ANSI/AHRI Standard 600-2023 (I-P)

2023 Standard for

Performance Rating of Water/Brine to Air Heat Pump Equipment

Approved by ANSI on 5 October 2023

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

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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 tests conducted under its standards/guidelines will be non-hazardous or free from risk.

ICS Code: 27.080

Note:

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

For SI ratings, see AHRI Standard 601 (SI), which is currently under development.

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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.

2023 Edition

This edition of AHRI Standard 600, *Performance Rating of Water/Brine to Air Heat Pump Equipment*, was prepared by the Geothermal and Water-Source Heat Pump Standards Technical Committee. The standard was approved by the Unitary Standards Subcommittee on 11 September 2023. This standard was approved as an American National Standard (ANS) on 5 October 2023.

Origin and Development of AHRI Standard 600

In the last few years the DOE has promoted moving commercial WSHP's to IEER metric. IEER is not a recognized metric by ISO so AHRI began the development of a separate AHRI 600 IEER Calculation Methodology Standard for WSHP as simply an IEER calculation methodology using original ISO/AHRI/ANSI/ASHRAE 13256:98 performance data. This draft AHRI 600 WSHP IEER calculation standard did go out for public review in the fourth quarter of 2022, but development was shortly thereafter halted.

After a review, the WSHP standards committee felt the recommended DOE changes diverged so significantly from ISO/AHRI/ANSI/ASHRAE 13256:98 standard that it warranted development of a new AHRI standard and recommended eventually abandoning ISO/AHRI/ANSI/ASHRAE 13256:98. Therefore, beginning in first quarter 2023 a new expanded AHRI 600 Performance Rating of Water/Brine to Air Heat Pump Equipment was developed using AHRI 340/360 as a framework and included the IEER methodology from the original AHRI 600. The current version is complete with commercial metrics and includes IEER calculation requirements. The committee's next task is to add in the residential seasonal metric sections using AHRI 210/240 as inspiration.

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Committee Personnel

Geothermal and WSHP Standards Technical Committee

Participant	Interest Category Classification	Voting Member Role	State / Country
Robert Brown, Chair WaterFurnace International, Inc., ClimateMaster, Inc.	Product Manufacturer	Chair	IN, USA
George Baker Modine Manufacturing Company	Product Manufacturer	Primary	WI, USA
Beth Braddy Trane U.S. Inc.	Product Manufacturer	Primary	GA, USA
Craig Buschur Total Green Mfg. Corp.	Product Manufacturer	Primary	OH, USA
Daniel Ellis Comfortworks, Inc.	Product Manufacturer	Primary	OK, USA
Henry Ernst Daikin Applied Americas Inc.	Product Manufacturer	Primary	MN, USA
Kevin Grundy Systemair Inc.	Product Manufacturer	Primary	ON, CA
Albin Ivanowski Mitsubishi Electric Cooling & Heating	Product Manufacturer	Primary	GA, USA
Dan Jackson Enertech Global, LLC	Product Manufacturer	Primary	IL, USA
Yogesh Magar Packless Industries, Inc.	Product Manufacturer	Primary	TX, USA
Jeromy Snyder UL Solutions	Testing Laboratory	Primary	KY, USA
Kevin Teakell Aaon, Inc.	Product Manufacturer	Primary	OK, USA
Alexander Ussery Intertek	Testing Laboratory	Primary	NY, USA
Richard Weekley FHP Manufacturing Company, Bosch Thermotechnology Corp	Product Manufacturer	Primary	FL, USA
William Buschur Total Green Mfg. Corp.	Product Manufacturer	Alternate for Craig Buschur	OH, USA
Caesar Chan Systemair Inc.	Product Manufacturer	Alternate for Kevin Grundy	ON, CA
Armen Davtyan FHP Manufacturing Company, Bosch Thermotechnology Corp	Product Manufacturer	Alternate to Richard Weekley	FL, USA
Piyush Desai Packless Industries, Inc.	Product Manufacturer	Alternate for Yogesh Magar	TX, USA
Benny DiMarco Daikin Applied Americas Inc.	Product Manufacturer	Alternate for Henry Ernst	MN, USA
Tim Hammond WaterFurnace International, Inc., ClimateMaster, Inc.	Product Manufacturer	Alternate for Robert Brown	IN, USA
Rick Hand WaterFurnace International, Inc., ClimateMaster, Inc.	Product Manufacturer	Alternate for Robert Brown	IN, USA
Shawn Hern WaterFurnace International, Inc., ClimateMaster, Inc.	Product Manufacturer	Alternate for Robert Brown	IN, USA
Rohit Hemade Modine Manufacturing Company	Product Manufacturer	Alternate for George Baker	WI, USA
Byron Horak Intertek	Testing Laboratory	Alternate for Alexander Ussery	NY, USA

