OPERATIONS MANUAL

WATER-SOURCE HEAT PUMPS CERTIFICATION PROGRAM For 60 Hz Products

AHRI WSHP OM - JANUARY 2018

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PREFACE

The following manual outlines the procedures and policies of the Performance Certification Program for Water-Source Heat Pumps (WSHP) operated by the Air-Conditioning, Heating, and Refrigeration Institute (AHRI). This manual is to be used in conjunction with the AHRI General Operations Manual (OM) for AHRI Certification Programs. Where the AHRI General Operations Manual and this product-specific manual differ, this product-specific operations manual shall prevail.

The revision of this manual supersedes all previous revisions. The current edition of this manual, as well as the AHRI General Operations Manual, can be accessed through the AHRI website, www.ahrinet.org.

The WSHP Certification Program by AHRI provides for independent verification of the Water-Source Heat Pumps manufacturers' stated equipment performance. Safety criteria are not within the scope of this program.

Participation in the program is voluntary. Any manufacturer, regardless of AHRI membership, may obtain approval of Program Ratings and use of the AHRI WSHP Certification Mark hereinafter referred to as the "Mark". The Mark is the Participant's public representation that the ratings of randomly selected samples have been verified by an independent laboratory in accordance with test procedures prescribed by this operations manual. A Certification Agreement is executed between the manufacturer and AHRI specifying the conditions under which such Ratings and the Mark may be used. No manufacturer has the right to use Program Ratings or to state that their products have been tested in conformance with the procedures outlined in this Rating Procedure unless and until they have received written authority from AHRI to use the Mark as applied to the specific approved Program Ratings.

This Operations Manual has been prepared to assure that administration of the program is carried out in a uniform manner. It is an amplification of the Certification Agreement signed by licensees and AHRI. General information, procedural details, and copies of forms are included in this Operations Manual. Provisions of the Operations Manual may be amended as provided in the Certification Agreement.

This certification program complies with requirements of the ISO/IEC Standard 17065:2012, *General Requirements for Bodies Operating Product Certification Systems.*

Note:

This manual supersedes Water-Source Heat Pumps Operations Manual, January 2017.
For 50 Hz products, refer to the Water-Source Heat Pumps Operations Manual for 50 Hz Products.

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CERTIFICATION OPERATIONS MANUAL FOR

WATER-SOURCE HEAT PUMPS

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1. Program Overview

1.1 *Applicable Rating Standard*. It is mandatory for program Participants to comply with the provisions of the latest editions of ANSI/AHRI/ASHRAE/ISO Standard 13256-1 *Water-source heat pumps - Testing and rating for performance - Part 1: Water-to-Air and brine-to-air heat pumps* and ANSI/AHRI/ASHRAE/ISO Standard 13256-2 *Water-source heat pumps - Testing and rating for performance - Part 2: Water-to-Water and brine-to-water heat pumps* (Standard).

1.2 *Product Definitions*. All terms in this document shall follow the AHRI General Operations Manual and the Standard definitions unless otherwise defined in this section.

1.2.1 *Water-Source Heat Pump (WSHP).* WSHPs may consist of one (1) or more factory-made assemblies that include indoor space conditioning and/or domestic water heating heat exchanger(s), compressor(s), and a liquid-side heat exchanger. When provided in more than one (1) assembly, the separate assemblies are designed to be used together. WSHPs may provide space heating, space cooling, domestic water heating, or a combination of these functions and may also include the functions of liquid circulation, thermal storage, air circulation, air cleaning, dehumidifying or humidifying. There are two (2) classes of WSHPs:

1.2.1.1 *Water-to-Air Heat Pump*. A heat pump which consists of one (1) or more factory-made assemblies which normally include an indoor conditioning coil with 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. When such equipment is provided in more than one (1) assembly, the separated assemblies should be designed to be used together. Such equipment may also provide functions of domestic water heating and hydronic space heating, air cleaning, dehumidifying, and humidifying.

1.2.1.2 *Water-to-Water Heat Pump.* A heat pump which consists of one (1) or more factory-made assemblies which normally include an indoor-side refrigerant-to-water heat exchanger, compressor(s), and an outdoor-side refrigerant-to-water or refrigerant-to-brine heat exchanger(s), including means to indirectly provide both cooling and heating, cooling-only, or heating-only functions. When such equipment is provided in more than one assembly, the separated assemblies should be designed to be used together.

1.2.2 *Water-Source Heat Pump Applications*. WSHPs use circulating liquid as a thermal energy source/sink to provide space conditioning and/or domestic water heating. WSHPs are designed for use in the following applications, with those that utilize the thermal energy of the ground or groundwater classified as geothermal heat pumps.

