AHRI Standard 340/360

2015 Standard for

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

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IMPORTANT

SAFETY DISCLAIMER

AHRI does not set safety standards and does not certify or guarantee the safety of any products, components or systems designed, tested, rated, installed or operated in accordance with this standard/guideline. It is strongly recommended that products be designed, constructed, assembled, installed and operated in accordance with nationally recognized safety standards and code requirements appropriate for products covered by this standard/guideline.

AHRI uses its best efforts to develop standards/guidelines employing state-of-the-art and accepted industry practices. AHRI does not certify or guarantee that any test conducted under its standards/guidelines will be non-hazardous or free from risk.

Note:

This 2015 standard supersedes ANSI/AHRI Standard 340/360-2007 with Addendum 1 and 2.

AHRI CERTIFICATION PROGRAM PROVISIONS

Scope of the Certification Program

The Certification Program applies to 50 Hz and 60 Hz equipment including:

- Unitary Air-conditioners and Heat Pumps from 65,000 Btu/h to less than 250,000 Btu/h;
  - Single Packaged and Split Systems
  - Air-cooled and water-cooled
- Air-cooled Air-conditioning Condensing Units from 135,000 Btu/h to less than 250,000 Btu/h (covered by AHRI Standard 365);
- Air-cooled Single Packaged Unitary Air-conditioners from 250,000 Btu/h to less than 760,000 Btu/h.

Products sold in the intended market of the US and Canada must comply with the "certify all requirements". For 60 Hz and 50 Hz products sold outside the intended market of the US and Canada, certification is optional. If the participant does not wish to carry certification of a model sold for use outside the intended market, this product shall carry a separate and unique model number from an existing AHRI certified model number to avoid market confusion.

Certified Ratings

The following certified ratings are verified by test:

Unitary Air-conditioners

Air-cooled, water-cooled and evaporatively-cooled from 65,000 Btu/h to below 250,000 Btu/h.

1. Cooling Capacity, Btu/h at Standard Rating Conditions
2. Energy Efficiency Ratio, EER, Btu/W·h at Standard Rating Conditions
3. Integrated Energy Efficiency Ratio, (IEER), Btu/W·h at Standard Rating Conditions

Unitary Air-Cooled Packaged Air-Conditioners from 250,000 Btu/h to less than 760,000 Btu/h.

1. Cooling Capacity, Btu/h at Standard Rating Conditions
2. Energy Efficiency Ratio, EER, Btu/W·h at Standard Rating Conditions
3. Integrated Energy Efficiency Ratio, (IEER), Btu/W·h at Standard Rating Conditions

Air-source Unitary Heat Pump Equipment

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Air-cooled from 65,000 Btu/h to below 250,000 Btu/h.

1. Cooling Capacity, Btu/h at Standard Rating Conditions
2. Energy Efficiency Ratio, EER, Btu/W·h at Standard Rating Conditions
3. Integrated Energy Efficiency Ratio, IEER, Btu/W·h at Standard Rating Conditions
4. High Temperature Heating Standard Rating Capacity, Btu/h at 47°F
5. High Temperature Coefficient of Performance, COP_H, W/W, at 47°F
6. Low Temperature Heating Standard Rating Capacity, Btu/h, at 17°F
7. Low Temperature Coefficient of Performance, COP_H, W/W, at 17°F

Conformance to the requirements of the maximum operating condition test, cooling low temperature operation test, insulation efficiency test (cooling), and condensate disposal test (cooling) are also verified initially by test for manufacturers applying into the AHRI ULE Certification Program.

Foreword:

AHRI Standard 340/360 – 2015 contains many significant revisions to the 2007 standard.

1. The revised standard includes definition and test requirements for Double-duct commercial unitary equipment.
2. Definitions have been expanded and clarified including an updated definition for IEER.
3. Table 1, *Classification of Commercial and Industrial Unitary Air-Conditioner Equipment* has been rewritten for clarity.
4. Table 2, *Classification of Commercial and Industrial Unitary Heat Pump* Equipment has been rewritten for clarity.
5. The part load efficiency, IEER, test method is simplified by eliminating the iterative OD test conditions needed to achieve a desired load point. The new method requires an additional test point at known conditions to be run in order to interpolate to the desired load point. This simplifies the test procedure (Table 6). This method also reduces the uncertainty with the addition of a 3% tolerance for part load percent.
6. Section 5, *Test Requirements*, has been expanded to cover items not documented in ASHRAE Standard 37.
7. The standard adds a tolerance of 3% on required part load Percent Load point where interpolation and degradation is not required (Table 7).
8. The revised standard includes optional *International Rating Conditions* (Section 6.3) relevant to international requirements that may be used optionally. The Rating Conditions are intended to align with ISO 5151, 13253 and 15042 conditions.
9. The standard includes a step by step procedure to generate IEER ratings based on either test method or computer simulation. This also includes clarification on procedures for fixed, capacity, staged capacity and variable capacity units (Section 6.4).
10. Verification test uncertainty allowances have been explained and clarified for the performance metrics in the standard. (Section 6.5 & Section 6.6).
11. Documentation of the confidence level has been added at 90% for EER, IEER and COP.
12. Tolerances have been added for airflow at ± 3%.
13. Appendix D, *Atmospheric Pressure Correction*, has been added to the standard, which prescribes a computational method to correct measured product performance for air density variations resulting from atmospheric pressure changes due to weather conditions and altitude. Revisions were made throughout the standard to reflect the atmospheric pressure corrections.
14. Appendix E. *Unit Configuration for Standard Efficiency Determination*, has also been added to the standard, which prescribes the requirements for the configuration of a unit that is used for determining the Standard Rating Cooling and Heating Capacity and efficiency metrics. Appendix E documents DOE certification requirements agreed to with the development of the AEDM procedure.
15. The revised standard tightens the tolerances on external static pressure and airflow. (Appendix F, Section F4 & F5).
16. Appendix G, *Examples of IEER Calculations*, provides a comprehensive set of IEER calculation examples covering many potential product configurations.
17. References have been updated to reflect the latest available standards.
18. Appendix F, *Method of Testing Unitary Air Conditioning Products*, has been updated to reflect test procedures not defined by ASHRAE 37-2009.

