AHRI Standard 1365-2024 (SI/I-P)

Performance Rating of Commercial and Industrial Unitary Air-conditioning and Heat Pump Condensing Units

AIR-CONDITIONING, HEATING, & REFRIGERATION INSTITUTE

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ICS Codes: 3.120 and 27.080

Note:

This is a new standard; a prior version does not exist.

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Intent

This standard is intended for the guidance of the industry, including manufacturers, engineers, installers, contractors, and users.

Review and Amendment

This standard is subject to review and amendment as technology advances.

2024 Edition

This edition of AHRI Standard 1365, *Performance Rating of Commercial and Industrial Unitary Air-conditioning and Heat Pump Condensing Units*, was prepared by the AHRI 365 Standards Work Group and the Commercial Unitary Standards Technical Committee. The standard was approved by the Standards Committee on 5 December 2024.

Origin and Development of AHRI Standard 1365

The first edition of AHRI 1340 (SI/I-P) was published in December 2023 to introduce new metrics for commercial and industrial air-conditioners and heat pumps, IVEC, and IVHE. AHRI 1365-2024 (SI/I-P) was created to align the product metrics for split outdoor units greater than or equal to 135,000 Btu/h to be referenced in ASHRAE 90.1 and other efficiency standards.

AHRI Standard 1365-2024 (SI/I-P) does not replace AHRI 365-2009 (I-P) where IEER ratings are required. AHRI 1365-2024 (SI/I-P), to be effective at a later date, should be used for IVEC and IVHE ratings.

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Standards Work Group (SWG)-365 and 1365 Scope:

This standards work group is responsible for the revision of AHRI 365 and AHR 1365.

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Commercial Unitary Standards Technical Committee (STC) Scope:

The Commercial Unitary STC is responsible for the development and maintenance of AHRI standards and guidelines pertaining to Commercial & Industrial Unitary Air-conditioning and Heat Pump Equipment including split systems, remote condensing units, and packaged equipment.

Out of scope: Unitary Small Equipment, Packaged Terminal AC/HP, Furnaces, Variable Refrigerant Systems (VRF), Geothermal and Water Source HP, Single Package Vertical Unit (SPVU), Performance Rating of Zoning products, DX-Dedicated Outdoor Air System Units (DOAS) Demand response and smart grid interface

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PERFORMANCE RATING OF COMMERCIAL AND INDUSTRIAL UNITARY AIR-CONDITIONING AND HEAT PUMP CONDENSING UNITS

Section 1. Purpose

This standard establishes definitions, classifications, test requirements, rating requirements, minimum data requirements for *published ratings*, operating requirements, marking and nameplate data, and conformance conditions that include the cooling *IVEC* annualized metric and full load *EER2* metric and heat pump *IVHE* and $IVEC_C$ annualized efficiency metrics and full load $COP2_H$ at 47°F (8.3°C), 17°F (-8.3°C), and 5°F (-15°C) for commercial and industrial unitary air-conditioning and heat pump split condensing units.

Section 2. Scope

2.1 Scope

This standard applies to factory-made commercial and industrial air cooled, water cooled and evaporatively cooled unitary air-conditioning and air source heat pump condensing units greater than or equal to 135,000 Btu/h as defined in Section 3.2.

This standard applies only to electrically operated, vapor compression refrigeration systems.

2.2 Exclusions

This standard does not apply to the following:

- Commercial and industrial unitary air-conditioning and heat pump equipment with a capacity less than or equal to 135,000 Btu/h (39.5 kW) and greater than or equal to 65,000 Btu/h (19 kW) as defined in AHRI 340/360 (I-P) and AHRI 1340 (I-P)

  Note: Condensing units with a capacity ≤135,000 Btu/h (39.5 kW) are rated as a matched system with fan coil or air handler.

- Air-cooled unitary air-conditioners and unitary heat pumps as defined in AHRI 210/240-2024 (I-P) and AHRI 1600 (I-P), with capacities less than 65,000 Btu/h (19 kW)
- Testing and rating of condensing units for refrigeration purposes, as defined in AHRI 520
- Testing and rating of condensing units for dedicated outdoor air systems, as defined in AHRI 920 (I-P) and AHRI 921 (SI) with Addendum 1
- Potable water heating equipment units covered by AHRI 1300 (I-P) and AHRI 1301 (SI)
- Water-source heat pumps as defined in AHRI 600 (I-P)
- Variable refrigerant flow air-conditioners and heat pumps as defined in AHRI 1230 (I-P)
- Rating of units equipped with desuperheater/water heating devices as defined in AHRI 470
- Units with adiabatically pre-cooled condensers

2.3 Other Applicable Standards

Commercial and industrial unitary air-conditioning and heat pump outdoor condensing units can be rated using AHRI 365 (SI/I-P).

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Section 3. Definitions

All terms in this document shall follow the standard industry definitions in the ASHRAE Terminology website unless otherwise defined in this section.

3.1 Expression of Provisions

Terms that provide clear distinctions between requirements, recommendations, permissions, options, and capabilities.

3.1.1 "Can" or "cannot"

Express an option or capability.

3.1.2 "May"

Signifies a permission expressed by the document.

3.1.3 "Must"

Indication of unavoidable situations and does not mean that an external constraint referred to is a requirement of the document.

3.1.4 "Shall" or "shall not"

Indication of mandatory requirements to strictly conform to the standard and where deviation is not permitted.

3.1.5 "Should" or "should not"

Indication of recommendations rather than requirements. In the negative form, a recommendation is the expression of potential choices or courses of action that is not preferred but not prohibited.

3.2 Standard-specific Definitions

3.2.1 Air Sampling Device

A combination of *air sampling tree(s)*, conduit, fan and *aspirating psychrometer* or *dew-point hygrometer* used to determine dry-bulb temperature and moisture content of an air sample from critical locations.

3.2.1.1 Air Sampling Tree

An assembly consisting of a manifold with branch tubes with multiple sampling holes that draws an air sample from a critical location from the unit under test (such as indoor air inlet, indoor air outlet, outdoor air inlet).

