AHRI Standard 390 I-P (2021)

2021 Standard for

Performance Rating of Single Package Vertical Air-conditioners And Heat Pumps

AIR-CONDITIONING, HEATING, & REFRIGERATION INSTITUTE
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2311 Wilson Boulevard, Suite 400
Arlington, VA 22201, USA
www.ahrinet.org
PH 703.524.8800
FX 703.562.1942

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PERFORMANCE RATING OF SINGLE PACKAGE VERTICAL AIR-CONDITIONERS AND HEAT PUMPS

Section 1. Purpose

1.1 *Purpose.* The purpose of this standard is to establish, for Single Package Vertical Air-conditioners and Heat Pumps: definitions; classifications; test requirements; rating requirements; minimum data requirements for Published Ratings; operating requirements; marking and nameplate data; and conformance conditions.

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

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

Section 2. Scope

2.1 *Scope.* This standard applies to factory-assembled commercial or industrial Single Package Vertical Air-conditioner and Heat Pump equipment as defined in Section 3.

2.1.1 *Energy Source.* This standard applies to electrically operated, vapor-compression refrigeration systems.

2.1.2 *Installation.* The Single Package Vertical Air-conditioner and Heat Pump is intended for ducted or non-ducted installation with field or factory supplied grilles.

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

- Unitary air-conditioners and unitary heat pumps as defined in AHRI Standard 210/240 and AHRI Standard 340/360.
- Variable refrigerant flow multi-split air conditioners and heat pumps as defined in ANSI/AHRI Standard 1230.
- Unit Ventilators as defined in AHRI Standard 840.
- Computer and Data Processing Room Air-conditioners as defined in AHRI Standard 1360.
- Packaged Terminal Air-conditioners and heat pumps as defined in AHRI Standard 310/380.

Section 3. Definitions

All terms in this document shall follow the standard industry definitions in the current edition of *ASHRAE, Terminology,* https://www.ashrae.org/resources--publications/free-resources/ashrae-terminology, unless otherwise defined in this section.

3.1 *Coefficient of Performance (COP).* A ratio of Heating Capacity in watts to the power input values in watts at any given set of Rating Conditions, expressed in W/W.

3.2 *Cooling Capacity.* The Net Capacity associated with the change in air enthalpy which includes both the Latent and Sensible Capacities, expressed in Btu/h and includes the heat of circulation fan(s) and motor(s).

3.2.1 *Full Load Cooling Capacity.* Cooling Capacity at full load Standard Rating Conditions expressed in Btu/h.

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

3.2.3 *Part-load Cooling Capacity.* Cooling Capacity at Part-load Standard Rating Conditions expressed in Btu/h.

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

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3.3 *Designed and Marketed.* Means the application of the equipment as stated in any publicly available document (e.g., product literature, catalogs, and packaging labels).

3.4 *Ducted Unit.* An air conditioner or heat pump that is Designed and Marketed to deliver conditioned air to the indoor space through a duct(s) or return air to the unit through a duct(s). A factory-installed wall sleeve(s) shall not be considered as a duct.

3.5 *Energy Efficiency Ratio.* A ratio of the Cooling Capacity in Btu/h to the power input values in watts at any given set of Rating Conditions expressed in (Btu/h)/W .

3.5.1 *Integrated Energy Efficiency Ratio (IEER).* A weighted calculation of mechanical cooling efficiencies at full load and part-load Standard Rating Conditions expressed in (Btu/h)/W

3.5.2 *Standard Energy Efficiency Ratio (EER).* A ratio of the Cooling Capacity in Btu/h to the total operating power input in watts at Standard Rating Conditions expressed in (Btu/h)/W.

3.6 *Indoor Airflow.*

3.6.1 *Full Load Indoor Airflow*. The Standard Airflow rate at 100% capacity as specified by the manufacturer and at the external static pressure as listed in sections 5.7.1.1 and 5.7.1.2, expressed in cfm.

3.6.2 *Part-load Indoor Airflow.* The Standard Airflow at the part-load ratings conditions as specified by the manufacturer and at the external static pressure as listed in Table 2 with modifications defined in section 5.7.1.3, expressed in cfm. This may be different for each part-load rating point.

3.7 *Heating Capacity.* The capacity associated with the change in dry-bulb temperature, expressed in Btu/h.