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

Section 1. Purpose

1.1 *Purpose*. The purpose of this standard is to establish for Commercial and Industrial Unitary Air-conditioning and Heat Pump Equipment: 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, federal and state regulations, and efficiency standards developed by American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), International Energy Conservation Code (IECC), Canadian Standards Association (CSA), Department of Energy (DOE), 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-made Commercial and Industrial Unitary Air-conditioning and Heat Pump Equipment as defined in Section 3.

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

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 ANSI/AHRI Standard 210/240, with capacities less than 65,000 Btu/h.

2.2.3 Water-Source Heat Pumps as defined in ISO/ANSI/AHRI/ASHRAE 13256-1.

2.2.4 Variable Refrigerant Flow Air Conditioners and Heat Pumps as defined in ANSI/AHRI Standard 1230.

2.2.5 Rating of units equipped with desuperheater/water heating devices (as defined in ANSI/AHRI Standard 470) in operation.

2.2.6 Commercial and Industrial Condensing Units with a capacity greater than 135,000 Btu/h as defined in ANSI/AHRI Standard 365 (I-P), *Performance Rating of Commercial and Industrial Unitary Air-conditioning Condensing Units*.

2.3 *Other Applicable Standards*. Commercial and Industrial Unitary Air-conditioning and Heat Pump Equipment may also be rated using the following standards:

2.3.1 Single vertical packaged air conditioners rated using ANSI/AHRI Standard 390.

2.3.2 Dedicated outdoor air systems rated using ANSI/AHRI Standard 920 (I-P).

2.3.3 Air conditioners and condensing units serving computer rooms rated using ANSI/AHRI Standard 1360.

2.3.4 Commercial and industrial unitary air-conditioning condensing units rated using ANSI/AHRI Standard 365 (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 (https://www.ashrae.org/resources--publications/free-resources/ashrae-terminology), unless otherwise defined in this section.

3.1 *Basic Model*. All systems within a single equipment class and which have the same or comparably performing compressor(s), condensing coil(s), evaporator coil(s), and air moving system(s) that have a common "nominal" Cooling Capacity.

Note: See 10 CFR §429 for DOE definition.

3.2 *Commercial and Industrial Unitary Air-conditioner*. One or more factory-made assemblies, which normally include a cooling coil, an air moving device, a compressor(s) and condenser combination, and may include a heating function as well. Where such equipment is provided in more than one assembly, the separate assemblies shall be designed to be used together, and the requirements of rating outlined in this standard shall be based upon the use of matched assemblies. The functions of Commercial and Industrial Unitary Air-conditioners, either alone or in combination with a heating plant, are to provide air-circulation, cooling, dehumidification, and may include the Functions of heating, humidifying, outdoor air ventilation, and air cleaning.

3.3 *Commercial and Industrial Unitary Heat Pump.* One or more factory-made assemblies, which normally include an indoor conditioning coil, an air moving device, compressor(s), and an outdoor coil(s), including means to provide a heating function and may or may not include a cooling function. When such equipment is provided in more than one assembly, the separate assemblies shall be designed to be used together, and the requirements of rating outlined in the standard shall be based upon the use of matched assemblies. Commercial and Industrial Unitary Heat Pumps shall provide the function of heating and may include the function of air circulation, air cooling, dehumidifying or humidifying, outdoor air ventilation, and air cleaning.

3.4 *Cooling Capacity*. The net capacity associated with the change in air enthalpy between the air entering the unit and the air leaving the unit, which includes both the Latent and Sensible Capacities expressed in Btu/h and includes the heat of circulation fan(s) and motor(s).

3.4.1 *Standard Cooling Capacity*. 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 Appendix F.

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

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

3.5 *Double-duct System.* Double-duct air conditioner or heat pump means air-cooled commercial package air conditioning and heating equipment that is either a horizontal single package or split-system unit; or a vertical unit that consists of two components that may be shipped or installed either connected or split; is intended for indoor installation with ducting of outdoor air from the building exterior to and from the unit, where the unit and/or all of its components are non-weatherized and are not marked (or listed) as being in compliance with UL 1995/CSA C22.2 No.236 or equivalent requirements for outdoor use. If it is a horizontal unit, the complete unit shall have a maximum height of 35 inches or the unit shall have components that do not exceed a maximum height of 35 inches. If it is a vertical unit, the complete (split, connected, or assembled) unit shall have components that do not exceed maximum depth of 35 inches; and, a rated Cooling Capacity greater than and equal to 65,000 Btu/h and less than or equal to 300,000 Btu/h.

3.6 *Energy Efficiency Ratio (EER)*. 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/W·h.

3.6.1 *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/W·h for a unit configured in accordance with Appendix E, and when tested in accordance with the requirements of Appendix F.

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

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3.8 *Full Load Rated Indoor Airflow*. The Standard Airflow rate at 100% capacity as defined by the manufacturer and at the external static pressure as listed in Table 5. The airflow shall be expressed as Standard Air with a density of 0.075 lb/ft^3.