3.2.1.2 Aspirating Psychrometer

An instrument used to determine the humidity of air by simultaneously measuring both the wet-bulb and dry-bulb temperatures. The difference between these temperatures is referred to as the wet-bulb depression

3.2.1.3 Dew-point Hygrometer

An instrument used to determine the humidity of air by detecting visible condensation of moisture on a cooled surface.

3.2.2 Auxiliary Heat

Electric, natural gas, propane, steam or hot water heat used to supplement or be used at low ambient to assist the capacity delivered by a vapor compression heat pump cycle.

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3.2.3 Basic Model

All systems within a single equipment class, as defined in 10 CFR Part 431, that have the same or comparably performing compressor(s), heat exchangers, and air moving system(s) that have a common nominal *cooling capacity*.

Note: This term is further described in Section D.2.1.

3.2.4 Commercial and Industrial Unitary Air-conditioning Condensing Unit

A factory-made assembly of refrigeration components designed to compress and liquefy a specific refrigerant that consists of one or more refrigerant compressors, refrigerant condensers such as air cooled, evaporatively cooled, or water cooled, or a combination thereof, condenser fans and motors where used, and factory-supplied accessories.

3.2.5 Commercial and Industrial Unitary Heat Pump Condensing Unit

Commercial unitary heat pump condensing unit that contains one or more factory-made assemblies, that include compressor(s), and an air-cooled outdoor coil(s), including means to provide a heating function.

3.2.6 Cooling Capacity (q_t)

The net capacity associated with the change in air enthalpy between the air entering the unit and the air leaving the unit that includes both the *latent* and *sensible capacities* expressed in Btu/h and includes the heat of circulation fan(s) and motor(s).

3.2.6.1 Latent Capacity (q_l)

Capacity associated with a change in humidity ratio, expressed in Btu/h.

3.2.6.2 Sensible Capacity (q_{sci})

Capacity associated with a change in dry-bulb temperature, expressed in Btu/h.

3.2.6.3 Standard Cooling Capacity ($q_{t,A}$)

Full load *cooling capacity* at *standard rating conditions* for a unit configured in accordance with Appendix E, and when tested in accordance with the requirements of Section 5 and Section 6, expressed in Btu/h.

Note: The measured capacity is gross capacity and the rating standard cooling capacity shall be net capacity including the added heat from the *indoor fan power allowance*.

3.2.7 Ducted Condensing Unit

An air-cooled air conditioner or heat pump condensing unit that has the following characteristics:

- The unit is intended for indoor installation with ducting of outdoor air from the building exterior to and from the unit. For example, the unit, or the unit's components, or both, are non-weatherized.
- If the unit is a horizontal unit, the complete unit has a maximum height of 35 in (89 cm) or the unit has components that do not exceed a maximum height of 35 in (89 cm).
- If the unit is a vertical unit, the complete split, connected, or assembled unit has components that do not exceed a maximum depth of 35 in (89 cm).
- The unit has a rated *cooling capacity* greater than or equal to 65,000 Btu/h (19 kW) and less than 300,000 Btu/h (88 kW).

  Note: See Section 5.16 for test requirements for externally ducted condensers.

3.2.8 Defrost

A mode of operation for an air source heat pump where the cycle is reversed to temporarily heat the outdoor coil to remove ice that has built up when the heat pump is heating.

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3.2.9 Drain Pan Heater

A heater that heats the drain pan to make certain that water shed from the outdoor coil during a *defrost* does not freeze.

Note: This definition is restated in Table 39.

3.2.10 Economizer

3.2.10.1 Air Economizer

An optional feature that brings in additional outside cool air to cool the building when ambient temperature and or humidity levels are lower than the return air conditions.

Note: This definition is restated in Table 38 and Table 39.

3.2.10.2 Integrating Economizing

A control mode where both the *economizer* and mechanical cooling are operated to satisfy the building load. The *economizer* is operated at maximum capacity and the mechanical cooling is used to supplement the *economizer* cooling.

3.2.11 Energy Efficiency Ratio 2 (EER2)

A ratio of the *cooling capacity* to power input as specified in Section 6.2.10.

3.2.12 Hail Guard

A grille or comparable 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.

Note: This definition is restated in Table 39.

3.2.13 Heating Capacity (q_H)

The capacity associated with the change in dry-bulb temperature expressed in Btu/h.

Note: The heating capacity measured during the test is gross heating capacity and the rated heating capacity shall be net heating capacity and include the heat due to the *indoor fan power allowance heat*.

3.2.13.1 Integrated Heating Capacity (q_{Hint})

The net average *heating capacity* including the impact of capacity degradation due to *defrost* of the outdoor coil, expressed in units of Btu/h.

3.2.13.2 Instantaneous Heating Capacity (q_{Hinst})

The net capacity before and degradation due to frost buildup on the condenser coil.

3.2.14 Heating Coefficient of Performance 2 ($COP2_H$)

A ratio of the *heating capacity* in watts to the power input values in watts, as calculated in Section 6.3.13.

3.2.15 Indoor Fan Power Allowance

A factor that enables the use of the *IVEC* and *IVHE* metrics to represent the power of the indoor fan. See Section 5.16.

3.2.16 Integrated Ventilation, Economizing, and Cooling Efficiency (IVEC)

Total annual *cooling capacity* divided by total annual energy including mechanical cooling, *economizer*, cooling mode ventilation fan energy and off mode control energy and crankcase heat energy for an average building and average climate zone as defined in Section 6.2 and expressed in Btu/Wh (W/W).

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3.2.17 Integrated Ventilation and Heating Efficiency (IVHE and IVHE$_C$)

Total annual *heating capacity* for a heat pump including vapor compression *heating capacity* and auxiliary *heating capacity* divided by total heating model energy including mechanical vapor compression heating, *auxiliary heat* energy, heating mode ventilation fan energy and heating mode control power, and *crankcase heat power* as defined in Section 6.3 and expressed in Btu/Wh (W/W). *IVHE$_C$* is for colder climates and uses a colder climate zone weighted average load profile and is based on ASHRAE 169 Climate Zones 5 to 8. Expressed in Btu/Wh (W/W).