1.2.2.1 *Water-loop Heat Pump Application (WLHP)*. A WSHP using liquid circulating in a common piping loop and functions as a heat source/heat sink. The temperature of the water is usually mechanically controlled within a temperature range of 15°C [59°F] to 40°C [104°F].

1.2.2.2 *Ground-loop Heat Pump Application (GLHP)*. A WSHP using a liquid circulating through a subsurface piping loop placed in horizontal trenches, vertical bores, or submerged in a body of surface water. The temperature of the liquid is related to the climatic conditions and may vary from –5°C [23°F] to 40°C [104°F].

1.2.2.3 *Ground-water Heat Pump Application (GWHP).* A WSHP using water pumped from a well, body of surface water, or reclaimed water supply. The temperature of the water is related to the climatic conditions and may vary from 5°C [41°F] to 25°C [77°F] for deep wells.

1.2.3 *Total Cooling Capacity*. Amount of sensible and latent heat that the equipment can remove from the conditioned space in a defined interval of time, in W [Btu/h], as determined by specified test methods in the Standard.

1.2.4 *Net Total Cooling Capacity*. Total Cooling Capacity with fan power adjustment, in W [Btu/h].

1.2.5 *Heating Capacity*. Amount of heat that the equipment can add to the conditioned space in a defined interval of time, in W [Btu/h], as determined by specified test methods in the Standard.

1.2.6 *Net Heating Capacity*. Heating Capacity with fan power adjustment, in W [Btu/h].

1.2.7 *Rated Voltage*. Voltage shown on the nameplate of the equipment, in V.

1.2.8 *Rated Frequency*. Frequency shown on the nameplate of the equipment, in HZ.

1.2.9 *Energy Efficiency Ratio (EER)*. Ratio of the Net Total Cooling Capacity to the effective power input at any given set of rating conditions, in W/W [Btu/h/W].

1.2.10 *Coefficient of Performance (COP)*. Ratio of the Net Heating Capacity to the effective power input of the equipment at any given set of rating conditions, in W/W [Btu/h/W].

1.2.11 *Standard Air*. Dry air at 20.0°C [68.0°F] and 101.324 kPa [14.696 lb/in^2] having a mass density of 1.204 kg/m^3 [0.07516 lb/ft^3].

1.2.12 *Effective Power Input*. Average electrical power input to the equipment within a defined interval of time, in W; i.e., the sum of:

- power input for operation of the compressor excluding additional electrical heating devices;
- power input of all control and safety devices of the equipment; and
- Proportional power input of the conveying devices for the transport of the heat transfer media through the heat pump only (e.g., fans, pumps, whether internal or external, whether provided with the equipment or not).

1.3 *Program Scope*. This program applies to 60Hz Production Models of WSHPs , as defined in Section 1.2, rated below 39,500W [135,000 Btu/h] in cooling and 58,600W [200,000 Btu/h] in heating at ISO Standard Rating Conditions.

1.3.1 *Program Scope Exclusions.* The Standard does not apply to the rating and testing of individual assemblies such as condensing units or coils, for separate use.

1.4 *Intended Market*. The Intended Market for this certification program, includes all products defined in Section 1.3 that are sold for use in the U.S. (including U.S. Territories) and Canada. Production Models operating at 60 Hz sold for use outside the U.S. and Canada may be optionally certified.

1.5 *Basic Model Group (BMG)*. A Participant's listings shall be grouped by BMG. A BMG shall consist of a model or models with the same or comparable compressor used with the same or comparable refrigerant-to-liquid heat exchanger. This definition applies to both package units and split systems. A Water-to-Air Heat Pump shall not be in the same BMG as a Water-to-Water Heat Pump.

1.5.1 *Optional Subdivision by Indoor Blower Motor Type.* A Participant has the option to further subdivide BMGs by indoor blower motor type.

2. Qualification Process

2.1 *Original Equipment Manufacturer (OEM) Applicants*. With the additions noted below, the OEM qualification process shall proceed according to the AHRI General Operations Manual, Section 4.

STEP 2.1.1 *Certification Application Package*. In addition to the Application for AHRI Certification, Annual Sales Volume Form, and product-specific ratings and data, noted in the AHRI General Operations Manual, Section 4, STEP 4.1, Applicants shall submit the following documentation to AHRI:

- One test report for each BMG;
- An Applicant requesting AHRI to submit data to CEC, DOE, and NRCan shall submit third-party authorization, compliance forms and other necessary information; and
- Additional information may be needed to meet EPA ENERGY STAR® program requirements.