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

3.10 *Heating Coefficient of Performance (COP_H).* A ratio of the Heating Capacity in watts to the power input values in watts at any given set of Rating Conditions expressed in W/W. For heating COP, supplementary resistance heat shall be excluded.

3.11 *Integrated Energy Efficiency Ratio (IEER).* A weighted calculation of mechanical cooling efficiencies at full load and part load Standard Rating Conditions, defined in Section 6.2, expressed in Btu/W·h.

3.12 *Indoor Package Air-conditioners*. Units with factory-made assemblies of one or more evaporator fans, evaporator coils, and condensing units having means for air cooling, cleaning, dehumidification, heating with factory or field installed electric strip heaters and forced air circulation through a duct system and which may also have means for humidifying and control of temperature. These units do not have gas heat and are not heat pumps. Included are only those units that are assembled or designed to be assembled in a single unit (within a single factory made enclosure).

3.13 *Multi Zone Variable Air Volume (MZVAV)*. Units with control systems designed to vary the indoor air volume and refrigeration capacity/staging at a controlled discharge air temperature and static pressure as a means of providing space temperature control to independent multiple spaces with independent thermostats.

3.14 *Package Air-conditioners*. Units with factory-made assemblies of one or more evaporator fans, evaporator coils, and condensing units having means for air cooling, cleaning, dehumidification, heating with factory or field installed electric strip heaters and forced air circulation through a duct system and which may also have means for humidifying and control of temperature. These units do not have gas heat and are not heat pumps. Included are only those units that are assembled or designed to be assembled in a single unit (within a single factory made enclosure). Single package (cooling only) roof top units are included in this category.

3.15 *Package Heat Pumps*. Units that can both cool and heat with the refrigeration system which may have provision for electric, hot water, steam or gas heat (dual fuel) that are factory-made assemblies of one or more evaporator fans, evaporator coils, and condensing units having means for air cooling, heating, cleaning, dehumidification, and forced air circulation through a duct system and which may also have means for humidifying and control of temperature, with provision for modifying the performance so that either heating or cooling and dehumidification may be produced. Included are only those units that are assembled or designed to be assembled in a single unit (within a single factory made enclosure).

3.16 *Package Year Round Air-conditioners*. Gas and oil Package Air-Conditioners which are factory-made assemblies of one or more evaporator fans, evaporator coils, and condensing units and equipped with gas or oil fired heating sections and means for air cooling, cleaning, dehumidification, heating and forced air circulation through a duct system and which may also have means for humidifying and control of temperature. Included are only those units that are assembled or designed to be assembled in a single unit (within a single factory made enclosure).

3.17 *Part Load Rated Indoor Airflow*. The Standard Airflow at the part load ratings conditions as defined by the manufacturer and at the external static pressure as listed in Table 5 with modifications shown in Table 6. This may be different for each part load rating point. The airflow is expressed as Standard Air, expressed in units of ft^3/min.

3.18 *Percent Load.* The ratio of the part load Cooling Capacity over the measured full load Cooling Capacity at Standard Rating Conditions, expressed as a decimal.

3.19 *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 AHRI Standard 540, Table 2, rating test point A capacity (45/130/20/15). The modulating compressor or compressors shall be capable of modulating the unit capacity over a range of at least 50% to 100%. The unit may also include combination of fixed capacity and variable capacity compressors.

3.20 *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

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performance characteristics shown on the unit or published in specifications, advertising or other literature controlled by the manufacturer, at stated Rating Conditions.

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

3.20.2 *Standard Rating.* A rating based on tests performed at Standard Rating Conditions as listed in Table 3.

3.21 *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.

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

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

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

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

3.23 *Single Zone Variable Air Volume (SZVAV)*. Units with a control system designed to vary the indoor air volume and refrigeration capacity/staging as a means to provide zone control to a single or common zones, controlled by a single space thermostat input. The capacity, as well as the Supply Air shall be controlled either through modulation, discrete steps or combinations of modulation and step control based on the defined control logic.

Note: The supply air temperature can be one method used for the control logic.

3.24 *Split System Air-conditioners*. Units which are intended for air conditioning purposes with an air conditioning condensing unit that is installed remotely from the evaporator and requiring field connection by refrigerant lines.

3.25 *Split System Heat Pump*. Unit which is intended for heat pump purposes with an outdoor unit that is installed remotely from the indoor coil, air handler, or fan coil and requiring field connection by refrigerant lines.

3.26 *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.

3.27 *Standard Air.* Air weighing 0.075 lb/ft^3 which approximates dry air at 70.0°F and at a barometric pressure of 29.92 in Hg or an atmospheric pressure of 14.696 psia.

3.28 *Standard Airflow*. The volumetric flowrate of air corrected to standard air conditions expressed in scfm. When correcting measured airflow to standard air, the correction should be based on the air density at the airflow test measurement station.

3.29 *Stepped Fan Control*. Units with control systems designed to use multiple stages of indoor fans in discrete steps based on the stages of capacity and/or defined control logic.

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

Section 4. Classifications

4.1 Commercial and Industrial Unitary Air-conditioning and Heat Pump Equipment within the scope of this standard shall be classified as shown in Tables 1 and 2.