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Participant	Interest Category Classification	Voting Member Role	State / Country
Jok Konghuayrob Mitsubishi Electric Cooling & Heating	Product Manufacturer	Alternate for Albin Ivanowski	GA, USA
Jitendra Malik Systemair Inc.	Product Manufacturer	Alternate for Kevin Grundy	ON, CA
Venkatesh Mantalwad Trane U.S. Inc.	Product Manufacturer	Alternate for Beth Braddy	TN, USA
Charles Meaker Enertech Global, LLC	Product Manufacturer	Alternate for Dan Jackson	IL, USA
Ian McIver FHP Manufacturing Company, Bosch Thermotechnology Corp	Product Manufacturer	Alternate to Richard Weekley	FL, USA
Brent Stockton Aaon, Inc.	Product Manufacturer	Alternate for Kevin Teakell	OK, USA
Satoshi Tsujita Mitsubishi Electric Cooling & Heating	Product Manufacturer	Alternate for Albin Ivanowski	GA, USA
Aroon Viswanathan Modine Manufacturing Company	Product Manufacturer	Alternate for George Baker	WI, USA
John Bade 2050 Partners	—	Non-voting	—
Damon Bosetti Dandelion Energy	—	Non-voting	—
Sean Faltermeier Guidehouse	—	Non-voting	—
Arjun Mahal Guidehouse	—	Non-voting	—
Mark Umland Guidehouse	—	Non-voting	—
Joscha Mueller Lawrence Berkeley National Laboratory	—	Non-voting	—
Scott Young Lawrence Berkeley National Laboratory	—	Non-voting	—
Catherine Rivest U.S. Department of Energy	—	Non-voting	—
Troy Watson U.S. Department of Energy	—	Non-voting	—
Rupal Choksi Madison IAQ	—	Non-voting	—
Achintya Prasad	AHRI Staff Liaison		

Geothermal and WSHP Standards Technical Committee Scope:

The Geothermal and Water Source Heat Pump Standards Technical Committee is responsible for the development and maintenance of AHRI standards and guidelines pertaining to Water-Source, Ground Water-Source, and Ground-Source Closed-Loop Heat Pumps equipment; Calculation of Integrated Energy Efficiency Ratio (IEER) and Simultaneous Heating and Cooling Efficiency (SCHE) for Water-Source Heat Pumps; Direct Geo exchange Heat Pumps; Water-to-Air Heat Pumps and Brine-to-Air Heat Pumps Seasonal Efficiency Ratings Calculations.

The following product types are out of scope for this STC: Unitary Small Equipment, Packaged Terminal AC/HP, Commercial or Industrial AC/HP, Furnaces, Variable Refrigerant Flow (VRF), Single Package Vertical Unit (SPVU), and Performance Rating of Zoning products.

For product definitions refer to the AHRI website sector pages.

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Unitary Standards Subcommittee

Participant	Interest Category Classification	Voting Member Role	State / Country
Henry "Skip" Ernst Daikin Applied	Product Manufacturer	Chair	MN, USA
Robert Brown WaterFurnace International, Inc.	Product Manufacturer	Primary	IN, USA
Bradley Dunn United CoolAir Corp.	Product Manufacturer	Primary	PA, USA
Dana Fischer Mitsubishi Electric Cooling & Heating	Product Manufacturer	Primary	GA, USA
Armin Hauer ebm-papst Inc.	Product Manufacturer	Primary	CT, USA
Jeffrey Kellow GE Appliances, a Haier Company	Product Manufacturer	Primary	KY, USA
David Koesterer Nortek Global HVAC LLC	Product Manufacturer	Primary	MO, USA
Lane Liudahl Trane U.S. Inc.	Product Manufacturer	Primary	WI, USA
Sachin Nehete Rheem Sales Company, Inc.	Product Manufacturer	Primary	GA, USA
Bruce Perkins Lennox International Inc.	Product Manufacturer	Primary	TX, USA
Patrick Riley Carrier Corp.	Product Manufacturer	Primary	IN, USA
Karl Best	AHRI Staff Liaison		

Unitary Standards Subcommittee Scope:

The scope of the Unitary Standards Subcommittee is standards and guidelines related to the end products that are part of the AHRI Unitary Industry Sector. (The definition of and list of products associated with each sector are found on the AHRI website sector pages.)

These lists represent the membership at the time the Standards Technical Committee and Standards Subcommittee were balloted on the final text of this edition. Since that time, changes in the membership may have occurred. Membership on these committees shall not in and of itself constitute an endorsement by the committee members or their employers of any document developed by the committee on which the member serves.