3.8 *Manufacturer's Installation Instructions.* Manufacturer's documentation that come packaged with or appear in the labels applied to the unit. Online manuals are acceptable 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 Installation Instructions," "manufacturer's published recommendations," "manufacturer installation and operation manuals," "installation instructions" and other similar references means Manufacturer's Installation Instructions.

3.8.1 *Manufacturer Specifications*. Documentation provided by the manufacturer. All references to "manufacturer-specified" values or values "specified by the manufacturer" and other similar references means Manufacturer Specifications.

3.8.2 *Supplemental Test Instructions (STI).* Additional instructions developed by the manufacturer and certified to the United States Department of Energy (DOE). STI shall include no instructions that deviate from Manufacturer's Installation Instructions other than those described below shall include:

All instructions that do not deviate from Manufacturer's Installation Instructions but provide additional specifications for test standard requirements allowing more than one option.

All deviations from Manufacturer's Installation Instructions necessary to comply with steady state requirements. STI shall provide steady operation that matches to the extent possible the average performance that would be obtained without deviating from the Manufacturer's Installation Instructions.

3.9 *Net Capacity*. The calculated system capacity that results when accounting for the heat generated from an indoor supply fan.

3.10 *Non-ducted Unit.* An air conditioner or heat pump that is not Designed and Marketed to deliver conditioned air to the indoor space through a duct(s) or return air to the unit through a duct(s). A factory-installed wall sleeve(s) shall not be considered as a duct.

3.11 *Percent Load.* The ratio of the part-load Cooling Capacity to the measured Standard Cooling Capacity, expressed in units of percent, %.

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

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

3.12.2 *Certified Rating(s).* A Published Rating of certified data as defined by Section 3.9 of the AHRI Single Packaged Vertical Unit Operations Manual which is verified by audit testing.

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

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

3.13.1 *Standard Rating Conditions.* Rating Conditions used as the basis of comparison for performance characteristics, as defined in Table 3.

3.14 *"Shall" or "Should".* "Shall" or "should" will be interpreted as follows:

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

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

3.15 *Single Package Vertical Unit (SPVU).*

NOTE: The terms “Equipment” and “Unit” are used interchangeably with SPVU.

3.15.1 *Single Package Vertical Air-conditioner (SPVAC).* A type of air-cooled small or large package air conditioning and heating equipment; factory assembled as a single package having its major components arranged vertically, which is an encased combination of cooling and optional heating components. This equipment is intended for exterior mounting on, adjacent interior to, or through, an outside wall; and is powered by single or three phase current. It may contain separate indoor grille(s), outdoor louvers, various ventilation options, indoor free air discharge, indoor ductwork, wall plenum or sleeve. Heating components may include electrical resistance, steam, hot water, gas or no heat, but shall not include reverse cycle refrigeration as a heating means. SPVAC, either alone or in combination with a heating plant, shall provide air-circulation, air-cleaning, cooling with controlled temperature and dehumidification, and may include the function of heating, humidifying and ventilation.

3.15.2 *Single Package Vertical Heat Pump (SPVHP).* A SPVAC that is configured to provide only refrigeration heating or that utilizes reverse cycle refrigeration as its primary heat source to provide cooling and heating and that may also include heating by means of electrical resistance, steam, hot water, or gas.

3.16 *Single Package Vertical Unit Types.*

3.16.1 *Fixed Capacity Controlled Units.* Products limited by the controls to a single stage of refrigeration capacity.

3.16.2 *Proportionally Controlled Units.* Units incorporating one or more variable capacity compressors in which the compressor capacity can be modulated continuously or in steps not more than 5% of the full load rated capacity by adjusting variable capacity compressor(s) capacity and or the stages of refrigeration capacity. The unit may also include combination of fixed capacity and variable capacity compressors.

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3.16.3 *Staged Capacity Controlled Units.* Units incorporating only fixed capacity or discrete steps of compression and limited by the controls to multiple stages of refrigeration capacity.

3.17 *Standard Air.* Air weighing 0.075 lb/ft^3 which approximates dry air at 70°F and at a barometric pressure of 29.92 in Hg.

3.18 *Standard Airflow.* The volumetric flowrate of air corrected to Standard Air conditions expressed in Standard Cubic Feet per Minute (scfm). When correcting measured airflow to Standard Air, the correction should be based on the air density at the airflow test measurement station.