3.2.18 Low-temperature Compressor Cut-in Temperature

The maximum outdoor dry-bulb temperature where the unit's internal controls prevent the heating operation of compressor(s) from starting due to the outdoor dry-bulb temperature being too low. Expressed in units of °F (°C).

Note: See Appendix G for method of test.

3.2.19 Low-temperature Compressor Cut-out Temperature

The maximum outdoor dry-bulb temperature where the unit's internal controls stop operating compressor(s) due to the outdoor dry-bulb temperature being too low. Expressed in units of °F (°C).

Note: See Appendix G for method of test.

3.2.20 Manufacturer Instructions

3.2.20.1 Manufacturer's Installation Instructions (MII)

Manufacturer's documents that come packaged with or appear in the labels applied to the unit(s), as specified in Section 5.3.1.

3.2.20.2 Supplemental Test Instructions (STI)

Additional instructions developed by the manufacturer and certified to the United States Department of Energy (DOE), as specified in Section 5.3.2.

3.2.20.3 Manufacturer-specified

Information provided by the manufacturer through *MII* or *STI*.

3.2.21 Makeup Water

The water supplied to an evaporative cooled condenser to compensate for the water evaporated and for use in control of cycles of concentration and blowdown rate.

3.2.22 Non-standard Ducted Condenser Fan

A higher-static condenser fan/motor assembly designed for 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.

Note: This definition is restated in Table 38.

3.2.23 Operating Levels

Is determined by the number of compressors operating, the modulation level of each operating compressor, and the indoor fan speed. The modulation level of a single compressor is determined by the speed, duty cycle, vapor injection setting, and state of any other operating parameters that affect the continuous capacity of the compressor at a single set of operating conditions.

3.2.23.1 Boost Heating Operating Level (B)

The *operating level* with the maximum capacity that is allowed by the controls at 17.0°F (-8.3°C) outdoor dry-bulb temperature, with a capacity at 17.0°F (-8.3°C) outdoor dry-bulb temperature that is greater than the capacity of the *high heating operating level* at 17.0°F (-8.3°C). See Section 6.3.6 for requirements.

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3.2.23.2 Boost 2 Heating Operating Level (B2)

An *operating level* allowed by the controls at 5.0°F (-15°C) outdoor dry-bulb temperature with a capacity at 5.0°F (-15°C) outdoor dry-bulb temperature that is greater than the capacity of the *boost heating operating level* at 5.0°F (-15°C) outdoor dry-bulb temperature and less than or equal to the maximum capacity allowed by the controls at 5.0°F(-15°C) outdoor dry-bulb temperature. See Section 6.3.6 for requirements.

Note: This is not used in the determination of *IVHE* and is intended to define the maximum *heating capacity* at 5.0 °F (-15 °C).

3.2.23.3 High Heating Operating Level (H)

The *operating level* with the maximum capacity that is allowed by the controls at 47.0°F (8.3°C) outdoor dry-bulb temperature. See Section 6.3.6 for requirements.

3.2.23.4 Low Heating Operating Level (L)

The *operating level* with the minimum capacity that is allowed by the controls at 47.0°F (8.3°C) outdoor dry-bulb temperature. See Section 6.3.6 for requirements.

3.2.23.5 Medium Heating Operating Level (M)

An *operating level* allowed by the controls at 47.0°F (8.3°C) outdoor dry-bulb temperature with a capacity at 47.0°F (8.3°C) outdoor dry-bulb temperature that is greater than the capacity of the *low heating operating level* at 47.0°F (8.3°C) outdoor dry-bulb temperature and less than the capacity of the *high heating operating level* at 47.0°F (8.3°C) outdoor dry-bulb temperature. See Section 6.3.6 for requirements.

3.2.24 Power Correction Capacitor

A capacitor that increases the power factor measured at the line connection to the equipment.

Note: This definition is restated in Table 39.

3.2.25 Published Rating

A statement of the assigned values of those performance characteristics, under stated *rating conditions*, where a unit can be chosen to fit the application. These values apply to all units of the same nominal size and type (identification) produced by the same manufacturer. This 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*.

3.2.25.1 Application Rating

A rating based on tests performed at *rating conditions* other than *standard rating conditions*.

3.2.25.2 International Ratings

A rating based on tests performed at *international rating conditions* as listed in Table 41.

3.2.25.3 Standard Rating

A rating based on tests performed at *standard rating conditions*.

3.2.26 Rating Conditions

Any set of operating conditions where a single level of performance results and causes only that level of performance to occur.

3.2.26.1 International Rating Conditions

Rating conditions used as the basis of comparison for performance characteristics for products sold outside North America as defined in Table 41.

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3.2.26.2 Part Load Rating Conditions

Rating conditions used as the basis of calculating the *IVEC* and *IVHE* annualized efficiency metrics as defined in Table 7.

3.2.26.3 Standard Rating Conditions

Rating conditions used as the basis of comparison for performance characteristics as defined in Table 7.

3.2.27 Rating Power

Electrical power used to deliver capacity and during off modes of operation.

3.2.27.1 Crankcase Heat Power (P_{CCH})

The power used to keep the temperature of the compressor lubrication oil warm enough to prevent migration of the refrigerant to the oil when the compressor is off, expressed in W. See Section E.8 for requirements.

3.2.27.2 Compressor Power (P_C)

The power needed for all compressors, including any inverter losses, variable-speed drive losses, and auxiliary power required for compressor operation, expressed in W. This can include *crankcase heat power*. See Section E.8 for requirements.

3.2.27.3 Condenser Section Power (P_{CD})

The power needed for all fans, pumps, and other condenser section components, including any inverter or variable-speed drive losses, expressed in W. See Section E.8 for requirements.

