systems, the discharge air test duct shall be 30 cm wider on each side and equal in height to the discharge opening of the unit under test. Transitions from one duct dimension to another duct dimension shall be 90°.

5.1.2 *Upflow Unit Test Duct.* For Upflow Units where there is limited height to meet the requirement in ANSI/ASHRAE Standard 37 in the test chamber, refer to Figure 1 for test duct requirements. Use defined static pressure values including 75 Pa external static pressure deduction from the intended test static pressure as prescribed by Table 4 (or static pressure intended by application test) as an allowance for the additional test duct elbow.

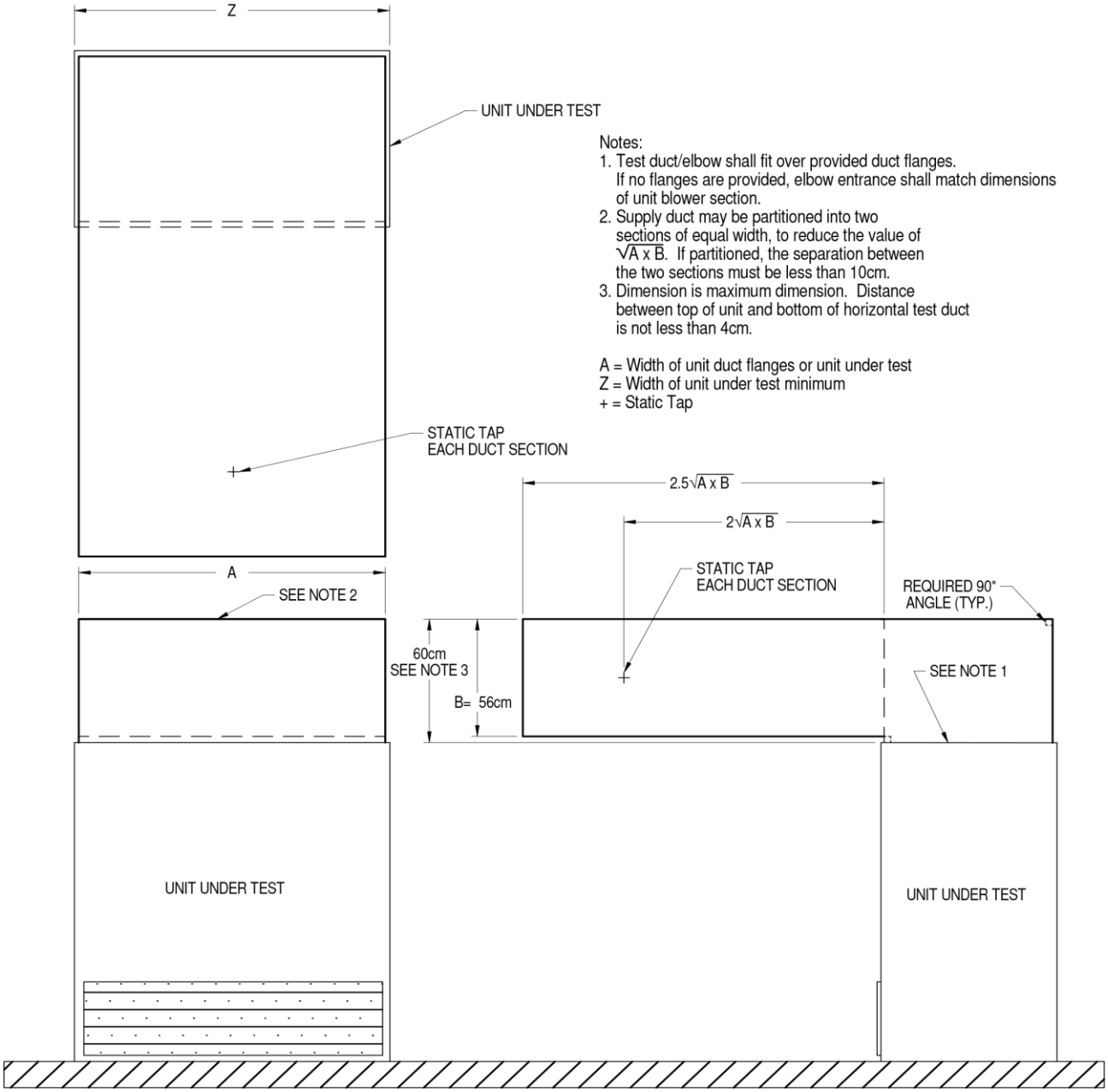


Figure 1. Limited Height Test Chamber Upflow Unit Test Duct

5.1.3 *Total System Power Measurement.* Total input system power, kW, shall be measured at the electrical source connection (e.g. main power circuit breaker(s), main power distribution block(s), main power disconnect(s)) of the CRAC or CRAH under test.

5.1.4 *Refrigerant Line Length for Split Systems*. All Standard Ratings for equipment in which the outdoor section is separated from the indoor section, shall be determined with at least 760 cm of interconnection tubing on each line of the size recommended by the manufacturer. Such equipment in which the interconnection tubing is furnished as an integral part of the machine not recommended for cutting to length shall be tested with the complete length of tubing furnished, or with 760 cm of tubing, whichever is greater. At least 150 cm of the interconnection tubing shall be exposed to the outside conditions. The line sizes, insulation, and details of installation shall be in accordance with the manufacturer's published recommendation.