3.19 *Standard Filter.* The filter designated by the manufacturer as the "default" or "standard" filter in the marketing materials for the model.

3.20 *Supply Air.* Air delivered by a unit to the conditioned space expressed as Standard Air.

Section 4. Classifications

Classifications. Equipment covered within the scope of this standard shall be classified as shown in Table 1.

Table 1. Classification of Single Packaged Vertical Units

Designation	AHRI Type [1]	Arrangement
Single Package Vertical Air Conditioner	SPV-A	ELEC/GAS HEAT [2] ID FAN EVAP OD FAN or PUMP COMP COND
Single Package Vertical Heat Pump	HSP-A HSP-A-O[3] HOSP-A HOSP-A-O[3]	ELEC/GAS HEAT [2] ID FAN EVAP OD FAN or PUMP COMP COND

Notes:
1. "-A" indicates air-cooled condenser.
2. Optional component.
3. A suffix of "-O" following any of the above classifications indicates equipment not intended for use with field-installed duct systems.

Section 5. Test Requirements

5.1 *Test Requirements.* All Standard Ratings shall be in accordance with the test methods and procedures as described in this standard and its appendices.

5.1.1 Units shall be tested in accordance with ANSI/ASHRAE Standard 37 as amended by this section, and APPENDIX D and APPENDIX E.

5.2 *Instruction Priority*. Units shall be installed per Manufacturer's Installation Instructions. In the event of conflicting instructions regarding the set-up of the unit under test, 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 *Manufacturer Specifications Priority*. In the event of conflicting information Manufacturer Specifications, the hierarchy is:

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5.3.1 Certification report (information provided to authorities having jurisdiction).

5.3.2 Manufacturer's Installation Instructions.

5.4 *Break-in.* Manufacturers may optionally specify a "break-in" period, not to exceed 20 hours, to operate the equipment under test prior to conducting the test. If an initial "break-in" period is specified by the manufacturer, no testing shall commence until the manufacturer-specified break-in period is completed. Each compressor of the unit shall undergo this "break-in" period.

5.5 *Test Unit Duct Installation Requirements*. For Ducted Units, follow ASHRAE Standard 37 duct requirements. For Non-ducted Units, use the provisions in Section E6.

5.6 *Refrigerant Charging.* Use the tests or operating conditions specified in the Manufacturer's Installation Instructions for charging. If the Manufacturer's Installation Instructions do not specify a test or operating conditions for charging or there are no manufacturer's instructions, charging shall be conducted at the full load Standard Rating Condition. If the Manufacturer's Installation Instructions contain different sets of refrigerant charging criteria for field installation and for lab testing, use the field installation criteria.

5.6.1 If the Manufacturer's Installation Instructions give a specified range for superheat, sub-cooling, or refrigerant pressure, the average of the range shall be used to determine the refrigerant charge.

5.6.2 In the event of conflicting information between charging instructions, use the instruction priority order indicated in section 5.2. Conflicting information is defined as multiple conditions given for charge adjustment where all conditions specified cannot be met. If such instances of conflicting information occur within the highest-ranking set of instructions for which refrigerant charging instructions are provided, follow the hierarchy in Table 1 for priority. Unless the Manufacturer's Installation Instructions specify a tighter charging tolerance, the tolerances specified in Table 1 shall be used.

Table 1. Test Condition Tolerance for Charging Hierarchy

Fixed Orifice			Expansion Valve		
Priority	Method	Tolerance	Priority	Method	Tolerance
1	Charge Weight	± 1.0 oz	1	Charge Weight	± 1.0 oz
2	Super-heat	± 2.0°F	2	Sub-cooling	± 2.0°F
3	High Side Pressure or Saturation Temperature	± 4.0 psi or ± 1.0°F	3	High Side Pressure or Saturation Temperature	± 4.0 psi or ± 1.0°F
4	Low Side Pressure or Saturation Temperature	± 4.0 psi or ± 1.0°F	4	Low Side Pressure or Saturation Temperature	± 2.0 psi or ± 0.8°F
5	Low Side Temperature	± 2.0°F	5	Approach Temperature	± 1.0°F
6	High Side Temperature	± 2.0°F			

5.6.3 Install one or more refrigerant line pressure gauges during the setup of the unit unless either of the following conditions are met: (1) the Manufacturer's Installation Instructions indicate that pressure gauges shall not be installed; or (2) charging is based only on parameters, such as charge weight, that don't require measurement of refrigerant pressure. Use methods for installing pressure gauge(s) at the required location(s) as indicated in Manufacturer's Installation Instructions if specified. Install pressure gauges depending on the parameters used to verify or set charge, as described in the following paragraphs.