3.2.27.4 Controls Power (P_{CT})

The power of all controls and all auxiliary loads that are not part of the *compressor power*, *condenser section power*, or *indoor fan power*, expressed in W. This can include *crankcase heat power*. See Section E.8 for requirements.

3.2.27.5 Indoor Fan Power (P_{IF})

The power needed for the fans, motors, belt drives, and variable-speed drive losses for all indoor fans, expressed in W. See Section E.8 for requirements.

Note: For condensing units, a required indoor fan power allowance is used as calculated by Equation 1.

3.2.28 Split System

Any commercial and industrial unitary air-conditioning system or commercial and industrial unitary heat pump system that has one or more of the major assemblies separated from the others.

3.2.29 Standard Energy Efficiency Ratio (EER2)

A ratio of the capacity to power input value obtained at *standard rating conditions*.

3.2.30 Standard Air

Air having a mass density of 0.075 lb (0.034 kg) of dry air per ft^3 (1.201 kg/m^3).

3.2.31 Ventilation Air

The minimum amount of outdoor air required for the purpose of controlling air contaminant levels in buildings.

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Section 4. Classifications

Commercial and industrial unitary condensing unit air-conditioning and heat pump equipment within the scope of this standard shall be classified as shown in Table 1.

Table 1 Classification of Commercial and Industrial Unitary Air-conditioning Condensing Unit Equipment

Designation	AHRI Type	Condenser Type	Arrangement
Remote condensing unit	RCU-A	Air	COMPRESSOR CONDENSOR
	RCU-E	Evaporatively	
	RCU-W	Water	
Heat pump remote condensing unit	HRCU-A	Air	COMPRESSOR CONDENSOR

Section 5. Test Requirements

5.1 Summary

All *standard ratings* shall be in accordance with the test methods and procedures as described in this standard and the appendices.

Units shall be tested in accordance with ASHRAE 37 and ASHRAE 30 as amended by this section and Appendix E.

5.2 Optional System Features

Use Appendix D to determine the optional system features to be included during the tests and the settings for each optional system feature during the tests.

5.3 Instructions

5.3.1 Manufacturer's Installation Instructions (MII)

Units shall be installed in accordance with the *MII*, as defined in Section 3.2.20.1. Online manuals can be used if referenced on the unit label or in the documents that come packaged with the unit.

All references to "manufacturer's instructions," "manufacturer's published instructions," "manufacturer's published recommendations," "manufacturer installation and operation manuals," "installation instructions" and other referenced information from the manufacturer means *MII*.

The *MII* include certification reports provided to regulatory bodies by the manufacturer. The *MII* certified parameters in the *MII* certification reports shall not deviate from the *MII*.

5.3.2 Supplemental Test Instructions (STI)

STI are defined in Section 3.2.20.2 and shall include both:

1) all instructions that do not deviate from *MII* but provide additional specifications for test standard requirements that can have more than one option
2) all deviations from *MII* necessary to comply with steady state requirements

STI shall provide steady operation that matches to the extent achievable the average performance that can be obtained without deviating from the *MII*. *STI* shall not include instructions that deviate from *MII* other than those described in Section 5.3.2(2).

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5.3.3 Conflicting Instructions

In the event of conflicting instructions regarding the set-up of the unit under test, excluding charging instructions for condensing units described in Section 5.3.4, priority shall be given to installation instructions that appear on the unit's label over installation instructions that are shipped with the unit.

5.3.4 Instructions for Condensing Units

In the event of conflicting charging instructions for condensing units, priority shall be given to the installation instructions that are shipped with the unit over the installation instructions that appear on the unit's label.

5.4 Break-in

Conduct a compressor break-in period prior to conducting the test if there is a *manufacturer-specified* break-in period. Conduct the break-in period using the *manufacturer-specified* duration and conditions; however, the duration shall not exceed twenty hours and the outdoor temperature shall not exceed 115°F (46.1°C). When there is a *manufacturer-specified* break-in period, each compressor of the unit shall undergo this break-in period. Testing shall not commence until the *manufacturer-specified* break-in period is completed.

5.5 Defrost Controls

Defrost controls shall be left at manufacturer's factory settings if the *MII* provided with the equipment do not specify otherwise. To facilitate testing of any unit, the manufacturer shall provide information and any necessary hardware to manually initiate a *defrost* cycle.

5.6 Auxiliary Heat

Do not test with operation of *auxiliary heat* or any heating components other than the reverse cycle heat pump functionality.

5.7 Head Pressure Control

For units with condenser head pressure controls, the head pressure controls shall be enabled and operated in automatic mode. Set head pressure controls as specified by the *MII*. If there are not any such instructions, use the as-shipped setting. If this results in unstable operation, such as outside of the test tolerances specified in Section 5.19, and testing requirements cannot be met, then the procedures in Section E.6 shall be used.

5.8 Line Length for Condensing units

All *standard ratings* for condensing units where the condensing unit is separated from the indoor section shall be determined with at least 25 ft (7.6 m) of interconnection tubing on each line of the size specified in the *MII*.

Use the absolute minimum length of tubing necessary to physically connect the system, subject to the minimum specified length, but use not less than 25 ft (7.6 m). Such equipment where the interconnection tubing is furnished as an integral part of the machine and not intended to be cut to length in accordance with the *MII*, shall be tested with the complete length of tubing furnished, or with 25 ft (7.6 m) of tubing, whichever is greater. At least 10 ft (3.0 m) 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 *MII*.

If more than 25 ft (7.6 m) of tubing is used, the applicable *cooling capacity* correction factor in Table 2 shall be multiplied by the measured full load *cooling capacity* to determine the final full load *cooling capacity*. Do not use the *cooling capacity* correction factors when determining part-load *cooling capacity*.

Note: There is not any *heating capacity* correction for heat pumps.