5.1.5 *Humidification Capacity Test*. The Humidification Capacity measurement shall use air enthalpy method as prescribed in ANSI/ASHRAE Standard 37. The humidifier entering water conditions shall be referred from ANSI/AHRI Standard 640. Testing for Humidification Capacity shall be sampled at maximum of 5 minute intervals for a total of at least 13 readings in one hour.

5.1.6 *Ducted Indoor Condenser/Condensing Unit Test.* External static pressure measurements shall be made in accordance with Section 6.4 and Section 6.5 of ANSI/ASHRAE Standard 37.

5.1.7 *Water Valves.* Water cooled and chilled water units shall be tested with 2-way control valves.

5.1.8 *Unit Airflow Rate.* The airflow of the indoor unit shall be within 3% of the unit's rated air flow at the Standard Rating Conditions. If the unit is not able to operate at the airflow and static pressure Rating Conditions as setup in the test facility, the unit airflow shall be adjusted to operate at the rated static pressure conditions.

5.1.9 *Compressors in the Indoor Unit.* This type of unit shall be tested in accordance with ANSI/ASHRAE 37, Figure 1 (the airflow measurement apparatus may be part of the room conditioning apparatus). If the compressor is in the indoor unit airstream or within a compartment insulated from the conditioned space, superscript h in Table 1 of ASHRAE 37 does not apply.

5.1.10 *Primary Test Method.* The indoor air enthalpy method shall be used for all primary tests.

5.1.11 *Break In*. If an initial break in period is required to achieve performance, the break in period of an operating system shall not exceed 20 hours within the manufacturer defined operating limits of the unit. No testing shall commence until the manufacturer specified break-in period is completed.

5.1.12 *Refrigerant Charging.* All test samples shall be charged at Standard Rating Conditions (or conditions specified by the manufacturer in the installation instructions) in accordance with the manufacturer's installation instructions or labels applied to the unit.

Section 6. Rating Requirements

6.1 *Standard Ratings*. Standard Ratings shall be established at the Standard Rating Conditions specified in Tables 2 and 3. These Standard Rating Conditions are based on different design operating temperatures for different types of CDPR units. Where direct expansion equipment is provided in more than one assembly and the separate assemblies are to be used together, the requirements of rating outlined in this standard are based upon the use of matched assemblies.

Table 2. Indoor Return Air Temperature Standard Rating Conditions			
Mounting Location	**Standard Model**	**Cooling (Return Dry-bulb / Dew-point), ºC**	**Humidification (Return Dry-bulb / Dew-point), ºC**
Ceiling Mounted Unit	Ceiling Mounted Unit–ducted	24.0 / 11.0	24.0 / 5.6
	Ceiling Mounted Unit–nonducted		
Floor Mounted Unit	Upflow Unit–nonducted	24.0 / 11.0	
	Upflow Unit–ducted	29.5 / 11.0	
	Downflow Unit	29.5 / 11.0	
	Horizontal-flow Unit	35.0 / 11.0	

Table 3. Heat Rejection / Cooling Fluid Standard Rating Conditions[1]		
System Type	**Fluid Condition**	**Test Condition**
Air-cooled units	Entering outdoor ambient dry-bulb temperature, ºC	35.0
Water-cooled units (typically connected to a cooling tower)[2]	Entering water temperature, ºC	28.5
	Leaving water temperature, ºC	35.0
	Water flow rate, L/s	N/A
Glycol-cooled units (typically connected to a common glycol loop)[3]	Entering glycol temperature, ºC	40.0
	Leaving glycol temperature, ºC	46.0
	Glycol flow rate, L/s	N/A
	Glycol solution concentration	40% Propylene Glycol by Volume
Chilled-water units (typically connected to a common chilled water loop)[4]	Entering water temperature, ºC	10.0
	Leaving water temperature, ºC	16.5

Notes:
1. All ratings are at standard atmospheric pressure.
2. For the NSenCOP calculation, add allowance for cooling tower fan(s) and heat rejection loop water pump power input in kW to the unit total input in kW = 5% of the unit net sensible capacity.
3. For the NSenCOP calculation, add allowance for dry cooler fan(s) and heat rejection loop glycol pump power input in kW to the unit total input in kW = 7.5% of the unit net sensible capacity.
4. For the NSenCOP calculation, add allowance for chilled water pump power input in kW to unit total input in kW (See Equation 1 below).

The equation for pump power is as follows (See Note 4 in Table 3):

$$kW_{pump} = \dot{M} \cdot H \cdot SG / (A \cdot PE) \quad (1)$$

Where:

A = 1000 Conversion Factor, L/m^3
H = Pressure drop from the entrance to the exit of the unit, kPa
$\dot{M}$ = Flow rate, L/s
PE = 0.65 Pump Efficiency (65%)
SG = Specific gravity of fluid
kW_{pump} = Pump power input, kW

6.2 *Standard Capacity Ratings*. For each combination of Standard Model (Table 2) and system type (Table 3) a single capacity rating shall be established at the Standard Rating Conditions.