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Unitary Consensus Body

Participant	Interest Category Classification	Company
Henry Ernst	Product Manufacturer	Daikin Applied Americas Inc.
Caroline Henley	Testing Laboratory	UL Solutions
Lanny Huffman	Consumer/User	Hickory Sheet Metal
Jennifer Kane	Product Manufacturer	Trane Technologies
Stephen Kowalski	Testing Laboratory	Oak Ridge National Laboratory
Joe Pessa	Component Manufacturer	Dynamic Air Quality Solutions
Aniruddh Roy	General Interest	Energy Solutions
Doug Tucker	Product Manufacturer	Mitsubishi Electric Cooling & Heating

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PERFORMANCE RATING OF WATER/BRINE TO AIR HEAT PUMP EQUIPMENT

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 for *water/brine to air heat pump equipment*:

Section 2. Scope

2.1 Scope

This standard applies to factory-made *water/brine to air heat pump equipment* as defined in Section 3.

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

2.2 Exclusions

This standard does not apply to the following:

- Rating and testing of independent components, such as condensing units or coils, for separate use
- Air-cooled unitary air-conditioners and unitary heat pumps as defined in AHRI 210/240, with capacities less than 65,000 Btu/h
- Commercial and industrial unitary air-conditioning and heat pump equipment as defined in AHRI 340/360 (I-P)
- Variable refrigerant flow air-conditioners and heat pumps as defined in AHRI 1230
- Rating of units equipped with *desuperheater*/water heating devices, as defined in AHRI 470, in operation
- Commercial and industrial unitary air-conditioning condensing units with a capacity greater than 135,000 Btu/h as defined in AHRI 365 (I-P)

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.

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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 Economizer

An automatic system that enables a cooling system to supply and use outdoor air to reduce or eliminate the need for mechanical cooling during mild or cold weather, provides energy efficiency improvements on an annualized basis, and is a function of regional ambient conditions.

3.2.2 Air Sampling Device(s)

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.

3.2.2.1 Air Sampling Tree

An assembly consisting of a manifold with branch tubes with multiple sampling holes that draws an air sample from the indoor air inlet or outlet.

3.2.2.2 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.

3.2.2.3 Dew-point Hygrometer

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

3.2.3 Barometric Relief Dampers

An assembly with dampers that open when there is a positive pressure differential.

3.2.4 Basic Model

All systems within a single equipment class, as defined in 10 CFR Part 431, having the same primary energy source, such as electricity or natural gas, and that have the same or comparable compressors, same or comparable heat exchangers, and same or comparable nominal capacity.

3.2.5 Coated Coils

An indoor coil or outdoor coil whose entire surface, including the entire surface of both fins and tubes, is covered with a thin continuous non-porous coating to reduce corrosion.

3.2.6 Coefficients of Performance

3.2.6.1 Coefficient of Performance (COP)

A ratio of the *heating capacity* in watts to the power input values in watts at any given set of *rating conditions* expressed in watts/watt.

3.2.6.2 Applied Coefficient of Performance (ACOP)

A ratio of the *heating capacity* in watts to the power input values in watts at *standard rating conditions* H2, including system pump and cooling tower power, expressed in watts/watt, as determined in Section 6.4.5.

3.2.7 Coil-only Indoor Unit

An *indoor unit* that is distributed in commerce without an indoor fan or separate designated air mover, and when installed in the field, relies on a separately installed furnace or modular blower for indoor air movement.

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3.2.8 Compressor Modulation

3.2.8.1 Compressor Modulation Level

The level of operation of the unit that is determined by the number of compressors operating and the modulation level of each operating compressor. The modulation level of a single compressor is determined by the speed, pulse width, mechanical loading, and any other operating parameters that affect the continuous capacity of the compressor at a single set of operating conditions.

3.2.8.2 Intermediate Compressor Modulation Level

A *compressor modulation level* that results in a continuous capacity between that of the minimum and *maximum compressor modulation levels*. Section 6.3.2.4 and Section 6.3.2.5 specify requirements used in this standard.

3.2.8.3 Maximum Compressor Modulation Level

The *compressor modulation level* that results in the maximum continuous capacity allowed by the controls at a single set of operating conditions.

3.2.8.4 Minimum Compressor Modulation Level

The *compressor modulation level* that results in the minimum continuous capacity allowed by the controls at a single set of operating conditions.

3.2.9 Condenser Pump/Valves/Fittings

Additional components in the water/brine circuit for flow control or filtering.