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

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

5.6.4 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

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refrigerant charge has leaked during the test, repair the refrigerant leak, repeat any necessary set-up steps, and repeat all tests.

5.7 *Setting Indoor Airflow and External Static Pressure*

5.7.1 *Minimum External Static Pressure for Testing*

5.7.1.1 *Non-Ducted Units*. Test at zero external static pressure (ESP) for all test conditions.

5.7.1.2 *Ducted Units - Full Load Standard Rating Capacity.* Tests shall use the minimum ESP specified in Table 2.

Table 2. External Static Pressure

Capacity Ratings[1], x 1000 Btu/h	Minimum External Static Pressure, in H_2O[2,3]
≤ 28	0.10
> 28 and ≤ 42	0.15
> 42 and ≤ 70	0.20
> 70 and ≤ 105	0.25
> 105 and ≤ 134	0.30
> 134 and ≤ 210	0.35
> 210 and ≤ 280	0.40
> 280 and ≤ 350	0.45
> 350 and ≤ 400	0.55
> 400 and ≤ 500	0.65
> 500	0.75

Notes:
1. For units with cooling function use Standard Cooling Capacity
2. Static pressure tolerance of -0.0 in H_2O to +0.05 in H_2O
3. Standard Ratings shall be determined and tested with the Standard Filter for that model.

5.7.1.3 *Ducted Units – tests that do not use the full-load cooling airflow*. When conducting heating or part-load tests for which the manufacturer-specified fan control settings and/or manufacturer-specified airflow rates are different than for the full-load cooling test, minimum ESP requirements shall be calculated using Equation 1.

$$ESP_{adj} = ESP_{CFL} \bullet \left(\frac{Q_{dif}}{Q_{CFL}}\right)^2 \quad (1)$$

Where:

ESP_{adj} = Adjusted ESP requirement at heating airflow or part-load cooling airflow, in H_2O
ESP_{CFL} = ESP requirement at full-load cooling airflow specified in Table 2, in H_2O
Q_{dif} = Measured Part-load Airflow or manufacturer-specified heating airflow, scfm
Q_{CFL} = Measured Full Load Cooling Airflow, scfm

5.7.2 *Indoor Airflow Target Values*

5.7.2.1 All airflow rates, including those used for determining capacity, shall be expressed in terms of Standard Air.

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5.7.2.2 For the full-load cooling test, use the manufacturer-specified Full-Load Cooling Airflow. If an airflow is not specified by the manufacturer, use a value of 400 scfm per ton (i.e., per 12,000 Btu/h) of Full Load Cooling Capacity.

5.7.2.3 For the heating test, use the manufacturer-specified Heating Airflow rate. If this airflow rate is not specified, use the airflow that results from using the manufacturer-specified heating fan control settings at the adjusted ESP requirement determined per section 5.7.1.3. If neither the airflow rate nor fan control settings are provided for the heating test, but the manufacturer's instructions describe how to obtain steady-state heating operation (e.g., using thermostat or other control system input) that results in an automatic adjustment to airflow, use those instructions. If none of this information is available, use the full-load cooling airflow rate for the heating test.

5.7.2.4 For part-load tests, use the manufacturer-specified Part-Load Airflow rates. If these airflow rates are not specified by the manufacturer, use the airflow that results from using the manufacturer-specified part-load fan control settings at the ESP requirement determined per section 5.7.1.3. If neither airflow rates nor fan control settings are provided for the test point but the manufacturer's instructions describe how to obtain steady-state part-load operation (e.g., using thermostat or other control system input) that results in an automatic adjustment to airflow, use those instructions. If none of this information is available, use the full-load cooling airflow rate for the part-load cooling tests.

5.7.3 *Indoor External Static Pressure and Airflow Tolerances and Set-Up*

5.7.3.1 If the manufacturer does not specify a "default" or "standard" filter in the marketing materials, then the Standard Filter shall be the filter with the lowest level of filtration as specified the marketing materials for the model. If the marketing materials do not specify a "default" or "standard" filter or which filter option has the lowest filtration level, then the Standard Filter shall be any filter shipped with the unit by the manufacturer, or if no filter is shipped with the unit, any filter option identified in the marketing materials.