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Table 2 Refrigerant Line Length Correction Factors

Tubing length (X) Beyond the Required 25 ft (7.6 m) of Tubing, ft (m)	*Cooling Capacity* Correction Factor
3.3 (1.0) < X ≤ 20 (6.1)	1.01
20 (6.1) < X ≤ 40 (12.2)	1.02
40 (12.2) < X ≤ 60 (18.3)	1.03

5.9 Simulated Indoor Fan Coil

Because this standard is only for rating the condensing unit a simulated indoor heat exchanger needs to be used. For ease of testing, this standard requires that a refrigerant to water heat exchanger and a water test loop be used following the testing procedure outlined in ASHRAE 30 for chiller water systems. The water loop shall have the capabilities for controlling the water temperature for cooling and heating to obtain the rating midpoint saturated suction or midpoint saturated condensing temperature.

Note: The test setup should include an external separately controlled subcooler heat exchanger that can be used to obtain the rating liquid temperature. See Appendix D for testing requirements.

5.10 Refrigerant Charging

5.10.1 Conditions and Criteria

For refrigerant charging use the test or operating conditions specified in the *MII* for charging. If the *MII* do not specify a test or operating conditions for charging or there are not any *MII*, charging shall be conducted at *standard rating conditions* in cooling mode. If the *MII* contains two sets of refrigerant charging criteria, one for field installation and one for lab testing, use the field installation criteria. Perform charging of refrigerant blends only with refrigerant in the liquid state.

5.10.2 Parameter Ranges

If the *MII* give a *manufacturer-specified* range for a charging parameter, for example, superheat, subcooling, or refrigerant pressure, the average of the range shall be used to determine the refrigerant charge.

5.10.3 No Manufacturer Instructions

If there are not any *MII* or the *MII* do not provide parameters and target values, or both, set superheat to a target value of 12°F (-11°C) for fixed orifice systems or set subcooling to a target value of 10°F (-12°C) for expansion valve systems.

5.10.4 Conflicting Information

In the event of conflicting information between charging instructions, use the instruction priority order indicated in Section 5.3. Conflicting information is defined as multiple *manufacturer-specified* conditions given for charge adjustment where all *manufacturer-specified* conditions cannot be met. If such instances of conflicting information occur within the highest-ranking set of instructions where refrigerant charging instructions are provided, follow the hierarchy in Table 3, for fixed orifice or expansion valve, as applicable, unless the manufacturer specifies a different priority in the outdoor unit installation instructions. Unless the *MII* specify a tighter charging tolerance, the tolerances specified in Table 3 shall be used.

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Table 3 Tolerances for Charging Hierarchy

Expansion Valve		
Priority	**Parameter**	**Tolerance**
1	Liquid Temperature	± 2.0°F (± 1.1°C)
2	High side pressure or saturation temperature	± 4.0 psi (± 27.5 kPa) or ± 1.0°F (± 0.59°C)
3	Low side pressure or saturation temperature	± 2.0 psi (± 13.8 kPa) or ± 0.8°F (± 0.44°C)
4	Approach temperature[1]	± 1.0°F (± 0.59°C)
5	Charge weight	± 1% of nominal charge or 2.0 oz (56 g), whichever is greater

Notes:

1. Approach temperature means the refrigerant liquid temperature at the outdoor liquid service port minus the outdoor ambient temperature.

5.10.4.1 Pressure Gauge on Liquid Line

Install a pressure gauge at the location of the service connections on the liquid line if charging is based on subcooling, or high side pressure or corresponding saturation or dew point temperature.

5.10.4.2 Pressure Gauge on Suction Line

Install a pressure gauge at the location of the service connection on the suction line if charging is based on superheat, or low side pressure or corresponding saturation or dew point temperature.

5.10.5 No Further Changes

The refrigerant charge obtained as described in this section shall then be used to conduct all tests used to determine performance. All tests shall run until completion without further modification. If measurements indicate that refrigerant charge has leaked during the test, repair the refrigerant leak, repeat any necessary set-up steps, and repeat all tests.

5.11 Test Unit Location

5.11.1 Air-Cooled and Evaporatively-Cooled Equipment

A condensing unit shall be located in the outdoor test room, meaning, the test chamber is maintained at the air conditions specified for outdoor ambient air, unless the condensing unit is designed and marketed for indoor installation, for example, a ducted condenser, then the indoor condensing unit shall be located in the indoor test room.

5.11.2 Water-Cooled Equipment

The unit, including both units for condensing units, shall be located in the indoor test room.

5.12 Voltage and Frequency

Standard rating tests shall be performed at the nameplate rated voltage(s) and frequency.

For air-conditioners and heat pumps with dual nameplate 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 published.

Operating requirements tests shall be performed at the voltage(s) and frequency(ies) specified for each operating requirements test in Section 8.

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5.13 Instrumentation

5.13.1 Induction Watt-hour Meter

When testing air conditioners and heat pumps having a variable speed drive, an induction watt-hour meter shall not be used.

5.13.2 Atmospheric Pressure

Atmospheric pressure measuring instruments shall be accurate to within ± 0.5% of the reading.

5.13.3 Electrical Frequency

Measurement devices used to measure electrical frequency shall be accurate to within ± 0.2 Hz.

5.14 Indoor Fan Power Allowance

5.14.1 Background

To support the use of the IVEC and IVHE rating an allowance shall be included for indoor fan power. The objective is to align with the values that can be used for products rated as matched systems in accordance with AHRI 1340. The *indoor fan power allowance* is based on an assumed operating airflow of 350 cfm/ton (724 L^3/h kW) at full load for the cooling A point and assumes variable air volume operation with 350 cfm/ton (724 L^3/h kW) at each of the part load rating capacities.

Note: The indoor fan power allowances shall be added to the measure cooling and heating capacity measured during the test which is gross capacity and all calculations shall be based on net capacity.

For the cooling IVEC rating the operation the fan speed has been assumed to reduce with the capacity down to the minimum rated capacity but not any lower. The lowest fan speed shall be used for the IVEC ventilation. The values to use are listed in Table 4.