3.2.10 Condenser Water Reheat

A heat exchanger located downstream of the indoor coil that heats the supply air during cooling operation using water from the condenser coil to increase the ratio of moisture removal to *cooling capacity* provided by the equipment.

3.2.11 Constant-Volume Fan

A fan with automatic adjustment of operating speed to provide a fixed airflow rate.

3.2.12 Cooling Capacity

The capacity associated with the change in air enthalpy that includes both the latent and sensible capacities expressed in Btu/h.

3.2.12.1 Latent Capacity

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

3.2.12.2 Sensible Capacity

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

3.2.13 Desiccant Dehumidification Components

An assembly that reduces the moisture content of the *supply air* through moisture transfer with solid or liquid desiccants.

3.2.14 Desuperheater

A heat exchanger located downstream of the compressor on the high-pressure vapor line that moves heat to an external source, such as potable water.

3.2.15 Energy Efficiency Ratios

3.2.15.1 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).

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3.2.15.2 Applied Energy Efficiency Ratio (AEER)

A ratio of the full-load *cooling capacity* in Btu/h to the power input values in watts at *standard rating conditions* C3, including system pump and cooling tower power, expressed in Btu/(W·h), as determined in Section 6.3.11.2.

3.2.16 Evaporative Cooling of Ventilation Air

Indirectly or directly cooling ventilation air with water.

3.2.16.1 Direct Evaporative Cooling of Ventilation Air

A system that introduces water directly into the ventilation air.

3.2.16.2 Indirect Evaporative Cooling of Ventilation Air

A system where water is evaporated in secondary air stream and the heat is removed through a heat exchanger.

3.2.17 Fire/Smoke/Isolation Dampers

A damper assembly that includes means to open and close the damper mounted at the supply or return duct opening of the equipment.

3.2.18 Fixed Capacity Controlled Units

Products limited by the controls to a single stage of refrigeration capacity.

3.2.19 Fresh Air Dampers

An assembly with dampers and means to set the damper position in a closed and one open position to draw air into the equipment when the indoor fan is operating.

3.2.20 Full Load Rated Indoor Airflow

The *standard airflow* rate at 100% capacity as defined by the *manufacturer's installation instructions* and at the full-load cooling external static pressure (ESP).

3.2.21 Grill Options

Special grills used to direct airflow in unique applications such as up and away from a rear wall.

3.2.22 Heating Capacity

The capacity associated with the change in dry-bulb temperature between the air entering the unit and the air leaving the unit and includes the heat of circulation fan(s) and motor(s) but does not include supplementary heat, expressed in Btu/h.

3.2.23 High-effectiveness Indoor Air Filtration

Indoor air filters with greater air filtration effectiveness than the *standard filter*.

3.2.24 Hot Gas Bypass

A method for adjusting *cooling capacity* that diverts a portion of the high pressure, hot gas refrigerant from the source heat exchanger to the low-pressure portion of the refrigerant system.

3.2.25 Indoor Side

The part of the system that removes heat from or adds heat to the indoor airstream.

3.2.26 Indoor Unit

The portion of a split heat pump that houses the *indoor side* and can include other components.

3.2.27 Integrated Energy Efficiency Ratio (IEER)

A weighted calculation of mechanical cooling efficiencies at *standard rating conditions*, expressed in Btu/(W·h), as determined in Section 6.3.9.

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3.2.28 Low-static Heat Pump

Ducted equipment that produces greater than 0.10 in H_20 ESP and less than 0.40 in H_20 ESP when operated at the full load cooling airflow rate.

3.2.29 Manufacturer Instructions

3.2.29.1 Manufacturer's Installation Instructions

Manufacturer's documents that come packaged with or appear in the labels applied to the unit(s), as specified in Section 5.4.2.1.

3.2.29.2 Supplemental Test Instructions (STI)

Additional instructions developed by the manufacturer and certified to the United States Department of Energy (DOE), as specified in Section 5.4.2.2.

3.2.29.3 Manufacturer-specified

Information provided by the manufacturer through *manufacturer's installation instructions* or *STI*.

3.2.30 Non-Standard Low-Static Indoor Fan Motor

An indoor fan motor for a unit with a rated cooling capacity of 75,000 Btu/h, or greater, that cannot maintain ESP as high as specified in Section 5.5 when operating at the *full load rated indoor airflow* and is distributed in commerce as part of an individual model within the same basic model distributed in commerce with a different motor specified for testing that can maintain the required ESP.

3.2.31 Outdoor Side

The part of the system that rejects heat to or absorbs heat from the water or brine.

3.2.32 Outdoor Unit

The portion of a split heat pump that houses the *outdoor side* and can include other components.