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Table 1. Classification of Commercial and Industrial Unitary Air-Conditioning Equipment

Designation	AHRI Type[1,2]	Arrangement - ID	Arrangement – OD
Package and Indoor Package Air-conditioners	SP-A[5, 6] SP-E[6] SP-W[6, 7]		ELEC HEAT[3] / OD FAN or PUMP ID FAN / COMP EVAP / COND
Package Year Round Air -conditioners	SPY-A[5, 6] SPY-E[6] SPY-W[6, 7]		GAS HEAT[4] / OD FAN or PUMP ID FAN / COMP EVAP / COND
Air-conditioner with Remote Condenser	RC-A RC-E RC-W[7]	ID FAN EVAP	OD FAN or PUMP COMP COND
Split System Air-conditioners: Condensing Unit, Coil Alone	RCU-A-C RCU-E-C RCU-W-C[7]	EVAP	OD FAN or PUMP COMP COND
Split System Air-conditioners: Condensing Unit, Coil and Fan	RCU-A-CB[5] RCU-E-CB RCU-W-CB[7]	ID FAN EVAP ELEC HEAT[3]	OD FAN or PUMP COMP COND
Split System: Year Round Condensing Unit, Coil and Fan	RCUY-A-CB[5] RCUY-E-CB RCUY-W-CB[7]	GAS HEAT[4] ID FAN EVAP	OD FAN or PUMP COMP COND

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, "-E" indicates evaporatively-cooled condenser and "-W" indicates water-cooled condenser.
3. Optional component.
4. May also be other heat source except for electric strip heat.
5. For Double-duct, append “-DD” and outdoor arrangement moves from outdoor side to indoor side.
6. Components could be installed indoors as well in accordance with manufacturer’s installation instructions.
7. For water-cooled products, outdoor arrangement can move from outdoor side to indoor side.

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Table 2. Classification of Commercial and Industrial Unitary Heat Pump Equipment

Designation	AHRI Type[1,2]	Arrangement - ID	Arrangement – OD
Package Heat Pumps	HSP-A[4]		ELEC HEAT[3, 5] / ID FAN / EVAP | OD FAN or PUMP / COMP / COND
Year Round Package	HSPY-A		GAS HEAT / ID FAN / EVAP | OD FAN or PUMP / COMP / COND
Heat Pump with Remote Outdoor Coil	HRC-A-CB[4]	ID FAN / EVAP / COMP	OD FAN or PUMP / COND
Heat Pump with Remote Outdoor Coil with no Indoor Fan	HRC-A-C[4]	EVAP / COMP	OD FAN or PUMP / COND
Split System Heat Pump	HRCU-A-CB[4]	ELEC HEAT[3] / ID FAN / EVAP	OD FAN or PUMP / COMP / COND

Notes:

1. A suffix of "-O" following any of the above classifications indicates equipment not intended for use with field-installed duct systems.
2. For heating only, change the initial “H” to “HO”.
3. Optional component.
4. For Double-duct, append “-DD” and outdoor arrangement moves from outdoor side to indoor side.
5. May also be other heat sources.

Section 5. Test Requirements

5.1 All Standard Ratings shall be based on tests conducted 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 F.

5.1.1.1 Units shall be installed per manufacturer’s installation instructions. For products covered under ULE certification program, additional information shall be submitted through the certification process.

5.1.2 It is permissible for equipment for test to have manufacturer authorized personnel with knowledge of the control software present upon initial set-up during laboratory testing.

5.1.2.1 If equipment cannot be maintained at steady state conditions by its normal controls, then the manufacturer shall provide a method to modify or over-ride such controls so that steady state conditions are achieved, but the modifications shall represent the actual performance that would occur in normal operation.

5.1.2.2 Power used for any override controls that would not normally be installed in the field shall not be included in total power.

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5.1.3 *Break-in.* If an initial break-in period is required to achieve performance, the break-in conditions and duration shall be specified by the manufacturer, but shall not exceed 75 hours at room ambient conditions (≥60ºF), or 20 hours inside the test chamber at test conditions specified by the manufacturers. No testing shall commence until the specified break-in period is completed.

5.1.4 *Test Unit Installation Requirements*. For units that have horizontal and down flow configurations, due considerations shall be given to ASHRAE Standard 37 duct requirements.

5.1.5 *Defrost Controls*. Defrost controls shall be left at manufacturer's factory settings if the published installation instructions 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.

5.1.6 *Head Pressure Control*. Head pressure controls shall be left at manufacturer's settings and operated in automatic mode. If this results in unstable operation and the requirements of ASHRAE Standard 37 cannot be met then the procedures in Appendix F Section F7 for a time averaged head pressure control test shall be used.

5.1.7 *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 25 ft 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 25 ft of tubing, whichever is greater. At least 5 ft 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.

5.1.8 *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. 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.

Note: After completion of all required tests, it is good laboratory practice to achieve cooling full load test conditions for 30 continuous minutes and compare results to the previous set of full load tests after running part load cooling tests and/or heating tests. When comparing results, measured pressures and temperatures of refrigerant state points should be evaluated for any change since the initial full load test.

5.1.9 *Pressure Gauge*. When specified by the manufacturer, pressure gauges shall be installed during the setup and refrigerant charge verified based on manufacturer's installation instructions.

If refrigerant charging instructions are not available or the manufacturer does not specify to install the pressure gauges, then testing shall be performed at factory refrigerant charge without adjustment.

Section 6. Rating Requirements

6.1 *Standard Ratings.* Standard Ratings shall be established at the Standard Rating Conditions specified in Tables 3, 4, and 6. Standard Ratings related to Cooling or Heating Capacities shall be net values, including the effects of circulating fan heat, but not including supplementary heat. Standard Ratings shall be stated as total Cooling Capacity and total Heating Capacity.

Standard Ratings shall be based on the total power input to the compressor(s) and fan(s), plus controls and other items required as part of the system for operation at Standard Rating Conditions.

Standard Ratings of units which do not have indoor air-circulating fans furnished as part of the model, i.e., split systems with indoor coil alone, shall be established by subtracting 1,250 Btu/h per 1,000 cfm from the total Cooling Capacity, and by adding the same amount to the Heating Capacity. Total power input for both heating and cooling shall be increased by 365 W per 1,000 cfm of indoor air circulated.