6.2.1 *Unit Airflow Rate.* Standard cooling system ratings shall be determined at a total standard airflow rate (cooling coil airflow rate plus humidifier bypass airflow rate as configured or designed) delivered against at least the minimum external static pressures required by Section 6.2.4.

Air conditioners shall be rated at those airflow rates specified by the manufacturer while at Standard Rating Conditions. Once these conditions are established for this standard rating test, no further adjustment to the airflow rate shall be made.

6.2.2 *Condenser Airflow Rate.* Standard Ratings for units that are air cooled shall be determined at zero external static pressure unless the unit is intended to be installed with the outdoor airflow ducted. Where the fan drive is non-adjustable, the Standard Ratings shall be determined at the condenser airflow rate that is inherent to the air conditioner when operated with all the resistance elements associated with the inlet or discharge attachments that the manufacturer considers normal installation practice. If fan speed control, or partial fan operation in a multi-fan condenser, is utilized for condensing temperature control, it shall be utilized in this test as defined by the manufacturer's installation instructions.

6.2.3 Cooling tests shall be conducted without operating the reheating, adiabatic or non-adiabatic humidification functions of the air conditioner.

6.2.4 *External Static Pressures*. Filters, filter plenum, and other equipment recommended as part of the unit shall be in place, and the external static pressure specified in Table 4 shall be used for the following systems with a tolerance of ±12 Pa for all equipment (averaged during the run time). Unit airflow rate is specified in Section 6.2.1.

Table 4. Minimum External Static Pressure Standard Rating Conditions

Mounting Location	Standard Model	Net Sensible Cooling Capacity, kW	External Static Pressure, Pa[1]
Ceiling Mounted Unit	Ceiling Mounted Unit–nonducted	All	0.0
	Ceiling Mounted Unit–ducted	< 8.5	25
		≥ 8.5 and < 19	50
		≥ 19	75
Floor Mounted Unit	Upflow Unit–nonducted	All	0.0
	Upflow Unit–ducted	< 19	75
		≥ 19 and < 70	100
		≥ 70	125
	Downflow Unit	All	50
	Horizontal-flow Unit	All	0.0

Notes:
1. For air-cooled units designed and marketed to be installed with the outdoor airflow ducted, the unit shall be installed with return and supply outdoor coil ductwork installed per manufacturer's installation instructions and shall operate at 125 Pa external static pressure.

6.3 *Standard Efficiency Ratings.*

6.3.1 *Net Sensible Coefficient of Performance Rating (NSenCOP).* NSenCOP shall be the efficiency rating metric.

For air-cooled units, include all the indoor unit power and air-cooled condenser/condensing unit power.

For water, glycol, and chilled water units include all the indoor unit power and include the power allowance for pump and heat rejection as described in the notes section in Table 3.

6.4 *Standard Humidification System Capacities.* Humidification Capacities shall be established (without the cooling system in operation) at the Standard Rating Conditions as specified in Tables 2 and 3.

6.4.1 *Unit Airflow Rate*. Airflow shall remain as specified in Section 6.2.1 unless it is automatically changed by the standard control(s) provided with the indoor unit.

6.4.2 *Water Quality*. The water quality, conductivity and dissolved solids for the test are stated in AHRI Standard 640.

6.5 *Air Filter Standard Ratings.* Published air filter Standard Ratings shall be those defined in ANSI/ASHRAE Standard 52.2. At any Rating Condition described by this standard, the system shall be rated with clean filters of the manufacturer's choice. Optional filter applications may also be shown based on tests or engineering calculations. For this standard, a minimum MERV 8 rated filter sized to match the unit / system filter rack shall be used. Exception: Free Air Discharge units shall be rated with a minimum MERV 1 rating.

6.6 *Voltage and Frequency*. Standard Ratings shall be determined at the unit nameplate rated voltages and frequency. For air conditioners with dual voltage ratings, Standard Rating tests shall be performed at both voltages or at the lower of the two voltages if only a single standard rating is to be published.

6.7 *Application Ratings.* Units may be rated at conditions other than those shown above and may be published as Application Ratings and shall be based on calculations or tests using techniques described by this standard, with the method used to create the Application Rating clearly stated.

6.8 *Verification Testing Uncertainty*. When verifying the ratings by testing a sample unit, there are uncertainties that must be considered. Verification tests, including tests conducted under the AHRI certification program shall be conducted in a laboratory that meets the requirements referenced in this standard and ASHRAE Standard 37 and must demonstrate performance with an allowance for uncertainty. The following make up the uncertainty for products covered by this standard.

6.8.1 *Uncertainty of Measurement*. When testing a unit, there are variations that result from instrumentation as well as measurements of temperatures, pressure, and flow rates.

6.8.2 *Uncertainty of Test Rooms*. The same unit tested in multiple rooms and due to setup variations is not expected to yield the same performance.

6.8.3 *Uncertainty due to Manufacturing*. During the manufacturing of units, there are variations due to manufacturing production tolerances that impact the performance of the unit.

6.8.4 *Uncertainty of Performance Simulation Tools*. Due to the large complexity of options, manufacturers shall use performance prediction tools like an alternative efficiency determination method (AEDM).