3.2.33 Part Load Rated Indoor Airflow

The *standard airflow* at the part-load rating conditions as defined by the *manufacturer's installation instructions* and at the part-load ESP. This can be different for each part-load rating point.

3.2.34 Percent Load

The ratio of the *cooling capacity* at any set of *rating conditions*, to the calculated *cooling capacity* at IEER point A in in Table 10, expressed in units of percent, %.

3.2.35 Power Correction Capacitors

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

3.2.36 Powered Exhaust Air Fan

A fan that transfers directly to the outside a portion of the building air that is returning to the unit, rather than the building air recirculating to the indoor coil and back to the building.

3.2.37 Powered Return Air Fan

A fan that draws building air into the equipment.

3.2.38 Process Heat Recovery / Reclaim Coils / Thermal Storage

A heat exchanger located inside the unit that conditions the equipment's *supply air* using energy transferred from an external source using a vapor, gas, or liquid.

3.2.39 Proportionally Capacity Controlled Units

Units incorporating one or more variable-speed or variable-capacity compressors where the unit capacity can be modulated continuously or in steps not more than 5% of full-load capacity over a range of at least 50% to 100% of full-load capacity.

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3.2.40 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*.

3.2.40.1 Application Rating

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

3.2.40.2 Standard Rating

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

3.2.41 Rating Conditions

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

3.2.42 Refrigerant Reheat Coils

A heat exchanger located downstream of the indoor coil that heats the *supply air* during cooling operation using high pressure refrigerant to increase the ratio of moisture removal to *cooling capacity* provided by the equipment.

3.2.43 Single Package Heat Pumps

Units that are assembled or designed to be assembled in a single unit (within a single factory-made enclosure).

3.2.44 Sound Traps/Sound Attenuators

An assembly of structures where the supply air passes before leaving the equipment or where the return air from the building passes immediately after entering the equipment where the sound insertion loss is at least 6 dB for the 125 Hz octave band frequency range.

3.2.45 Split System Heat Pump

Heat pump designed with an *outdoor unit* that is installed remotely from the indoor coil, air handler, or fan coil and requiring field connection by refrigerant lines.

3.2.46 Staged Capacity Controlled Units

Units incorporating only fixed capacity or discrete steps of compression and are limited by the controls to multiple stages of refrigeration capacity. Units that have multiple stages of refrigeration that do not meet the definition of Section 3.2.39, *proportionally capacity controlled units*, meet this definition.

3.2.47 Standard Air

In I-P units, air weighing 0.075 lb/ft^3 that approximates dry air at 70°F and at a barometric pressure of 29.92 in Hg.

3.2.48 Standard Airflow

The volumetric flowrate of air converted to *standard air* conditions expressed in standard cubic feet per minute (scfm).

3.2.49 Standard Filter

The filter with the lowest level of filtration that is distributed in commerce with a model, as specified in Section 5.4.5.

3.2.50 Standard Rating Conditions

Rating conditions used as the basis of comparison for performance characteristics.

3.2.51 Steam/Hydronic Heat Coils

Coils used to provide supplemental heating that use steam or liquid as the working fluid.

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3.2.52 Supply Air

Air delivered by a unit to the conditioned space expressed as *standard air*.

3.2.53 UV Lights

A lighting fixture and lamp that shines light on the indoor coil, emitting ultraviolet light to inhibit growth of organisms on the indoor coil surfaces, the condensate drip pan, or other locations within the equipment.

3.2.54 Ventilation Energy Recovery System (VERS)

A system that preconditions outdoor air entering the unit through direct or indirect thermal or moisture exchange, or both thermal and moisture exchange, with the exhaust air.

3.2.55 Water/Brine to Air Heat Pump Equipment

A heat pump that consists of one or more factory-made assemblies with an indoor conditioning coil with air-moving means (except that *coil-only indoor units* do not have air-moving means), compressor(s), and refrigerant-to-water or refrigerant-to-brine heat exchanger(s), including means to provide both cooling and heating, cooling-only, or heating-only functions.

3.2.56 Waterside Economizer

A heat exchanger located upstream of the indoor coil that conditions the *supply air* when system water loop conditions are favorable so as not to utilize compressor operation.

Section 4. Classifications

Water/brine to air heat pump equipment within the scope of this standard shall be classified as shown in Table 1 and Table 2.