Electronic forms shall be obtained from AHRI. (available on www.ahrinet.org under the Product-Specific Certification Program).

STEP 2.1.2 *Processing Application Package*.

STEP 2.1.2.1 *Performance Certification Agreement for Original Equipment Manufacturer (OEM Agreement)*. No further action required beyond that listed in Section 4, STEP 4.2 of the AHRI General Operations Manual.

STEP 2.1.2.2 *Participation and Licensing Fee Invoice*. Payment of the Participation and Licensing Fee is due within 30 calendar days of the invoice issue date. Testing shall not be conducted until the invoice is paid in full. No further action required beyond that listed in Section 4, STEP 4.2 of the AHRI General Operations Manual.

STEP 2.1.3 *Selection and Acquisition of Test Samples*.

STEP 2.1.3.1 *Number of Qualification Tests*. 30% of an Applicant's total Water-to-Air Heat Pump and Water-to-Water Heat Pump BMGs, shall be tested with a minimum of one (1) model of each type. Fractional numbers shall be rounded to the nearest whole number using traditional rounding methods.

STEP 2.1.3.2 *Acquisition of Qualification Test Samples/Selection Criteria*. Within 30 calendar days of a request from AHRI, the Applicant shall have samples available for selection. Samples shall be acquired in accordance with Section 3 of this manual.

STEP 2.1.4 *Qualification Testing*. AHRI shall supply the Independent Third-party Laboratory Contracted by AHRI (Laboratory) with the Published Ratings. The Laboratory shall conduct the testing of the samples in accordance with the Standard, against the Published Ratings.

STEP 2.1.4.1 *Operating Tests.* In addition to the Performance Rating tests, all qualification tests shall include one of the following Operating Tests, chosen by AHRI, to be conducted at the end of the performance tests for:

- Maximum Operating Conditions Test;
- Minimum Operating Conditions Test;
- Voltage Tolerance Test; or
- Enclosure Sweat and Condensate Test.

If a first sample test fails any Operating Test, a second sample, shall be tested. If the second sample fails any Operating Test, then that model and BMG shall not be entered

into the AHRI Directory of Certified Product Performance (Directory) and the Applicant shall cease production and sale of the failed model and BMG in order to qualify into the certification program. An additional qualification sample shall be selected and tested (if all BMGs have not been tested) to continue the qualification process.

STEP 2.1.4.2 *Successful Completion of All Qualification Tests.* If all qualification tests pass, proceed to STEP 2.1.5.

STEP 2.1.4.3 *First Sample Qualification Test Failure*. Refer to Section 4, STEP 4.4.2 of the AHRI General Operations Manual for details regarding the first sample qualification failure options:

STEP 2.1.4.4 *Second Sample Qualification Test Failure*. Refer to Section 4, STEP 4.4.3 of the AHRI General Operations Manual for details regarding the second sample qualification failure options.

STEP 2.1.5 *Welcome to the Program*. No further action required beyond that listed in Section 4, STEP 4.5 of the AHRI General Operations Manual.

2.2 *Private Brand Marketer (PBM) Applicants*. With the additions noted below, the PBM qualification process shall proceed according to the AHRI General Operations Manual, Section 5.

PBM Applicants are not required to undergo qualification testing. PBM product certification is contingent upon the certification of the associated OEM product.

STEP 2.2.1 *Certification Application Package*. In addition to the Application for AHRI Certification Form noted in the AHRI General Operations Manual, Section 5, STEP 5.1, Applicants shall submit the following documentation to AHRI:

- An Applicant requesting AHRI to submit data to CEC, DOE and NRCan shall submit third-party authorization, compliance forms and other necessary.
- Additional information may be needed to meet EPA ENERGY STAR® program requirements

STEP 2.2.2 *Processing Application Package*.

STEP 2.2.2.1 *Performance Certification Agreement for Private Brand Marketer (PBM Agreement)*. No further action required beyond that listed in Section 5, STEP 5.2.1 of the AHRI General Operations Manual.

STEP 2.2.2.2 *OEM Agreement on Behalf of the PBM Applicant*. No further action required beyond that listed in Section 5, STEP 5.2.2 of the AHRI General Operations Manual.

STEP 2.2.2.3 *Licensing Fee Invoice*. Payment of the Licensing Fee is due within 30 calendar days of the invoice issue date.

STEP 2.2.3 *Welcome to the Program*. No further action required beyond that listed in Section 5, STEP 5.3 of the AHRI General Operations Manual.