6.9 *Uncertainty Allowances*. To comply with this standard, verification tests shall meet the Published Ratings with an uncertainty allowance not greater than those shown in Table 5.

Table 5. Uncertainty Allowances

Performance Metric	Uncertainty Allowance	Acceptance Criteria
Net Sensible Cooling Capacity	5%	≥ 95%
NSenCOP	5%	≥ 95%

Section 7. Minimum Data Requirements for Published Ratings

7.1 *Minimum Data Requirements for Published Ratings.* As a minimum, Published Ratings shall include the published values shown in Table 6. Standard Models shall be rated at the appropriate Standard Rating Conditions for that Standard Model (per Tables C1 and C2).

All claims to ratings within the scope of this standard shall include the statement "Rated in accordance with AHRI Standard 1361 (SI)." All claims to ratings outside the scope of this standard shall include the statement "Outside the scope of AHRI Standard 1361 (SI)."

Table 6. Published Ratings[1]

Published Values	Units	Significant Figures	Air-Cooled Units	Water-Cooled Units	Glycol-Cooled Units	Chilled Water Units	Fluid Economizer Units
General							
Model Number		-	■	■	■	■	■
Refrigerant Designation		-	■	■	■		■
Voltage	V	3	■	■	■	■	■
Frequency	Hz	2	■	■	■	■	■
Capacity							
Net Total Cooling Capacity	kW	3	■	■	■	■	■
Net Sensible Cooling Capacity	kW	3	■	■	■	■	■
Total Humidification Capacity	kg/h	3	■	■	■	■	■
Efficiency							
Net Sensible Coefficient of Performance (NSenCOP)	kW/kW	3	■	■	■	■	■
Air							
Unit Airflow Rate	m^3/h of Standard Air	-	■	■	■	■	■
External Static Pressure	Pa	2	■	■	■	■	■
Indoor Return Dry-bulb Temperature	ºC	-	■	■	■	■	■
Indoor Return Dew point and/or Wet-bulb Temperature	ºC	-	■	■	■	■	■
Outdoor Ambient Dry-bulb Temperature	ºC	-	■				
Fluid							
Fluid Flow Rate	L/s	-		■	■	■	■
Fluid Pressure Drop	kPa	2		■	■	■	■
Entering Water or Glycol Temperature	ºC	-		■	■	■	■
Glycol Solution Type	-				■		
Glycol Solution Concentration	%	2			■		

Notes:

1. Published Ratings and final reported test values shall be rounded to the number of significant figures shown in this table.

Section 8. Operating Requirements

8.1 *Operating Requirements.* CDPR Equipment shall comply with the provisions of this section such that any production unit shall meet the requirements detailed herein.

8.2 *Loss of Power Restart Time (Cooling).* CDPR Equipment shall operate for a minimum of 1 hour at Standard Rating Conditions for the appropriate Standard Rating Condition. Then all power to the equipment shall be interrupted for a period sufficient to cause the compressor(s) to stop and then be restored. The equipment shall resume cooling, within 10 minutes of restoration of power and shall then operate continuously for one (1) hour. Standard condition tolerances are not required to be maintained for the initial period after the restart has occurred.

8.3 *Low Temperature Start (Cooling).* Air Cooled CDPR Equipment operating at indoor Standard Rating Conditions for the appropriate Standard Rating Condition shall have the indoor blower running and the compressors off. During this time, the condenser/condensing unit shall be subjected to a four (4) hour continuous exposure (soak) at 4.5 °C outdoor ambient with controls set per the manufacturer's instructions. On a call for cooling, equipment shall startup and resume normal compressor cooling within 30 minutes and operate for one (1) hour without further interruption. Standard condition tolerances are not required to be maintained for the initial period after the restart has occurred. If a manufacturer chooses to confirm equipment operation below 4.5 °C, the same process may be used.

8.4 *High Temperature Operation (Cooling).* Air Cooled CDPR indoor units can be matched with larger condenser coils (and fans) to allow the system to operate at elevated entering outdoor ambient dry-bulb temperatures. Testing shall verify that indoor units and condensers/condensing units designed to operate at 52 °C entering outdoor ambient dry-bulb temperature can operate at standard indoor Rating Conditions (see Table 2) for that Standard Model for 15 minutes. This test shall follow the test at Standard Rating Conditions test by raising the entering outdoor ambient dry-bulb temperature. Loss of power restart time test shall not be conducted during the high temperature operation (cooling) test.

Section 9. Marking and Nameplate Data

9.1 *Marking and Nameplate Data*. As a minimum, the following information shall be shown in a conspicuous place on the equipment:

9.1.1 Name or trade name of manufacturer
9.1.2 Manufacturer's model number

Nameplate voltages for 60 Hertz systems shall include one or more of the equipment nameplate voltage ratings shown in Table 1 of AHRI Standard 110. Nameplate voltages for 50 Hertz systems shall include one or more of the utilization voltages shown in Table 1 of IEC Standard 60038.

Section 10. Conformance

10.1 *Conformance.* While conformance with this standard is voluntary, conformance shall not be claimed or implied for products or equipment within the standard's *Purpose* (Section 1) and *Scope* (Section 2) unless such product claims meet all of the requirements of the standard and all of the testing and rating requirements are measured and reported in complete compliance with the standard. Any product that has not met all the requirements of the standard cannot reference, state, or acknowledge the standard in any written, oral, or electronic communication.