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Table 1 Classification of Water/Brine to Air Conditioning Equipment

Designation	AHRI Type[1,2]	Arrangement – Indoor (ID)	Arrangement – Outdoor (OD)
Single Package and Indoor Package Air-conditioners	WBAC[4]	—	ELECTRIC HEAT[3] CD PUMP[3] ID FAN COMPRESSOR EVAPORATOR CONDENSER
Indoor Package Air-conditioners	WBAC-O[4]	ELECTRIC HEAT3 CD PUMP[3] ID FAN COMPRESSOR EVAPORATOR CONDENSER	—
Split System Air-conditioners: Condensing Unit, Coil Alone	WBAC-C[4]	ELECTRIC HEAT[3] EVAPORATOR	CD PUMP[3] ELECTRIC HEAT3 COMPRESSOR ID FAN CONDENSER
Split System Air-conditioners: Condensing Unit, Coil and Fan	WBAC-CB	ELECTRIC HEAT[3] ID FAN EVAPORATOR	CD PUMP[3] COMPRESSOR CONDENSER

Notes:

1. A suffix of "-O" following any of the above classifications indicates equipment not intended for use with field-installed duct systems.
2. Components can be installed indoors as well in accordance with the *manufacturer's installation instructions*.
3. Optional component.
4. Can be any other heat source except for electric strip heat.

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Table 2 Classification of Water/Brine to Air Heat Pump Equipment

Designation	AHRI Type[1,2]	Arrangement - Indoor (ID)	Arrangement – Outdoor (OD)
Single Package and Indoor Package Heat Pumps	WBAHP[4]	—	ELECTRIC HEAT[3] CD PUMP[3] ID FAN COMPRESSOR EVAPORATOR CONDENSER
Indoor Package Heat Pump	WBAHP-O[4]	ELECTRIC HEAT[3] CD PUMP[3] ID FAN COMPRESSOR EVAPORATOR CONDENSER	—
Split System Heat Pump: Condensing Unit, Coil Alone	WBAHP-C[4]	ELECTRIC HEAT[3] EVAPORATOR	CD PUMP[3] COMPRESSOR CONDENSER
Split System Heat Pump: Condensing Unit, Coil and Fan	WBAHP-CB	ELECTRIC HEAT[4] ID FAN EVAPORATOR	CD PUMP[3] COMPRESSOR CONDENSER

Notes:

1. A suffix of "-O" following any of the above classifications indicates equipment not intended for use with field-installed duct systems.
2. Components can be installed indoors as well in accordance with the *manufacturer's installation instructions*.
3. Optional component.
4. Can be any other heat source except for electric strip heat.

Section 5. Test Requirements

5.1 Summary

Perform all *standard rating* tests in accordance with ASHRAE 37, including the errata sheet issued 27 March 2019, and the additional requirements in Section 5 of this standard. In cases where there is a conflict, the language of this standard takes precedence over the language of ASHRAE 37.

5.2 Capacity Measurement

5.2.1 Primary Capacity Measurement

Use the indoor air enthalpy method specified in Section 7.3 of ASHRAE 37 as the primary method for capacity measurement.

5.2.2 Secondary Capacity Measurement

Use the outdoor liquid coil method, refrigerant enthalpy method, or compressor calibration method specified in Table 1 of ASHRAE 37 as a secondary method for capacity measurement for all tests.

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5.2.2.1 Outdoor Liquid Coil Method

5.2.2.1.1 ASHRAE 37 Requirements

If using the outdoor liquid coil method for secondary capacity measurement, follow all requirements in ASHRAE 37 relevant for the outdoor liquid coil method.

5.2.2.1.2 Agreement with Primary Capacity Measurement

The secondary capacity measurement from the outdoor liquid coil method shall be within ± 6% of the primary capacity measurement for all tests, including part-load tests.

5.2.2.2 Refrigerant Enthalpy Method

5.2.2.2.1 ASHRAE 37 Requirements

If using the refrigerant enthalpy method for secondary capacity measurement, follow all requirements in ASHRAE 37 relevant for the refrigerant enthalpy method, except that Section 7.5.1.3 of ASHRAE 37 does not apply for part-load cooling tests. Refrigerant enthalpy method measurements shall be taken for part-load tests regardless of the measured subcooling or superheat.

5.2.2.2.2 Agreement with Primary Capacity Measurement

The secondary capacity measurement from the refrigerant enthalpy method shall be within ± 6% of the primary capacity measurement for all full-load cooling tests and all heating tests. A match between primary and secondary measurements is not required for part-load cooling tests.

5.2.2.2.3 Refrigerant Flow Measurement Device

Refrigerant flow measurement device(s) shall be either elevated at least two ft from the test chamber floor or placed upon insulating material having a total thermal resistance R-value of at least 12 hr · ft^2 · °F/Btu and extending at least one ft laterally beyond each side of the exposed surfaces of the device(s).

5.2.2.2.4 Evaluation of Saturation Temperature

Saturation temperature shall be evaluated based on the pressure transducer located between the indoor coil and the compressor for the given operating mode, that is heating or cooling.