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Standard Ratings of water-cooled units from 65,000 to below 135,000 Btu/h shall include a total allowance for cooling tower fan motor and circulating water pump motor power inputs to be added in the amount of 10.0 W per 1,000 Btu/h Cooling Capacity.

Standard ratings for water cooled equipment shall be based on a fouling factor of 0.0000 $hr \cdot ft^2 \cdot {}^oF/Btu$.

6.1.1 *Values of Standard Capacity Ratings.* These ratings shall be expressed in terms of Btu/h in multiples of 1,000.

6.1.2 *Values of Energy Efficiency Ratios and Coefficients of Performance.* Energy Efficiency Ratio (EER) and Integrated Energy Efficiency Ratio (IEER) for cooling, whenever published, shall be expressed in multiples of the nearest 0.1. Coefficients of Performance (COP_H) for heating, whenever published, shall be expressed in multiples of the nearest 0.01.

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Table 3. Conditions for Standard Rating and Operating Tests

Test		Indoor Section[5]		Outdoor Section[7]					
		Air Entering		Air Entering				Water	
				Air Cooled		Evaporative			
		Dry-bulb, °F	Wet-bulb, °F	Dry-bulb, °F	Wet-bulb, °F	Dry-bulb, °F	Wet-bulb, °F	In, °F	Out, °F
Cooling	Standard Rating Conditions Cooling[3, 6]	80.0	67.0	95.0	75.0[1]	95.0	75.0	85.0	95.0
	Low Temperature Operating Cooling[3, 6]	67.0	57.0	67.0	57.0	67.0	57.0	--	70.0[2]
	Maximum Operating Conditions[3, 6]	80.0	67.0	115	75.0	100	80.0[4]	90.0[2]	--
	Part-Load Conditions (*IEER*)[3, 6]	80.0	67.0	Varies with load per Table 6	Varies with load per Table 6[1]	Varies with load per Table 6	Varies with load per Table 6	Varies with load per Table 6[2]	Varies with load per Table 6
	Insulation Efficiency[3, 6]	80.0	75.0	80.0	75.0	80.0	75.0	--	80.0
	Condensate Disposal[3, 6]	80.0	75.0	80.0	75.0	80.0	75.0	--	80.0
Heating	Standard Rating Conditions (High Temperature Steady State Heating)[6]	70.0	60.0	47.0	43.0	--	--	--	--
	Standard Rating Conditions (Low Temperature Steady State Heating)[6]	70.0	60.0	17.0	15.0	--	--	--	--
	Maximum Operating Conditions[6]	80.0	--	75.0	65.0	--	--	--	--

Footnotes:

1. The wet-bulb temperature condition is not required when testing air cooled condensers which do not evaporate condensate.
2. Water flow rate as determined from Standard Rating Conditions Test.
3. Cooling rating and operating tests are not required for heating only heat pumps.
4. Make-up water temperature shall be 90°F.
5. Indoor fan system external static pressure shall be set per Table 4.
6. All ratings are at standard atmospheric pressure. Measured data shall be corrected to an atmospheric pressure of 14.696 psia in accordance with Appendix D.
7. For some product classifications, the outdoor section may be located indoors.

6.1.3 *Standard Rating Tests*. Table 3 indicates the tests and test conditions which are required to determine values of standard full load capacity ratings and values of energy efficiency. Standard cooling ratings are not applicable for heating-only heat pumps.

6.1.3.1 *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 to be

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published.

6.1.3.2 *Atmospheric Pressure Corrections*. Standard Ratings for all products covered by this standard shall be based on a standard air atmospheric pressure of 14.696 psi. Cooling and Heating Capacity, EER, IEER and COP measurements obtained during test shall be corrected to Standard Air using the procedure in Appendix D. The test shall not be conducted if the atmospheric pressure is below 13.7 psia.

6.1.3.3 *Indoor Airflow Rate.*

6.1.3.3.1 All full load Standard Ratings shall be determined at the Full Load Rated Indoor Airflow. All airflow rates shall be expressed in terms of Standard Air, which has a density of 0.075 lb/ft^3. Recirculated air at 100% shall be used. A tolerance of ± 3% is allowed for tested values relative to the rated airflow.

6.1.3.3.2 All Part Load tests as required for the determination of IEER, other than MZVAV rated units shall be conducted at the Part Load Rated Indoor Airflow as specified by the manufacturer. Recirculated air at 100% shall be used. A tolerance of ± 3% is allowed for tested values relative to the rated airflow.

6.1.3.3.3 For MZVAV units, the airflow rate at part load shall be adjusted to maintain the supply air dry-bulb temperature measured at full load. Recirculated air at 100% shall be used.

6.1.3.3.4 Equipment which does not incorporate an indoor fan, but is rated in combination with a device employing a fan shall be rated as described under Section 6.1. For equipment of this class which is rated for general use to be applied to a variety of heating units, the indoor airflow rate shall be the lesser of:

6.1.3.3.4.1 The manufacturer specified Standard Ratings, not to exceed 37.5 scfm/1000 Btu/h of rated capacity; or

6.1.3.3.4.2 The airflow rate obtained through the indoor coil assembly when the pressure drop across the indoor coil assembly and the recommended enclosures and attachment means is not greater than 0.30 in H_2O.

6.1.3.3.5 For combined heating and cooling units the heating airflow and static shall be based on one of the following procedures

6.1.3.3.5.1 *Common Cooling and Heating Full Load Airflow*. For units that only have one rated airflow for cooling then when in heating operation the heating standard airflow (scfm) shall be the same as the cooling airflow ± 3% without regard to the resulting external static. The fan speed should first be set in the cooling mode and then when in heating no adjustments shall be made to the unit and only the code tester adjusted to obtain the rating airflow.