APPENDIX A. REFERENCES – NORMATIVE

A1 Listed here are all standards, handbooks, and other publications essential to the formation and implementation of the standard. All references in this appendix are considered part of the standard.

A1.1 AHRI Standard 110-2016, *Air-Conditioning, Heating, and Refrigerating Equipment Nameplate Voltages*, 2016, Air-Conditioning Heating & Refrigeration Institute, 2111 Wilson Blvd., Suite 500, Arlington, VA 22201, U.S.A.

A1.2 AHRI Standard 1230-2014 with Addendum 1, *Performance Rating of Variable Refrigerant Flow (VRF) Multi-split Air-conditioning and Heat Pump Equipment*, 2017, Air-Conditioning Heating & Refrigeration Institute, 2111 Wilson Blvd., Suite 500, Arlington, VA 22201, U.S.A.

A1.3 AHRI Standard 210/240-2017, *Performance Rating of Unitary Air-conditioning & Air-source Heat Pump Equipment*, 2017, Air-Conditioning Heating & Refrigeration Institute, 2111 Wilson Blvd., Suite 500, Arlington, VA 22201, U.S.A.

A1.4 AHRI Standard 340/360-2015, *Performance Rating of Commercial and Industrial Unitary Air-conditioning and Heat Pump Equipment*, 2015, Air-Conditioning Heating & Refrigeration Institute, 2111 Wilson Blvd., Suite 500, Arlington, VA 22201, U.S.A.

A1.5 AHRI Standard 640-2017, *Performance Rating of Commercial and Industrial Humidifiers*, 2017, Air-Conditioning Heating & Refrigeration Institute, 2111 Wilson Blvd., Suite 500, Arlington, VA 22201, U.S.A.

A1.6 ANSI/ASHRAE Standard 127-2012, *Method of Testing Method of Testing for Rating Computer and Data Processing Room Unitary Air Conditioners*, 2012, American Society of Heating, Refrigerating and Air-Conditioning Engineers, 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.

A1.7 ANSI/ASHRAE Standard 37-2009, *Method for Testing and Rating Unitary Air-Conditioning and Heat Pump Equipment*, 2009, American Society of Heating, Refrigerating and Air-Conditioning Engineers, 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.

A1.8 ANSI/ASHRAE Standard 52.2-2017, *Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size*, 2017, American Society of Heating, Refrigerating and Air-Conditioning Engineers, 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.

A1.9 ANSI/ASTM Standard B117-2016, *Standard Practice for Operating Salt Spray (Fog) Apparatus*, ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959, U.S.A.

A1.10 ANSI/ASTM Standard G85-2011, *Standard Practice for Operating Salt Spray (Fog) Testing*, ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959, U.S.A.

A1.11 ANSI/UL Standard 555-2006, *Standard for Fire Dampers*, Underwriters Laboratories, 333 Pfingsten Road Northbrook, IL 60062-2096 U.S.A.

A1.12 ANSI/UL Standard 555S-2014, *Standard for Smoke Dampers*, Underwriters Laboratories, 333 Pfingsten Road Northbrook, IL 60062-2096 U.S.A.

A1.13 ASHRAE Terminology, https://www.ashrae.org/resources--publications/free-resources/ashrae-terminology, 2017, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, N.E., Atlanta, GA 30329, U.S.A

A1.14 IEC Standard 60038-2009, *IEC Standard Voltages*, 2009, International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland.

APPENDIX B. REFERENCES – INFORMATIVE

B1 Listed here are standards, handbooks and other publications which may provide useful information and background but are not considered essential. References in this appendix are not considered part of the standard.

B1.1 ASHRAE DATACOM Series Book #3, *Design Considerations for Datacom Equipment Centers*. American Society of Heating, Refrigerating and Air-Conditioning Engineers, 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A

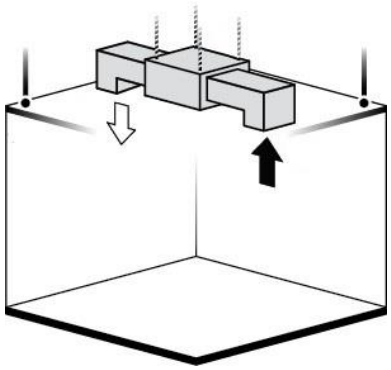
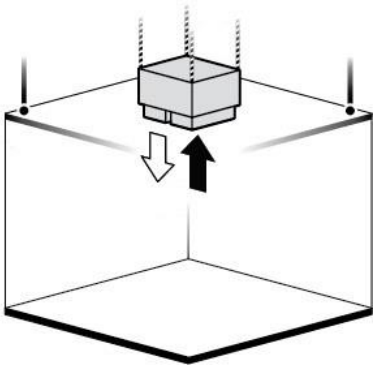
B1.2 ASHRAE 2015 HVAC Applications. American Society of Heating, Refrigerating and Air-Conditioning Engineers, 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A

APPENDIX C. STANDARD MODELS – NORMATIVE

C1 *Purpose.* The purpose of this appendix is to prescribe the requirements for the configuration of a unit (Standard Model) that is used for determining the Standard Rating. See Section 3 for definitions of Standard Models. All units, regardless of alternate possible configurations, shall be categorized and rated as one of the six (6) Standard Models.