5.7.3.2 Condition Tolerances. All tolerances for airflow and ESP specified in this section for setting airflow and ESP are also condition tolerances that apply throughout each test. Specifically, the average value of a parameter measured over the course of the test must vary from the target value by no more than the condition tolerance.

5.7.3.3 *Non-Ducted Units*

5.7.3.3.1 Use the manufacturer-specified fan control settings for all tests for which they are provided. Use the full-load cooling fan control settings Specified by the manufacturer for all tests for which fan control settings are not specified. If there are no manufacturer-specified fan control settings for any tests, use the as-shipped fan control settings for all tests.

5.7.3.3.2 For all tests, conduct the test at zero ESP with a condition tolerance of -0/+0.05 in H_2O.

5.7.3.3.3 For each test, the airflow tolerance is ± 3% of the manufacturer-specified airflow for that test. If airflow is not specified by the manufacturer for a heating or part-load test and the full-load cooling airflow is used for that test, the airflow tolerance is ± 3% of the full-load cooling airflow. If airflow is not specified by the manufacturer for a heating or part-load test and the full-load cooling airflow is not used for that test (if the manufacturer provides instructions to obtain steady-state operation per the provisions of sections 5.7.2.3 and 5.7.2.4), there is no airflow tolerance requirement for that test.

5.7.3.3.4 If both the ESP and airflow cannot be simultaneously maintained within tolerance for any test, maintain the ESP within the required tolerance and use an airflow as close to the manufacturer-specified value as possible. Use the measured airflow as the target airflow for all subsequent tests that call for the full-load cooling airflow.

5.7.3.3.5 If an airflow is used that deviates from the target airflow for that test by more than 3% because the airflow and ESP requirements cannot be simultaneously met (see section 5.7.3.3.4), the average airflow

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rate measured over the course of the test shall be within ± 3% of the airflow rate measured after setting airflow for that test.

5.7.3.4 *Ducted Units*

5.7.3.4.1 *Full-Load Cooling Test*

5.7.3.4.1.1 Operate the unit under conditions specified for the full-load cooling test using the manufacturer-specified fan control settings. If there are no manufacturer-specified fan control settings, use the as-shipped fan control settings. Adjust the airflow-measuring apparatus to maintain ESP within -0/+0.05 in H2O of the requirement specified in Table 2 and to maintain the airflow within ± 3% of the manufacturer-specified full-load cooling airflow.

5.7.3.4.1.2 If ESP or airflow are higher than the tolerance range, adjust the fan control settings (e.g., lower fan speed) to maintain both ESP and airflow within tolerance. If ESP or airflow are higher than the tolerance range at the lowest fan control setting (e.g., lowest fan speed), adjust the airflow-measuring apparatus to maintain airflow within tolerance and operate with an ESP as close as possible to the minimum requirement specified in Table 2.

5.7.3.4.1.3 If ESP or airflow are lower than the tolerance range, adjust the fan control settings (e.g., higher fan speed) to maintain both ESP and airflow within tolerance. If ESP or airflow are lower than the tolerance range at the maximum fan control setting (e.g., highest fan speed), adjust the airflow-measuring apparatus to maintain ESP within tolerance and operate with an airflow as close as possible to the manufacturer-specified value.

5.7.3.4.1.4 If both airflow and ESP tolerances cannot be met, (e.g., decreasing fan speed when the ESP or airflow are too high causes the ESP or airflow to be lower than the tolerance range, and increasing fan speed when the ESP or airflow are too low causes the ESP or airflow to be higher than the tolerance range), use the lower fan control settings and adjust the airflow measuring apparatus to maintain the ESP within -0/+0.05 in H2O of the requirement specified in Table 2 and to maintain the airflow within 90% of the manufacturer-specified full-load cooling airflow. If increasing ESP to within -0/+0.05 in H2O of the requirement specified in Table 2 reduces airflow of the unit under test to less than 90% of the rated airflow rate, then the next higher fan control setting shall be utilized to obtain rated airflow. Using this higher fan control setting, maintain airflow within the tolerance specified in section 5.7.3.3.3 and the ESP as close as possible to the manufacturer-specified value.