5.2.2.3 Compressor Calibration Method

5.2.2.3.1 ASHRAE 37 Requirements

If using the compressor calibration method for secondary capacity measurement, follow all requirements in ASHRAE 37 relevant for the compressor calibration method.

5.2.2.3.2 Evaluation of Saturation Temperature

Saturation temperature shall be evaluated based on the pressure transducer located between the indoor coil and the compressor for the given operating mode, that is heating or cooling.

5.3 Instrumentation

5.3.1 Power Measurements

Either power (in W) or integrated power (in W·h) shall be measured. Units with digitally modulating compressors require either an integrated power measurement or power measurements recorded at intervals not longer than one second.

5.3.2 Air Conditions

The air conditions shall be measured using the procedures defined in Appendix C.

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5.3.3 Induction Watt-hour Meter

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

5.3.4 Atmospheric Pressure Instrument Accuracy

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

5.3.5 Electrical Frequency Instrument Accuracy

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

5.3.6 Methanol Content Measurement Uncertainty

The uncertainty of measurement for the methanol content of the aqueous methanol solution shall be ± 1.5 percentage points of solution concentration by mass or less.

5.4 Installation and Setup

5.4.1 Optional System Features

Use Appendix D to determine the optional system features to be included and activated during the tests.

5.4.2 Instructions

5.4.2.1 Manufacturer's Installation Instructions

Units shall be installed in accordance with the *manufacturer's installation instructions*. 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 similar references means *manufacturer's installation instructions*.

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

5.4.2.2 Supplemental Test Instructions (STI)

STI are defined in Section 3.2.29.2 and shall include both:

1) all instructions that do not deviate from *manufacturer's installation instructions* but provide additional specifications for test standard requirements that can have more than one option
2) all deviations from *manufacturer's installation instructions* 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 *manufacturer's installation instructions*. *STI* shall not include instructions that deviate from *manufacturer's installation instructions* other than those described in Section 5.4.2.2(2).

5.4.2.3 Conflicting Instructions

In the event of conflicting instructions regarding the setup of the unit under test, excluding charging instructions for split systems, priority shall be given to installation instructions that appear on the unit's label over installation instructions that are shipped with the unit.

In the event of conflicting charging instructions for split systems, see Section 5.4.2.4.

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5.4.2.4 Split Systems

In the event of conflicting charging instructions for split systems, 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. For split systems, if the *manufacturer's installation instructions* for the components conflict, priority shall be given to the *outdoor unit* instructions over the *indoor unit* instructions, except for provisions regarding setting indoor airflow and ESP. For setting indoor airflow and ESP for such a split system, priority shall be given to the *indoor unit* instructions over the *outdoor unit* instructions.

5.4.3 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 liquid entering temperature shall not exceed 104°F. 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.

5.4.4 Recirculated Indoor Air

Use 100% recirculated indoor air in all tests.

5.4.5 Indoor Air Filter

Tests shall be completed with the *standard filter* installed. The *standard filter* is the indoor air filter with the lowest level of filtration that is distributed in commerce with a model. If the manufacturer does not specify what filter option has the lowest level of filtration in *manufacturer's installation instructions* or marketing materials for the model, then the *standard filter* shall be the filter designated as the default filter or the standard filter in the marketing materials for the model. If the manufacturer does not specify a default filter option or the filter option that has the lowest filtration level, then the *standard filter* shall be any filter shipped by the manufacturer.

5.4.6 Duct Installation Requirements

ASHRAE 37 duct requirements shall be followed, except as specified in Section 5.4.7.

The test apparatus including the interconnecting ductwork shall be insulated to have a minimum R-value of 13 $ft^2 \cdot °F \cdot hr/Btu$. Duct losses can be calculated using conduction factors, inside air and outside ambient temperature difference, and the total duct surface area between the unit and the temperature measurement location. Ducts that are exposed to multiple ambient temperatures shall be divided into zones and each zone calculated separately.

5.4.7 Non-Ducted Units

5.4.7.1 Free Air Test

A preliminary free air test shall be conducted prior to connecting a plenum, as specified in Section 5.4.7.3, ducting, and indoor air-side test apparatus to the unit. Airflow rate shall be set in accordance with Section 5.6. Operating tolerances defined in Table 7 shall be met for at least ten minutes, except for tolerances for indoor leaving air dry-bulb temperature, indoor leaving air wet-bulb temperature, ESP, and nozzle pressure drop. Record the average indoor fan power and average refrigerant temperature at the midpoint of the return bend of the indoor coil. After connecting the plenum, duct, and indoor air-side test apparatus to the unit, adjust the fan of the indoor air-side test apparatus attached to the duct as necessary to achieve the required plenum pressure of 0.00 in H_2O ESP with a tolerance of -0.00/+0.05 in H_2O.