3. Equipment Selection and Testing

3.1 *Annual Testing Requirement.* 20% of a Participant's Active Water-to-Air Heat Pump and Water-to-Water Heat Pump BMGs, with a minimum of one (1) model of each type. Fractional numbers shall be rounded to the nearest whole number using traditional rounding methods. Active and Production Stopped models may be selected for testing at AHRI's discretion.

3.2 *Location of Tests*. Testing shall be performed at the Laboratory and the sample shall be installed in the test facility in accordance with the Participant's published installation instructions in printed or electronic format.

3.3 *Selection of Test Samples.* Prior to the start of the testing year, AHRI shall notify the Participant in writing of the number of tests required for the testing year. AHRI shall establish the start and end dates for each quarter in the test year. All model selections for a program year will be issued prior to the start of the first quarter using data found on the Directory. The selection letter will indicate in which quarter each sample is to be tested. Samples shall arrive at the Laboratory by the start of each quarter.

3.4 *Method of Acquiring Test Samples*. AHRI or the Laboratory personnel shall make a Random Sample Selection or Random Component Selection from the Participant's stock inventory within 30 calendar days of selection by AHRI. AHRI, at its discretion, may request that a Laboratory Representative visit a Participant's facility to make a random selection from the facility without sending prior notification about which model(s) has been selected for testing. Selected samples shall be shipped to the Laboratory accompanied by the Participant's published installation instructions in printed or electronic format. Refer to Section 9 of the AHRI General Operations Manual.

3.4.1 *Sample Availability Notification.* The participant shall notify AHRI within seven (7) calendar days of receiving the WSHP Selection Letter if they are not able to make all of the chosen models available for selection within 30 calendar days. If no notification is received after seven (7) calendar days, then the chosen samples must be made available for selection by AHRI or AHRI's representative within 30 calendar days of the WSHP Selection Letter. AHRI-approved model substitutions, must be made available for selection by AHRI or AHRI's representative within 30 calendar days of AHRI's approval.

3.4.2 *60-Day Availability 50% of Chosen Models.* If a Participant notifies AHRI within seven (7) calendar days of the WSHP Selection Letter that one (1) or more of the chosen models cannot be made available for selection by AHRI or AHRI's representative within 30-days of the Sample Availability Notification, then the Participant may identify up to 50% of the models listed on the WSHP Selection Letter to be made available for selection by AHRI or AHRI's representative within 60 calendar days of Sample Availability Notification.

3.4.3 *Pretesting.* Pretesting refers to a procedure by which models that have been chosen by AHRI for the test year undergo performance testing to validate ratings prior to arriving at the third party laboratory. This excludes normal quality checks that are performed on every unit. Once AHRI has chosen the specific model to test, the sample shall not be manipulated in any way by the Participant. Pretesting is specifically prohibited for the selection pool.

3.5 *Sample Acquisition Timeframe*. The Participant shall deliver the selected sample(s) to the Laboratory within 14 calendar days of Random Audit, Random Sample or Random Component Selection by AHRI or Laboratory personnel. Failure to have second samples or replacement samples available within the given timeframe shall forfeit the Participant's opportunity for further testing, and shall be grounds for a program violation.

3.6 *Break-in Operation and Start-up of Test Samples*. A Participant may instruct the Laboratory to operate the equipment for a manufacturer-specified number of "break-in" hours prior to testing. The Participant is required to pay all costs involved.

3.7 *Required Equipment and Test Provisions*. The Laboratory shall give the Participant two (2) or more weeks advanced notification when that Participant's sample is scheduled to be tested. The Laboratory shall give the Participant no less than three (3) calendar days advanced notice prior to the sample's installation into the test room.

The Participant shall provide a complete equipment submittal for each model, which include the following mandatory and suggested information prior to the sample's installation into the test room :

Mandatory
- Published installation instructions in printed or electronic format.
- Punch List

Suggested
- Highlight pertinent items in the installation manual for testing.
- Photograph of manufacturer's test setup.

3.7.1 *Rating Tolerances*. Cooling Capacity, Heating Capacity, EER in cooling and COP in heating shall be based on data obtained in accordance with the provisions of the Standard. In order to pass a certification test, measured test results shall not be less than 95% of the certified ratings.

3.7.2 *Airflow and External Static Pressure Requirements for Water-to-Air Tests.* Refer to Appendix B for Airflow and External Static Pressure Requirements.