6.1.3.3.5.2 *Different Cooling and Heating Full Load Airflow*. If the unit is equipped with automatic controls that adjust the fan speed in heating, the airflow shall be at the Standard Air, scfm, specified by the manufacturer and using the static per Equation 1.

$$ESP_{HFL} = ESP_{CFL} \cdot \left(\frac{scfm_{HFL}}{scfm_{CFL}}\right)^2 \quad (1)$$

Where:

ESP_{CFL}= External static pressure at full load cooling rated, in H_2O
ESP_{HFL}= External static pressure at full load heating rated airflow, in H_2O
$scfm_{CFL}$ = Standard Supply Airflow at cooling full load rated conditions, scfm
$scfm_{HFL}$ = Standard Supply Airflow at heating full load rated conditions, scfm

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Table 4. External Static Pressure	
Rated Cooling Capacity, Btu/h•1000[1]	External Static Pressure, in H_2O[2, 3]
65 ≤ 70	0.20
71 ≤ 105	0.25
106 ≤ 134	0.30
135 ≤ 210	0.35
211 ≤ 280	0.40
281 ≤ 350	0.45
351 ≤ 400	0.55
401 ≤ 500	0.65
≥ 501	0.75

Footnotes:
1. Rated full load Cooling Capacity for units with cooling function; high temperature Heating Capacity for heating-only units.
2. The tolerance for external static pressure shall be determined using Section F4, Appendix F.
3. Standard ratings shall be determined and tested with manufacturer standard, lowest level of air filtration. For units with no filters or optional filters, refer to Section E3.2.1.

6.1.3.4 *Outdoor Airflow Rate.* All Standard Ratings shall be determined at the outdoor airflow rate at zero external static pressure. Where the fan drive is non-adjustable, the Standard Ratings shall be determined at the outdoor airflow rate inherent in the equipment. For adjustable speed fans, the outdoor fan speed shall be set as specified by the manufacturer or as determined by automatic controls. Once established, no changes affecting outdoor airflow shall be made unless automatically adjusted by unit controls.

6.1.3.4.1 *Double-ducted*. For product intended to be installed with the outdoor airflow ducted, the unit shall be installed with outdoor coil ductwork installed per manufacturer installation instructions and shall operate at 0.0 in H_2O external static pressure. External static pressure measurements shall be made in accordance with Section 6.4 and Section 6.5 of ASHRAE Standard 37.

6.1.3.5 *Requirements for Separate Assemblies.* All Standard Ratings for split systems shall be determined with 25 ft of interconnecting tubing on each line, with a maximum vertical separation of 10 ft. When interconnecting tubing is furnished as an integral part of the equipment and is not recommended for cutting to length, the equipment shall be tested with the complete length of tubing furnished, or with 25 ft of tubing, whichever is greater. At least 5.0 ft of the interconnecting 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.

6.1.3.6 *Full Load Indoor Fan External Static Pressures.* Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment shall be rated at the external static pressures in Table 4 at the Full Load Rated Indoor Airflow and capacity specified in Section 6.1.3.3. The tolerance for external static pressure shall be determined using Section F4, Appendix F.

Indoor air-moving equipment not intended for use with field installed duct systems (free discharge) shall be rated at 0.0 in H_2O external pressure.

6.1.3.7 *Part Load External Static and Airflow*. For part load testing the following procedures shall be used for indoor airflow and static.

6.1.3.7.1 *Fixed Speed Indoor Fan* Control - For fixed speed indoor fans the airflow rate shall be

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held constant at the Full Load Rated Indoor Airflow ±3%.

6.1.3.7.2 *Discrete Step Indoor Fan Control* - For units using discrete step fan speed control, the fan speed shall be adjusted as specified by the controls and the external static shall be reduced per Equation 2 below based on Part Load Rated Indoor Airflow and shall be maintained at the value -0.00 /+0.05 in H_2O.

$$ESP_{PL} = ESP_{FL} \cdot \left(\frac{scfm_{PL}}{scfm_{FL}}\right)^2 \quad (2)$$

Where:

ESP_{FL}= External static pressure at full load airflow, in H_2O
ESP_{PL}= External static pressure at part load airflow, in H_2O
$scfm_{FL}$ = Standard Supply Airflow at full load rated conditions, scfm
$scfm_{PL}$ = Standard Supply Airflow at part load rated conditions, scfm

6.1.3.7.3 Variable Speed SZVAV Fan Control - For SZVAV units, the fan speed shall be adjusted as specified by the controls and the minimum external static shall be reduced per Equation 2 based on Part Load Rated Indoor Airflow.

6.1.3.7.4 Variable Speed MZVAV Fan Control - For MZVAV units, the Part Load Rated Indoor Airflow shall be adjusted to maintain the supply air dry-bulb temperature measured at full load within a tolerance of ± 0.5ºF and the minimum external static shall be reduced per Equation 2 based on the resulting part load airflow.

If the full load measured leaving air dry-bulb temperature cannot be met at part load Rating Conditions due to controls limitations of the unit capacity and airflow modulation, then the part load rating point shall be run at the minimum step of unloading and minimum fan speed allowed by the controls, and the external static per Equation 2.

6.2 *Part Load Rating.* All equipment rated in accordance with this standard shall include an Integrated Energy Efficiency Ratio (IEER), even if they only have one stage of Cooling Capacity control.