C2 *Standard Model Airflow Configurations.* As shown in Section 3, CDPR may have a variety of mounting and airflow configurations which allow operation across a variety of applications. Tables C1 and C2 show the airflow configurations of the six (6) Standard Models defined by this standard. All other CDPRs within the scope of this Standard (Application Configurations), can be a combination of one Direction and two Connections (one Discharge from Unit and one Return to Unit).

Table C1. Ceiling Mounted Standard Model Airflow Configurations[1]

Connection	Type	Pictorial representations of Ceiling Mounted Standard Models are shown in Figures C1.1 and C1.2.
Ducted Discharge and Ducted Return	**Ceiling Mounted Unit–ducted Standard Model**	**Figure C1.1. Ceiling Mounted Unit–ducted** 
Ducted Discharge and Free Air Return	Application Configuration[2]	
Free Air Discharge and Ducted Return	Application Configuration[2]	**Figure C1.2. Ceiling Mounted Unit–nonducted[3]** 
Free Air Discharge and Free Air Return	**Ceiling Mounted Unit–nonducted Standard Model**	

Notes:
1. The bolded texts in this table represent the Standard Model.
2. Application Configuration shall be rated as a Ceiling Mounted Unit–ducted Standard Model.
3. Connections pictured below unit are not ductwork, and represent free air supply and return plenums / grills that may protrude below the ceiling.

Table C2. Floor Mounted Standard Model Airflow Configurations[1,2]

Connection	Air Flow Direction		
	Downflow	Horizontal-flow	Upflow
Raised Floor Plenum Discharge and Ducted Return	Application Configuration[3]	N/A	N/A
Raised Floor Plenum Discharge and Free Air Return	**Downflow Unit Standard Model**	N/A	N/A
Ducted Discharge and Raised Floor Plenum Return	N/A	N/A	Application Configuration[5]
Ducted Discharge and Ducted Return	Application Configuration[3]	Application Configuration[4]	Application Configuration[5]
Ducted Discharge and Free Air Return	Application Configuration[3]	Application Configuration[4]	**Upflow Unit–ducted Standard Model**
Free Air Discharge and Raised Floor Plenum Return	N/A	Application Configuration[4]	Application Configuration[5]
Free Air Discharge and Ducted Return	Application Configuration[3]	Application Configuration[4]	Application Configuration[5]
Free Air Discharge and Free Air Return	Application Configuration[3]	**Horizontal-flow Unit Standard Model**	**Upflow Unit–nonducted Standard Model**

Notes:
1. N/A = Not Applicable.
2. The bolded texts in this table represent the Standard Model.
3. Application Configuration shall be rated as a Downflow Unit Standard Model.
4. Application Configuration shall be rated as a Horizontal-flow Unit Standard Model.
5. Application Configuration shall be rated as an Upflow Unit–Ducted Standard Model.

Pictorial representations of Floor Mounted Standard Models are shown in Figures C2.1, C2.2, and C2.3.

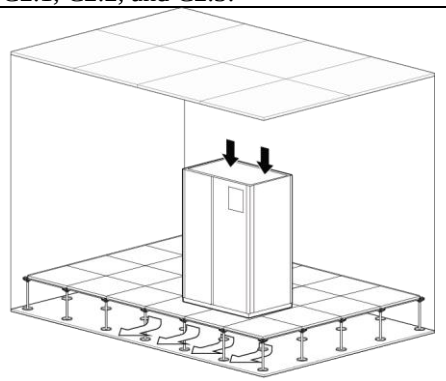


Figure C2.1. Downflow Unit

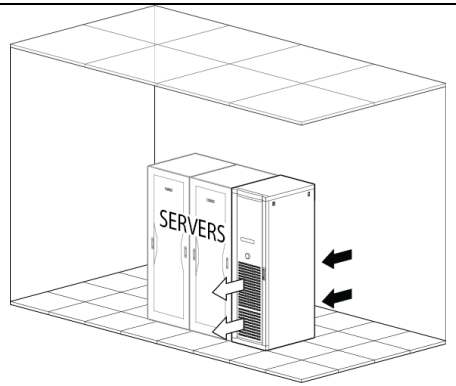


Figure C2.2. Horizontal-flow Unit

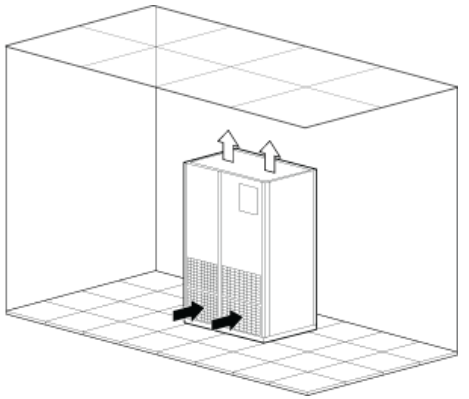


Figure C2.3. Upflow Unit–Ducted or Upflow Unit–nonducted

C3 *Standard Model Design Features Excluded from Testing*. CDPR have a variety of design options which may include capabilities for higher external statics due to the ductwork design, enhanced dehumidification capabilities due to local weather conditions, and features for overall annual efficiency improvement like economizers, energy recovery, evaporative cooling, ventilation air requirements, and enhanced IAQ features and filtration. Standards such as ANSI/ASHRAE Standard 90.1 include performance allowances and prescriptive requirements for many of these features. Standard Ratings shall be determined and tested without the following features unless that feature is not optional.