For heat pump heating the indoor fan power allowance is assumed to be the full load cooling A point indoor fan power allowance and is assumed to be held constant for all IVEC heating ratings except for ventilation For heating ventilation the *indoor airflow power allowance* shall be the IVEC D test point indoor fan power allowance. The full load and part load indoor fan power allowance values are listed in Table 5.

The cooling IVEC power allowances are show in Table 4.

Table 4 IVEC Cooling Fan Power Allowance

Full Load Cooling A Point Capacity Btu/h (kW)	Full Load Cooling A Point *Indoor Fan Power Allowance* W/cfm (Wh/m^3)	Part Load *Indoor Fan Power Allowance* W/cfm (Wh/m^3)	Ventilation *Indoor Fan Power Allowance* W/cfm (Wh/m^3)
≥ 135,000 and < 280,000 (≥ 39.5 and < 82.0)	0.432(0.733)	See Equation 1	See Equation 1[1]
≥ 280,000 (≥ 82.0)	0.609 (1.034)	See Equation 1	See Equation 1[1]

Note:
1. Ventilation *fan power allowance* is determined using the lowest load percentage (LP) from the *IVEC* or *IVHE* test points but not less than 24% *ventilation air* based on 400 cfm/ton (827 L^3/h kW), or 27.4% at 350 cfm/ton (724 L^3/h kW).

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Table 5 IVHE Heat Pump Fan Power Allowance

Full Load Cooling A Point Capacity Btu/h (kW)	Full load *Indoor Fan Power Allowance* All Heating Test Points W/cfm (Wh/m^3)	Ventilation *Indoor Fan Power Allowance* W/cfm (Wh/m^3)
≥ 135,000 and < 280,000 (≥ 39.5 and < 82.0)	0.432 (0.733)	See Equation 1[1]
≥ 280,000 (≥ 82.0)	0.609 (1.034)	See Equation 1[1]

Note:

1. Ventilation *indoor fan power allowance* is determined using the lowest load percentage (LP) from the *IVEC* or *IVHE* test points but not less than 24% *ventilation air* based on 400 cfm/ton (827 L^3/h kW), or 27.4% at 350 cfm/ton (724 L^3/h kW).

5.14.2 Part Load Fan Power Allowance

For part load fan power allowance use the following Equation 1 as a function of the load percentage (LP) shown in Equation 5.

Note: The LP shown in Equation 5 should not be lower than the minimum rating LP that the unit is capable of running.

$$FP_X = FP_A \times (a \times LP^7 + b \times LP^6 + c \times LP^5 + d \times LP^4 + e \times LP^3 + f \times LP^2 + g \times LP + h) \quad \textbf{1}$$

Where:

FP_A	=	Part load fan power allowance (W/cfm)
LP	=	Load percentage as shown in Equation 5
A	=	Full load rating point
a	=	230.357 (135.583)
b	=	947.3889 (557.612)
c	=	-1604.35 (-944.285)
d	=	1443.171 (849.4183)
e	=	739.241 (-435.101)
f	=	214.9772 (126.5308)
g	=	-32.7921 (-19.3007)
h	=	2.20288 (1.296566)
x	=	Cooling rating point

5.15 Outdoor Airflow for Units with Free Air Discharge Condensers

All *standard ratings* shall be determined by the outdoor airflow obtained without condenser ducting. Where the fan drive is non-adjustable, the *standard ratings* shall be determined at the outdoor airflow inherent in the equipment. For adjustable speed fans, the outdoor fan speed shall be set as specified in the *MII* or as determined by automatic controls. Once established, changes affecting outdoor airflow shall not be made unless automatically adjusted by unit controls or adjusted to achieve stability as described in Section E.6.3 or Section E.6.4.

5.16 Outdoor Airflow and ESP for Units with Ducted Condensers

For ratings for applications with ducted condensers, the condensing units shall be rated with 0.5 in (0.12 kPa) condenser ESP using the provisions of Section 5.16.1.

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5.16.1 Rating Based on Non-zero Condenser ESP

5.16.1.1 Installation and Setup

Install the unit with outdoor coil ductwork and ESP measurements made in accordance with Section 6.4 and Section 6.5 of ASHRAE 37 and manufacturer's instructions as applicable. Set outdoor air ESP by symmetrically restricting the outlet of the outdoor air outlet duct downstream of the minimum duct length specified in Section 6.4.2.1 of ASHRAE 37, such as at least 2.5 times the mean geometric cross-sectional dimension from the equipment outlet.

5.16.1.2 Full-Load Cooling Test

If manufacturer's instructions provide guidance for setting outdoor airflow, for example, outdoor fan control settings, set the outdoor airflow in accordance with manufacturer's instructions, while maintaining the outdoor air ESP within - 0.00/+ 0.05 in H_2O (- 0.00/+ 0.012 kPa) of 0.5 in H_2O (0.12 kPa). If manufacturer's instructions do not provide guidance for setting outdoor airflow, test using the as-shipped outdoor fan setting while maintaining the outdoor air ESP within - 0.00/+ 0.05 in H_2O (- 0.00/+ 0.012 kPa) of 0.5 in H_2O (0.12 kPa). If the outdoor air ESP cannot be maintained within - 0.00/+ 0.05 in H_2O (- 0.00/+ 0.012 kPa) of 0.5 in H_2O (0.12 kPa) at the *manufacturer-specified* or as-shipped fan setting, as applicable, operate with a fan setting as close as achievable to the target fan setting, such as *manufacturer-specified* or as-shipped, so that the outdoor air ESP requirement is met.

5.16.1.3 Heating and Part Load Cooling Tests

Adjustment is not needed to change the outdoor air ESP for heating or part-load cooling tests. If *MII* specify outdoor fan settings for heating or part-load cooling tests or describe how to obtain steady-state heating or part-load cooling operation that results in an automatic adjustment to outdoor airflow, for example, using thermostat or other control system input, operate at the outdoor airflow resulting from using the *MII*.