5.7.3.4.1.5 After setting the airflow for the full-load cooling test, no adjustments may be made to the fan control settings for the full-load cooling test. If the ESP measured after setting airflow exceeds the minimum ESP requirement by more than 0.05 in H2O (because the ESP and airflow requirements cannot be simultaneously met, see section 5.7.3.4.1.2 and 5.7.3.4.1.4), there is no condition tolerance for ESP. If an airflow less than 97% of the manufacturer-specified full-load cooling airflow is used for the full-load cooling test (because the airflow and ESP requirements cannot be simultaneously met, see section 5.7.3.4.1.3 and 5.7.3.4.1.4), there is no condition tolerance for airflow.

5.7.3.4.2 *Heating Test and Part-load Tests*

5.7.3.4.2.1 If the manufacturer-specified part-load airflow or the manufacturer-specified heating airflow is the same as the manufacturer-specified full-load cooling airflow (and for heating tests and part-load tests for which an airflow is not specified by the manufacturer and the manufacturer-specified full-load cooling airflow is used as the airflow for the test), use the fan control settings used for the full-load cooling test. Adjust the airflow-measuring apparatus to maintain the airflow within ± 3% of the measured full-load cooling airflow without regard to the resulting ESP. No changes are to be made to the fan control settings for the test.

5.7.3.4.2.2 If the manufacturer-specified part-load airflow or the manufacturer-specified heating airflow differs from the manufacturer-specified full-load cooling airflow, use the following provisions.

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5.7.3.4.2.2.1 Operate the system under conditions specified for the heating test or part-load test using the manufacturer-specified fan control settings for that test condition. If there are no manufacturer-specified fan control settings for the heating test or part-load test, use the manufacturer-specified fan control settings for the full-load cooling test. If there are no manufacturer-specified fan control settings for any tests, use the as-shipped fan control settings.

5.7.3.4.2.2.2 Adjust the airflow-measuring apparatus to maintain ESP within -0/+0.05 in H2O of the adjusted ESP requirement determined per section 5.7.1.3 and maintain airflow within ± 3% of the manufacturer-specified airflow for the heating or part-load test.

If ESP or airflow are higher than the tolerance range, adjust the fan control settings (e.g., lower fan speed) to maintain both ESP and airflow within tolerance. If ESP or airflow are higher than the tolerance range, at the lowest fan control setting (e.g., lowest fan speed), adjust the airflow-measuring apparatus to maintain airflow within tolerance and operate with an ESP as close as possible to the minimum requirement specified in Table 2.

If ESP or airflow are lower than the tolerance range, adjust the fan control settings (e.g., higher fan speed) to maintain both ESP and airflow within tolerance (but without adjusting sheaves and without exceeding the final fan control settings used for the full-load cooling test). If ESP or airflow are lower than the tolerance range at the maximum fan control setting (e.g., highest fan speed), adjust the airflow-measuring apparatus to maintain ESP within tolerance and operate with an airflow as close as possible to the manufacturer-specified value.

If both airflow and ESP tolerances cannot be met, (e.g., decreasing fan speed when the ESP or airflow are too high causes the ESP or airflow to be lower than the tolerance range, and increasing fan speed when the ESP or airflow are too low causes the ESP or airflow to be higher than the tolerance range), use the lower fan control settings and adjust the airflow measuring apparatus to maintain the ESP within -0/+0.05 in H2O of the requirement specified in Table 2 and to maintain the airflow within 90% of the manufacturer-specified full-load cooling airflow. If increasing ESP to within -0/+0.05 in H2O of the requirement specified in Table 2 reduces airflow of the unit under test to less than 90% of the rated airflow rate, then the next higher fan control setting shall be utilized to obtain rated airflow. Using this higher fan control setting, maintain airflow within the tolerance specified in section 5.7.3.3.3 and the ESP as close as possible to the manufacturer-specified value. After setting the airflow, no changes are to be made to the fan control settings.

5.7.3.4.2.2.3 If the ESP measured after setting airflow exceeds the adjusted ESP requirement determined per section 5.7.1.3 by more than 0.05 in H2O (because the ESP and airflow requirements cannot be simultaneously met, see section 5.7.3.4.2.2.2), there is no condition tolerance for ESP. If an airflow less than 97% of the manufacturer-specified airflow is used for a test (because the airflow and ESP requirements cannot be simultaneously met, see section 5.7.3.4.2.2.2), there is no condition tolerance for airflow.