The fan settings used for the preliminary free indoor air test shall remain unchanged throughout the full-load cooling test. Confirm that indoor fan power measured with the indoor air-side test apparatus connected is within 2% of the average values measured for the free air test. Confirm that refrigerant temperature at the midpoint of the return bend of the indoor coil is within 0.5°F of the average values measured for the free air test. Increase plenum size if necessary to match the measured values within these tolerances.

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5.4.7.2 Inlet Plenum

An inlet plenum for non-ducted units shall not be used.

5.4.7.3 Outlet Plenum and Duct Requirements

For non-ducted units, a plenum (enlarged duct box) shall be installed between the duct and the *indoor unit*, as depicted in Figure 1. The plenum shall have a cross-sectional area at least two times the area of the *indoor unit* combined outlet. For all outlets, the plenum shall extend for a distance of at least 3.5 times the square root of the cross-sectional area of the units combined outlet prior to any duct transitions, elbows, or *air sampling tree* used for air condition measurement.

If elbows are connected to the end of the plenum, the elbows shall have a centerline radius equal to at least 1.5 times the duct width in the elbow's radial direction or have turning vanes. Air velocities calculated as measured volume flow divided by duct or plenum cross-sectional area shall not exceed 250 ft per minute inside the plenum and 500 ft per minute in the connecting duct at the connection to the plenum. Figure 1 shows a plenum construction example.

Manifolded static pressure taps shall be installed in the plenum in at least four locations spaced uniformly around the plenum in accordance with Section 6.5 of ASHRAE 37. The static pressure taps shall be located at a distance from the outlet equal to 2.8 times the square root of the cross-sectional area of the combined outlets. Static pressure in the plenum shall be maintained within 0.05 in H_2O of ambient pressure.

Air sampling trees used for temperature measurement shall be placed in the duct between the airflow measurement apparatus and the minimum required plenum length.

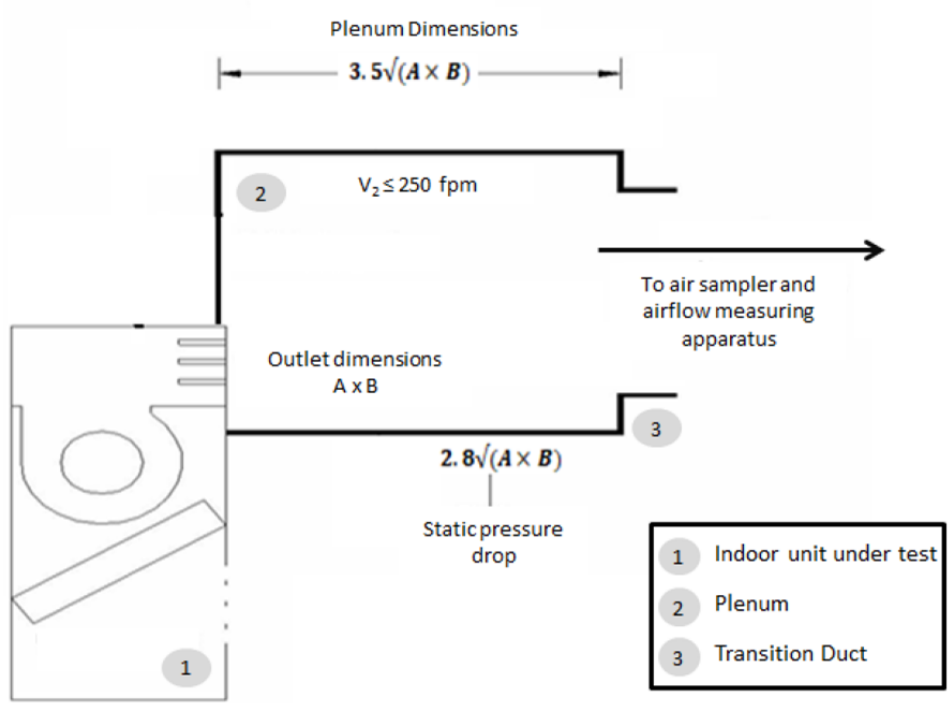


Figure 1 Example Test Setup for Outlet Plenum for Non-Ducted Units (Informative)

5.4.8 Units Too Tall for Test Chamber

If the height of the unit under test plus a vertical outlet duct with pressure taps for measuring ESP compliant with Section 6.4.2.1 or Section 6.4.3 of ASHRAE 37 is both greater than 14 ft and too tall for the test chamber, use the limited-height approach in Appendix E.

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