5.16.2 Rating Based on Zero Condenser ESP

5.16.2.1 Installation and Setup

Install the unit with outdoor coil ductwork and ESP measurements made in accordance with Section 6.4 and Section 6.5 of ASHRAE 37 and manufacturer's instructions as applicable. The unit shall operate at 0.0 in H_2O (0.0 kPa) ESP with a condition tolerance of - 0.00/+ 0.05 in H_2O (- 0.00/+ 0.012 kPa). If manufacturer's instructions provide guidance for setting outdoor airflow, for example, outdoor fan control settings, set the outdoor airflow in accordance with manufacturer's instructions while maintaining the outdoor air ESP within - 0.00/+ 0.05 in H_2O (- 0.00/+ 0.012 kPa) of 0.0 in H_2O (0.0 kPa). If manufacturer's instructions do not provide any guidance for setting outdoor airflow, test using the as-shipped outdoor fan setting while maintaining the outdoor air ESP within -0.00/+ 0.05 in H_2O (- 0.00/+ 0.012 kPa) of 0.0 in H_2O (0.0 kPa). If the outdoor air ESP cannot be maintained within -0.00/+ 0.05 in H_2O (- 0.00/+ 0.012 kPa) of 0.0 in H_2O (0.0 kPa) at the *manufacturer-specified* or as-shipped fan setting, as applicable, operate with a fan setting as close as achievable to the target fan setting, such as *manufacturer-specified* or as-shipped, so that the outdoor air ESP requirement is met.

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5.16.2.2 Outdoor Air ESP Tolerance

The outdoor air ESP tolerance of - 0.00/+ 0.05 in H_2O (- 0.00/+ 0.012 kPa) is a condition tolerance that applies throughout the test. Specifically, the average value of the outdoor air ESP measured over the course of the test shall vary from the target value by not more than the condition tolerance. An operating tolerance for ESP is specified in Section 5.19.

5.17 Outdoor Air Water Vapor Content

Outdoor air water vapor content shall be controlled for the following tests.

For cooling tests of air-cooled equipment that use condensate obtained from the evaporator to enhance condenser cooling, and all evaporatively-cooled equipment, entering outdoor air shall be controlled to the wet-bulb temperature requirements in Table 7 and wet-bulb tolerances in Section 5.19.

For cooling tests of air-cooled single package units that do not reject condensate to the outdoor coil, and where all or part of the indoor section of the equipment is located in the outdoor chamber, entering outdoor air shall be controlled to the dew point temperature requirements in Table 7 and dew point tolerances in Section 5.19.

For heating tests of all air-source heat pumps, entering outdoor air shall be controlled to the wet-bulb temperature requirements in Table 22 and wet-bulb tolerances in Section 5.19.

For all other tests, there are not any requirements on outdoor air water vapor content.

5.18 Water Flow Rate for Water-cooled Condensing Units

For the full-load cooling test, set water flow rate to meet the required entering and leaving water temperatures.

Except as adjusted for operation at low condenser temperatures in accordance with Section E.6, for part-load cooling tests, use *manufacturer-specified* full-load water flow rates. For all part-load cooling tests, the water flow rate shall not exceed the water flow rate used for the full-load cooling test. If the *manufacturer-specified* part-load cooling water flow rate is higher than the water flow rate used for the cooling full-load test, use the water flow rate used for the cooling full-load test. If no *manufacturer-specified* value for part-load cooling water flow rate is provided, use the water flow rate used for the cooling full-load tests. If using a target water flow rate in part-load tests, the condition tolerance on water flow rate is 1% of the target water flow rate.

5.19 Test Tolerances

5.19.1 Order of Precedence

Tolerances specified in this standard supersede tolerances specified in ASHRAE 37.

5.19.2 Operating Tolerance

Test operating tolerance is the maximum permissible range that a measurement shall vary over the specified test interval. Specifically, the difference between the maximum and minimum sampled values shall be less than or equal to the specified test operating tolerance. If the operating tolerance is expressed as a percentage, the maximum permissible range is the specified percentage of the average value of the measured test parameter.

5.19.3 Condition Tolerance

Test condition tolerance is the maximum permissible difference between the average value of the measured test parameter and the specified test condition. If the condition tolerance is expressed as a percentage, the condition tolerance is the specified percentage of the test condition.

5.19.4 Table of Tolerances

Test operating tolerances and condition tolerances are specified in Table 6.

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5.19.5 Refrigerant Temperatures

Tolerances on saturated refrigerant temperature and liquid refrigerant temperature apply only for the compressor calibration and refrigerant enthalpy methods. The saturation temperature, in this case, shall be evaluated based on the pressure transducer located between the indoor coil and the compressor for the given operating mode, heating or cooling.

Table 6 Tolerances

Measurement	Test Operating Tolerance	Test Condition Tolerance
Outdoor dry-bulb temperature, °F (°C):		
Entering	2.0 (1.1)	0.5 (0.28)
Leaving	2.0/3.0 (1.1/1.67)[1,2]	—
Outdoor wet-bulb temperature, °F (°C):		
Entering	1.0 (0.56)	0.3 (0.17)[3]
Leaving	1.0 (0.56)[2]	—
Outdoor dew point temperature[4], °F (°C):		
Entering	—	3.0 (1.67)
Water serving water cooled condenser temperature, °F (°C):		
Entering	0.5 (0.28)	0.2 (0.11)
Leaving	0.5 (0.28)	0.2 (0.11)
Water serving water cooled condenser flow rate, when flow rate specified (percent)	2.0	1.0
Evaporative Condenser Makeup water temperature, °F (°C)	10.0 (5.5)	5.0 (2.8)
Midpoint Saturated refrigerant temperature[5], °F (°C):	3.0 (1.7)	0.5 (0.28)
Liquid refrigerant temperature[5], °F (°C):	0.5 (0.28)	0.2 (0.11)
Midpoint Saturated Condensing temperature, °F (°C):	3.0 (1.7)	0.5 (0.28)
Electrical voltage (percent of reading)	2.0	1.0
Electrical Frequency[6], Hz	0.4	0.2
Water flow rate (percent of reading)	2.0	See Section 5.18

Notes:
1. The test operating tolerance is 2.0°F (1.1°C) for cooling tests and 3.0°F (1.7°C) for heating tests.
2. Applies only when using the outdoor air enthalpy method.
3. Applicable for heating tests of air-cooled units and only applicable for cooling tests when testing evaporatively-cooled equipment or, air-cooled equipment that rejects condensate to the outdoor coil. See Section 5.17.
4. Applicable only when testing single package units that do not reject condensate to the outdoor coil where all or part of the indoor section of the equipment is located in the outdoor chamber. See Section 5.17.
5. See Section 5.19.5.
6. When using electrical generators, tolerances can be doubled.