5.7.3.4.2.2.4 For heating tests and part-load tests for which an airflow is not specified by the manufacturer and the manufacturer-specified full-load cooling airflow is not used as the airflow for the test (because the manufacturer provides fan control settings or instructions to obtain steady-state operation for the test, per the provisions of sections 5.7.2.3 and 5.7.2.4), use the manufacturer-specified fan control setting for that test condition or adjust the system control input to obtain the heating or part-load operation specified by the manufacturer. Adjust the airflow-measuring apparatus to meet the adjusted ESP requirement determined per section 5.7.1.3 with a condition tolerance of -0/+0.05 in H2O, using the measured heating or part-load airflow in the ESP calculation. After setting the airflow, no changes are to be made to the fan control settings.

5.8 *Standard Rating Tests.* Table 3 indicates the tests and test conditions which are required to determine values of Standard Capacity Ratings and Energy Efficiency.

5.8.1 *Electrical Conditions.* Nameplate voltages are shown in Table 1 of ANSI/AHRI Standard 110. Standard Rating Tests shall be performed at the nameplate rated voltage and frequency unless otherwise specified in this standard.

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For equipment which is rated with 208/230 dual or 208-230 nameplate voltages, Standard Rating Tests shall be performed at 230 V.

For all other dual or range nameplate voltage equipment covered by this standard, the Standard Rating Tests shall be performed at both voltages or at the lower voltage if only a single Standard Rating is to be published.

5.8.2 *Atmospheric Pressure*. Tests shall be conducted at an atmospheric pressure of at least 13.7 psia. Atmospheric pressure measuring instruments shall be accurate to within ± 0.5% of the reading.

5.8.3 *Supplementary Heat*. All supplementary heat sources, including electric resistance heat, shall be turned off or disconnected from power during the test.

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Table 3. Standard Rating Test Conditions and Operating Requirements

Test	Air Entering Indoor Side, °F		Air Entering Outdoor Side, °F	
	Dry-bulb	Wet-bulb	Dry-bulb	Wet-bulb
Cooling Mode				
Full Load Standard Rating Capacity Test, Cooling[1,2]	80.0	67.0	95.0	75.0[3]
Part-load Standard Rating Conditions	80.0	67.0	Varies with load per Table 7	Varies with load per Table 7[3]
Cooling Mode Operation Tests				
Low Temperature Operation, Cooling	67.0	57.0	67.0	57.0[3]
Maximum High Temperature Operation	80.0	67.0	115.0	75.0[3]
Condensate Disposal	80.0	75.0	80.0	75.0
Insulation Effectiveness	80.0	75.0	80.0	75.0[3]
Heating Mode				
Full Load Standard Rating Capacity Test, Heating[1,2]	70.0	60.0[4]	47.0	43.0
Part-load Capacity Test Heating	70.0	60.0[4]	62.0	56.5
Heating Mode Operation Tests				
Low Temperature Operation, Heating[5]	70.0	60.0[4]	17.0	15.0
Maximum High Temperature Operation	80.0	-	75.0	65.0

Notes:

1. Same Conditions used for voltage tolerance tests.
2. Refer to Appendix D for Standard Rating Conditions for products sold outside the US and Canada.
3. Only required if unit rejects condensate to Outdoor Coil. For 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 room, maintain an outdoor room dew point temperature of 60.5ºF.
4. Maximum value for all tests. If outdoor air enthalpy method is used for Single Package Heat Pumps, then the wet bulb shall be adjusted to match as close as reasonably possible to the dew point of the outdoor entering air.
5. Only applicable if the manufacturer's Published Rating includes low-temperature specifications.

5.8.4 *Outdoor-side Airflow Rate.* All Standard Ratings shall be determined at the outdoor-side airflow rate Specified by the manufacturer where the fan drive is adjustable. Where the fan drive is non-adjustable, Standard Ratings shall be determined at the outdoor-side airflow rate inherent in the equipment. Outdoor air-side attachments used for testing shall be specified in the supplemental test instructions (if offered for sale with or without outdoor air-side attachments, one of the optional outdoor air-side attachments shall be specified by the manufacturer and used for testing). Once established, the outdoor-side air circuit of the equipment shall remain unchanged throughout all tests prescribed herein unless automatically adjusted by the unit controls.

5.8.5 *Moisture Removal Determination.* Indoor air moisture removed shall be determined at Standard Rating Conditions, cooling.

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