6.2.1 *IEER Background*. The IEER has been developed to represent a single metric for the annualized performance of the mechanical cooling system**.** It is based on a volume weighted average of 3 building types and 17 climate zones and includes 4 rating points at 100%, 75%, 50% and 25% load at condenser conditions seen during these load points. It includes all mechanical cooling energy, fan energy and other energy required to deliver the mechanical cooling, but excludes operating hours seen for just ventilation, economizer operation and does not include system options like demand ventilation, Supply Air reset, energy recovery and other system options that might be applied on a job. The purpose of the metric is to allow for comparison of mechanical cooling systems at a common industry metric set of conditions. It is not intended to be a metric for prediction of building energy use for the HVAC systems.

Building energy consumption varies significantly based on many factors including, but not limited to, local occupancy schedules, ambient conditions, building construction, building location, ventilation requirements and added features like economizers, energy recovery, evaporative cooling, etc. IEER is comparative metric representing the integrated full load and part load annualized performance of the mechanical cooling of the air- conditioning unit over a range of operating conditions. It does not include performance of hybrid system features like economizers, energy recovery and heat reclaim. IEER is not intended to be a predictor of the annual energy consumption of a specific building in a given climate zone. To more accurately estimate energy consumption of a specific building an energy analysis using an hour-by-hour analysis program should be performed for the intended building using the local weather data.

6.2.1.1 *IEER Requirements.* The general equations used for calculation of the IEER are defined in Section 6.2.2.

To help in the application of the general equations specific step by step procedures have been included in

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the following sections for various product classifications in Table 5.

Table 5. Section References for Different Product Classifications	
Product Classifications	Section Reference
IEER for Fixed Capacity Controlled Units	6.2.4
IEER for Staged Capacity Controlled Units	6.2.5
IEER for Proportionally Controlled Units	6.2.6

For calculation examples showing the procedures for calculating the IEER see Appendix G.

6.2.2 *General IEER Equations.* For units covered by this standard, the IEER shall be calculated using test derived data and the Equation 3.

$$IEER = (0.020 \cdot A) + (0.617 \cdot B) + (0.238 \cdot C) + (0.125 \cdot D) \quad 3$$

Where:

A = EER at 100% Capacity at AHRI Standard Rating Conditions (see Table 3)
B = EER at 75% Capacity and reduced condenser temperature (see Table 6)
C = EER at 50% Capacity and reduced condenser temperature (see Table 6)
D = EER at 25% Capacity and reduced condenser temperature (see Table 6)

The IEER rating requires that the unit efficiency be determined at 100%, 75%, 50%, and 25% Percent Load at the conditions specified in Table 6 and at the part load rated airflow, if different than the full load rated airflow.

The EER at 100% Capacity is the Standard Energy Efficiency Ratio. No additional test at 100% Cooling Capacity is required.

Table 6. IEER Part-Load Rating Conditions[1, 2, 3]	
Conditions	Condition
Indoor Air	
Return Air Dry-bulb Temperature	80.0°F
Return Air Wet-bulb Temperature	67.0°F
Part Load Rated Indoor Airflow	Note 1
Condenser (Air Cooled)	100% Load = 95ºF
Entering Dry-bulb Temperature (OAT)	75% Load = 81.5ºF
	50% Load = 68.0ºF
	25% Load = 65.0ºF
Condenser Airflow Rate, cfm	Note 2
Condenser (Water Cooled)	100% Load = 85ºF
Entering Condenser Water Temperature (EWT)	75% Load = 73.5ºF
	50% Load = 62.0ºF
	25% load = 55.0ºF
Condenser Water Flow Rate, gpm	full load flow
Condenser (Evaporatively Cooled)	100% Load = 74.5ºF
Entering Wet-Bulb Temperature (EWB)	75% load = 66.2ºF
	50% Load = 57.5ºF
	25% Load = 52.8ºF

Notes:

1. Refer to Section 6.1.3.7 for indoor airflow and static
2. Condenser airflow shall be adjusted, if required per Section 5.1.6.
3. The atmospheric pressure is standard atmospheric pressure, 14.696 psia (See Appendix D for test correction procedure and limitations).

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6.2.3 *Rating Adjustments.* The IEER shall be determined at the 4 ratings loads and condenser conditions as defined in Table 6. If the unit is not capable of running at the 75%, 50% or 25% load then Section 6.2.3.1 or Section 6.2.3.2 shall be followed to determine the rating at the required load.

6.2.3.1 *Interpolation*. If the units cannot run at the 75%, 50% or 25% points within a tolerance of ± 3% but is capable of running at load above and below the rating load of 75%, 50% or 25% interpolation of the test points shall be used to determine the EER rating at the 75%, 50% or 25% loads.

Note: In this edition of the AHRI Standard 340/360, the part load rating condenser temperatures have been fixed at the 100%, 75%, 50% and 25% values shown in Table 6. In the 2007 standard these were a function of the actual load. This change does not impact the units that can run at the 75%, 50%, and 25% load conditions; however, for interpolating ratings the condenser temperature is now fixed at the 75%, 50% and 25% rating points. As a result, two tests at different loads above and below the rating point shall be used for interpolating ratings. For example, if the unit is an air cooled unit and the rating at a 75% load is being determined, but the unit can only run at 80% load and 60% load, then the unit can be run at those percent part loads at the same outdoor air temperature and the 75% rating can interpolated (see Figure 1). Figure 1 also shows the difference between the AHRI Standard 340/360 2007 and 2015 editions.