Section 6. Rating Requirements

6.1 Standard Ratings

Use the requirements of Section 6 to determine all *standard ratings*. Perform all tests using the requirements of Section 5.

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6.1.1 Criteria for Standard Ratings

Standard ratings shall meet the following criteria:

- Standard cooling ratings shall be established at the standard rating conditions specified in Table 7 for North American ratings, or Appendix F for international ratings.
- Standard heat pump (HP) heating ratings shall be established at the standard rating conditions specified in Table 22.
- Standard ratings related to cooling or heating capacities shall be net values, including the effects of circulating fan heat.
- Standard ratings shall be based on the total power input. See Appendix D regarding features to be included and activated during the test. Power used for any override controls only used for laboratory testing shall not be included in total power.
- Standard ratings shall be based on 100% recirculated indoor air.

6.1.2 Standard Ratings Power

6.1.2.1 Full Load Ratings

Full load *EER2*, $COP2_H$, and ratings shall not include operation of any heating components other than the reverse cycle heat pump functionality. Control power and power losses of variable speed control devices shall be included in *standard ratings* as described in Section 5 and Section 6.

6.1.2.2 Annual Rating Metrics

Annual *IVEC* and *IVHE* efficiency metrics shall include the energy use of all electric energy using devices including compressors, condenser fans, indoor fans, controls, crankcase heat, and auxiliary electric heat. The *IVEC* cooling metric procedures are defined in Section 6.2. The *IVHE* heating metric procedures are defined in Section 6.3.

6.1.2.3 IVEC Ratings

IVEC shall include the annual energy applicable to all *commercial unitary air-conditioners* and *commercial unitary heat pumps*. This includes the rules for each of the components described in Section 6.1.2.3.1 through Section 6.1.2.3.5.

6.1.2.3.1 Compressor Power (P_C)

During all modes of cooling operation.

6.1.2.3.2 Condenser Section Power (P_{CD})

During all modes of cooling operation.

6.1.2.3.3 Indoor Fan Power Allowance (P_{IF})

Because this standard only applies to the condensing unit, an *indoor fan power allowance* during mechanical-only cooling, integrated *economizer* cooling, and *economizer*-only cooling and *indoor fan power* of air conditioners for all ventilation hours or *indoor fan power* of heat pumps for ventilation that occurs above the ambient changeover temperature of 49°F (9.4°C) shall be used based on Section 5.16.

6.1.2.3.4 Crankcase Heat and Control Power for All Cooling Only Units (P_{CCH} and P_{CT})

For units that are not heat pumps the crankcase heat power that is used during cooling, as well as all ventilation and periods without cooling include hours where there is heating.

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6.1.2.3.5 Crankcase Heat and Control Power for Heat Pumps (P_{CCH} and P_{CT})

IVEC includes the crankcase heat power during cooling and ventilation greater than the ambient changeover temperature of 49°F (9.4°C).

Note: *Crankcase heat power* at temperatures less than or equal to 49°F (9.4°C) is included in the *IVHE* heating metric.

6.1.2.4 IVHE Rating

The *IVHE* heating metric is applicable to all commercial unitary heat pumps.

The *IVHE* heat pump heating metric shall include all electric power described in Section 6.1.2.4.1 through Section 6.1.2.4.4.

6.1.2.4.1 Compressor Power (P_C)

During all modes of heating operation.

6.1.2.4.2 Condenser Section Power (P_{CD})

During all modes of heating operation.

6.1.2.4.3 Indoor Fan Power Allowance (P_{IF})

Because this standard only covers the condensing unit, an indoor fan power during heat pump heating operation and indoor fan power for ventilation that occurs at less than or equal to the ambient changeover temperature of 49°F (9.4°C). This shall be based on assuming the same cfm as cooling and the airflow during mechanical heat pump heating shall be assumed to be full load airflow based on a nominal 350 cfm/ton (724 L^3/h kW) using a fan power allowance as described in Section 5.16. For ventilation the lowest rated airflow from cooling shall be used to determine the fan power allowance.

6.1.2.4.4 Crankcase Heat and Control Power (P_{CCH} and P_{CT})

IVHE includes the *crankcase heat power* during heating and ventilation at or below the ambient changeover temperature of 49°F (9.4°C).

Note: Crankcase heat power at temperatures greater than 49°F (9.4°C) is included in the *IVEC* cooling metric.

Note: For all heat pumps, the *IVHE* heating metric includes calculated values of auxiliary electric heat in heating bins that have a load exceeding the capacity of the heat pump.

6.1.3 Standards Ratings for Water Cooled Equipment

Standard ratings for water cooled equipment shall be based on a fouling factor of 0.0000 h ft^2 °F/Btu (0.0000 m^2K/kW).

6.1.4 Standards Ratings for Ducted condenser Systems

Standard ratings for *double-duct systems* shall be established in accordance with Section 5.16.1.

6.2 Cooling Efficiency Metrics

For cooling efficiency, the full load *EER2* the *IVEC* shall be determined using the calculation procedures defined in Section 6.2.1.

The *EER2* is a full load efficiency based on the *standard ratings* conditions for Bin A as defined in Table 7 using the fan power allowance defined in Section 5.16.

Documents
Document Sharing Hub
Full document details: AHRI Standard 1365-2024 - Performance Rating of Commercial and Industrial Unitary Air-conditioning and Heat Pump Condensing Units