C3.1 *Non-standard Fans*. Units may have fans and drives that can be configured for non-standard rating airflows and static pressures. Standard Ratings shall be determined and tested with the motor, fan, and drive that would be selected based on product catalogs for the rating Standard Airflow and external static pressure as defined in Section 6.2.4.

C3.2 *Non-standard Compressors*. Non-standard units may have compressors not found in a manufacturers standard product literature for that unit. Such compressors may be selected to meet customer unique cooling capacity, dehumidification or electrical requirements.

C3.3 *Air Cooled DX Dual Cooling Coil*. A secondary fluid coil added in the air stream of an air cooled DX system for use as the primary or secondary cooling circuit in conjunction with a separate chiller or dry cooler or cooling tower for economization and/or redundancy.

C3.4 *Economizers.* Air economizers are used to provide cooling during reduced ambient conditions. They are used as a function of regional ambient conditions.

C3.5 *Energy Recovery and Storage*. Energy recovery and storage devices recover energy from an external source such as exhaust air and provide significant annualized energy efficiency improvements depending on the regional ambient and building operating load conditions.

C3.6 *Indirect/Direct Evaporative Cooling of Ventilation Air*. Water is used indirectly or directly to cool ventilation air. In dry climates, the water is evaporated to pre-cool the ventilation air. In a direct system the water is introduced directly into the ventilation air and in an indirect system the water is evaporated in secondary air stream and the heat is removed through a heat exchanger. This feature has limited applicability at the Standard Rating Conditions and is intended for dry climates where significant performance improvements are obtained

C3.7 *Evaporative Pre-cooling of Condenser Intake Air*. Water is evaporated into the air entering the air cooled condenser to lower the dry bulb temperature and thereby increase efficiency of the refrigeration cycle. This feature has limited applicability at the Standard Rating Conditions.

C3.8 *Desiccant Dehumidification Components*. An assembly that reduces the moisture content of the Supply Air through moisture transfer with solid or liquid desiccants.

C3.9 *Low Ambient Refrigerant Pressure Controls*. An assembly used to allow for unit operation at lower outdoor ambient temperatures than the standard operating control system.

C3.10 *Humidifiers*. An assembly that adds moisture to the air after the cooling coil such as an isothermal or adiabatic humidification device.

C3.11 *Steam or Hot Water Hydronic Heat Coils*. Heat exchanger coils and controls that are located downstream of the cooling coil that may heat the air using building steam or hot water during the dehumidification process.

C3.12 *Hot Gas Reheat Coils*. Heat exchanger coils and controls located downstream of the cooling coil that may heat the air using high pressure refrigerant during the dehumidification process.

C3.13 *Electric Reheat Elements*. Electric reheat elements and controls that are located downstream of the cooling coil that may heat the air using electrical power during the dehumidification process.

C3.14 *Powered Exhaust/Powered Return Air Fans*. A powered exhaust fan is a fan that transfers directly to the outside a portion of the building air that is returning to the unit, rather than allowing it to recirculate to the indoor coil and back to the building. A powered return fan is a fan that draws building air into the equipment.

C3.15 *Coated Coils*. An indoor coil or outdoor coil whose entire surface, including the entire surface of both fins and tubes, is covered with a thin continuous non-porous coating to reduce corrosion. A coating for this purpose will be defined based on what is deemed to pass ANSI/ASTM Standard B117 or ANSI/ASTM Standard G85 test of 500 hours or more.

C3.16 *Power Correction Capacitors*. A capacitor that increases the power factor measured at the line connection to the equipment. These devices are a requirement of the power distribution system supplying the unit.

C3.17 *Harmonic Distortion Mitigation Devices*. A high voltage device that reduces harmonic distortion measured at the line connection of the equipment that is created by electronic equipment in the unit. These devices can be a requirement of the power distribution system supplying the unit.

C3.18 *Automatic Transfer Switch*. A device that automatically switches from an A to a B electrical feed.

C3.19 *Non-standard Short Circuit Current Electric Panel*. A non-standard electrical panel (including an integrated or remote disconnect) to meet a higher short circuit rating.

C3.20 *Non-standard Power Transformer*. A device applied to a high voltage load that transforms input electrical voltage to that voltage necessary to operate the load.

C3.21 *Condensate Pump.* A device used to pump condensate and/or humidifier drain water from inside the unit to a customer drain outside the unit.

C3.22 *Non-standard Control Valves/Components*. A pressure or electromechanical water or refrigerant control valve or component used to control unit operation to meet customer specific requirements (such as a 3-way valve).

C3.23 *Non-standard Parts*. Special order parts unique to the unit model to meet customer specific requirements.