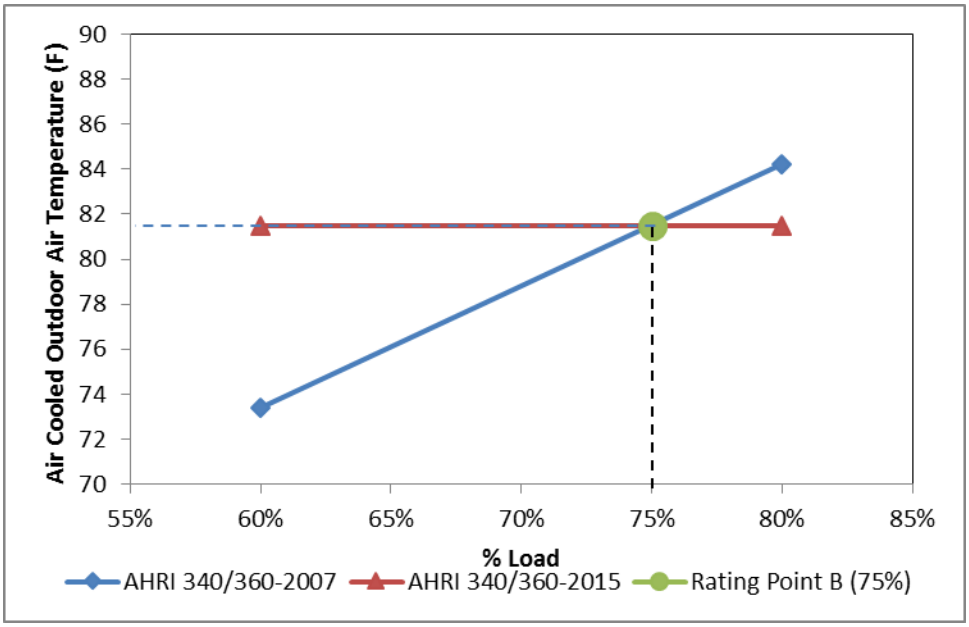


Figure 1. Example Revised Part Load Ambient Conditions for Interpolation

6.2.3.2 *Degradation*. If the unit cannot be unloaded to the 75%, 50%, or 25% load then the unit shall be run at the minimum step of unloading and minimum rated indoor airflow at the condenser conditions defined for each of the rating Percent Load IEER points listed in Table 6 and then the part load EER shall be adjusted for cyclic performance using Equation 4. All rating test data shall be adjusted to standard atmospheric pressure per Appendix E.

$$EER = \frac{LF \times Q_{corr}}{LF \times [C_D \times (P_C + P_{CD})] + P_{IF\,corr} + P_{CT}} \quad (4)$$

Where:

C_D = The degradation coefficient to account for cycling of the compressor for capacity less than the minimum step of capacity. C_D shall be determined using Equation 5.

P_C = Compressor power at the lowest machine unloading point operating at the desired part load rating condition, watts

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P_{CD} = Condenser Section power, if applicable at the desired part load rating condition, watts. For air cooled and evaporatively cooled units this power is the power of the fans and pumps. For water cooled units with a capacity of 65,000 Btu/h to less than 135,000 Btu/h it shall be the cooling tower power allowance per Section 6.1. Above 135,000 Btu/h, it shall be 0.

P_{CT} = Control circuit power and any auxiliary loads, watts

$P_{IF\ corr}$ = Atmospheric pressure corrected indoor fan motor power as per Appendix D at the fan speed for the minimum step of capacity, watts

Q_{corr} = Atmospheric pressure corrected Cooling Capacity as per Appendix D at the lowest machine unloading point operating at the desired part load rating condition, Btu/h

$$C_D = (-0.13 \cdot LF) + 1.13 \quad (5)$$

Where:

LF = Fractional "on" time for last stage at the desired load point, Noted in Equation 6.

$$LF = \frac{\left(Percent\ Load/_{100}\right) \cdot Full\ Load\ Net\ Capacity}{Part\ Load\ Net\ Capacity} \quad (6)$$

Note: For test verified ratings the Load Factor shall be based on test data corrected to standard atmospheric pressure.

6.2.4 Procedure for *IEER Calculations for Fixed Capacity Control Units.* For fixed capacity control units (single stage), the IEER shall be calculated using data and the Equation 4 and the following procedures.

The following sequential steps shall be followed:

6.2.4.1 *Step 1.* Each of the three part load rating points for 75%, 50% and 25% load shall be determined at the part load rating condenser entering temperature defined in Table 6 within tolerances defined in ASHRAE Standard 37 Table 2b.

Note: Because the unit only has a single stage of capacity, the actual Percent Load will be greater than the required rating Percent Load and the cyclic performance will be adjusted using the degradation calculations as per step 3. Part-load rated airflow, if different than full load airflow, shall be used as defined by the manufacturer, and with an external static as specified in the Section 6.1.3.7.

6.2.4.2 *Step 2.* All test data shall then be corrected for atmospheric pressure, as defined in Appendix D.

6.2.4.3 *Step 3.* The atmospheric pressure corrected rating shall be adjusted for cyclic degradation using the procedures in Section 6.2.3.

6.2.4.4 *Step 4.* The atmospheric corrected test results including adjustments for cyclic degradation from step 3 shall then be used to calculate the IEER using the procedures defined in Section 6.2.2. For example calculations, see Appendix G.

6.2.5 *IEER for Staged Capacity Controlled Units.* For Staged Capacity Controlled Units covered by this standard, the IEER shall be calculated using Equation 3 and the following procedures.

Staged Capacity Controlled units, for test purposes, shall be provided with the manual means to adjust the stages of refrigeration capacity and the indoor fan speed to obtain the rated airflow with the tolerance defined in Section 6.1.3.7.

The following sequential steps shall be followed.

6.2.5.1 *Step 1.* For part load rating points, the unit shall be configured per the manufacturer's instructions, including setting of stages of refrigeration for each part load rating point. The stages of refrigeration that

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