C3.24 *Hail Guards*. A grille or similar structure mounted to the outside of the unit covering the outdoor coil to protect the coil from hail, flying debris and damage from large objects.

C3.25 *Indoor Fan VFD.* A device connected electrically between the equipment's power supply connection and the indoor fan motor that can vary the frequency of power supplied to the motor in order to allow variation of the motor's rotational speed for convenience of quickly setting up the constant air flow

C3.26 *Compressor VFD*. A device connected electrically between the equipment's power supply connection and the compressor that can vary the frequency of power supplied to the compressor in order to allow variation of the compressor's rotational speed for capacity control.

C3.27 *Ducted Condenser Blowers*. A condenser fan/motor assembly designed for optional external ducting of condenser air that provides greater pressure rise and has a higher rated motor horsepower than the condenser fan provided as a standard component with the equipment.

C3.28 *Sound Traps/Sound Attenuators*. An assembly of structures through which the Supply Air passes before leaving the equipment or through which the return air from the building passes immediately after entering the equipment for which the sound insertion loss is at least 6 dB for the 125 Hz octave band frequency range.

C3.29 *Fire/Smoke/Isolation Dampers*. A damper assembly including means to open and close the damper mounted at the supply or return duct opening of the equipment. Such a damper may be rated by an appropriate test laboratory according to the appropriate safety standard, such as UL Standard 555 or UL Standard 555S.

C3.30 *Fire/Smoke Detectors*. A device installed in the unit that sense the presence of high temperature or smoke.

C3.31 *Hot Gas Bypass*. A method for adjusting cooling capacity that diverts a portion of the high pressure, hot gas refrigerant from the outdoor coil and delivers it to the low pressure portion of the refrigerant system.

C3.32 *Dampers.* An assembly used to control airflow including backdraft, outside air, and barometric pressure.

APPENDIX D. INTEGRATED NET SENSIBLE COP RATING - INFORMATIVE

D1 *Purpose.* The purpose of this appendix is to define the Integrated Net Sensible COP (iNSenCOP) rating. A long term goal is for iNSenCOP to replace NSenCOP after a more readily testable means has been standardized.

D2 *Background.* Data Centers require CDPR to operate over a wide range of outdoor ambient conditions while providing cooling for ITE that is independent of outdoor temperature conditions, therefore these units are specifically designed to provide continuous year round cooling at a constant indoor cooling load. The iNSenCOP rating allows for a single standardized value to simplify unit to unit year round cooling energy efficiency comparisons.

D3 *Test Limitations.* The B, C, and D tests in Table D1 are required to operate at the Standard Rating Condition (see Tables 2 and 3) cooling load, because the data center cooling load is constant year round. Since the compressor is oversized and economization means may be included for the B, C, and D tests, it should be understood that it could be difficult to maintain test conditions within the tolerances of the current test method.

D4 *Calculation.* iNSenCOP is calculated based on the NSenCOP ratings from Standard Rating Conditions (Tests A) and Reduced Ambient Rating Conditions (Tests B, C, and D). A weighted average of each of these ratings is used based on the normalized values of A = 13.4%, B = 27.1%, C = 38.1%, and D = 21.5%.

$$\begin{aligned} \text{iNSenCOP} = {} & (C_1 \cdot \text{Test A NSenCOP}) + (C_2 \cdot \text{Test B NSenCOP}) + \\ & (C_3 \cdot \text{Test C NSenCOP}) + (C_4 \cdot \text{Test D NSenCOP}) \end{aligned} \quad \text{D1}$$

Where:

C_1 = 0.134
C_2 = 0.271
C_3 = 0.381
C_4 = 0.215
iNSenCOP = Integrated Sensible Coefficient of Performance
NSenCOP = Net Sensible Coefficient of Performance

Standard Rating Conditions (Test A) are shown in Tables 2 and 3. Reduced ambient ratings (Tests B, C, and D) are shown in Table D1 on the following page. Refer to Section 6 for additional rating requirements not defined in this Appendix.

Table D1. Cooling Fluid Reduced Ambient Rating Conditions[1,2]				
Cooling Fluid	**Fluid Condition**	**Reduced Ambient Rating Condition Tests**		
		B	**C**	**D**
Air-cooled units	Entering outdoor ambient dry-bulb temperature, ºC	26.5	18.5	4.5
Water-cooled units (typically connected to a cooling tower)	Entering water temperature, ºC	21.0	13.0	7.0
	Leaving water temperature, ºC	N/A		
	Water flow rate, L/s	Max = Test A[3]		
Glycol-cooled units (typically connected to a common glycol loop)	Entering glycol temperature, ºC	29.5	18.5	1.5
	Leaving glycol temperature, ºC	N/A		
	Glycol flow rate, L/s	Max = Test A[3]		
	Glycol solution concentration	40% Propylene Glycol by Volume		
Chilled-water units (typically connected to a common chilled water loop)	Entering water temperature, ºC	10.0		
	Leaving water temperature, ºC	16.5		

Notes:
1. All ratings are at standard atmospheric pressure.
2. Include pumping power allowance shown in Notes 2, 3, and 4 of Table 3.
3. Test setup is as in Standard Rating Conditions (Test A), but the head pressure control may lower the flow rate.