3.8 *Certified Data*. In accordance with the Standard, the following certified ratings are verified by test

- Full-load Cooling Capacity, W [Btu/h];
- Full-load Heating Capacity, W [Btu/h];
- EER, Btu/h/W;
- COP, Btu/h/W;
- Part-load Cooling Capacity (if applicable), W [Btu/h];
- Part-load Heating Capacity (if applicable), W [Btu/h];
- Part-load EER (if applicable), Btu/h/W; and
- Part-load COP (if applicable), Btu/h/W.

Certified data at manufacturer's specified Part-load and Full-load shall be verified by test. Capacity ratings below the manufacturer's lowest Part-load value and above the Full-load value shall be considered Application Ratings. A Participant may certify a Full-load Capacity, and up to three (3) Part-load Capacities. For products with Part-load ratings, the highest Part-load Capacity rating in heating or cooling shall be no greater than 85% of the certified Full-load Capacity rating in heating or cooling, respectively.

For models that are capable of operating at more than one (1) Part-load rating point in heating and/or cooling mode, AHRI shall verify the following certified ratings by test:

- Full-load Cooling Capacity;
- Full-load Heating Capacity;
- One random Part-load Cooling point to be selected by AHRI; and
- One random Part-load Heating point to be selected by AHRI.

3.9 *Test Failures*.

3.9.1 *Options Following 1st Sample Failure*. When the Participant is notified of a first sample certified rating failure, the Participant has seven (7) calendar days to select one of the following options:

- Re-rate all models within the failed sample's BMG proportionate to the failed test's lowest rating ratio. The re-rate of the failed certified rating shall affect

corresponding ratings of all models within the BMG. The Participant's listings shall show ratings indicated by the final test(s) along with a "WAS" rating of the original certification;

- Test a second sample of the same model (sample shall be available within 45 calendar days following notification of failure); or Obsolete the model, and all models within the respective BMG; or
- Obsolete the model, which also obsoletes all models within the corresponding BMG.

3.9.2 *Options Following 2nd Sample Failure*. When the Participant is notified of a second-sample certified rating failure, the Participant has seven (7) calendar days to select one of the following options:

- Re-rate all models within the failed sample's BMG proportionate to the failed test's results; or
- Obsolete the model, which also obsoletes all models within the corresponding BMG.

4. Challenge Tests

Refer to Section 10 of the AHRI General Operations Manual.

5. AHRI Directory of Certified Product Performance

All certified products shall be listed in the Directory, www.ahridirectory.org. Certification shall not be implied nor claimed for any product not listed in the Directory. Except as noted below, the Participant shall follow the steps outlined in Section 11 of the AHRI General Operations Manual.

5.1 *Publication of Ratings in Certified Directory*. The information shown in Table 1 pertaining to each Water-to-Air and Water-to-Water model certified shall be published in the Directory:

5.1.1 *Models with Multiple Options for Indoor Blower Motor*. If a Participant offers both Permanent Split Capacitor (PSC) and Electronically Commutated Motor (ECM) indoor blower versions of a given model, then both PSC and ECM versions shall be listed on the AHRI Directory as separate models with unique AHRI reference numbers. The Participant's marketing literature and software shall not conflict with the certified ratings shown on the AHRI Directory. ECM and PSC versions of the same model may be certified as separate BMGs. Models with ECM-type indoor blowers that operate on a fixed torque setting shall be required to list the torque setting and rated airflow.

5.2 *Data Submittal Sheets*. Each Participant shall list its products by BMG. OEM and PBM Participants shall submit/edit product data via the Directory.

Table 1: Publication of Certified Ratings in the Directory

		Water-to-Water	Water-to-Air
AHRI Certified Reference Number		✓	✓
Model Status		✓	✓
Trade/Brand Name		✓	✓
Manufacturer		✓	✓
Model Number		✓	✓
Indoor Model Number		✓	✓
Frequency (50 or 60 Hz)		✓	✓
WLHP, GWHP, GLHP		✓	✓
Full-load Cooling[1]	Capacity (Btu/h)	✓	✓
	EER (Btu/h/Watt)	✓	✓
	Fluid Flow Rate (Gpm)	✓	✓
Full-load Heating[1]	Capacity (Btu/h)	✓	✓
	EER (Btu/h/Watt)	✓	✓
	Fluid Flow Rate (Gpm)	✓	✓
Part-load Cooling[1,2]	Capacity (Btu/h)	✓	✓
	EER (Btu/h/Watt)	✓	✓
	Fluid Flow Rate (Gpm)	✓	✓
Part-load Heating[1,2]	Capacity (Btu/h)	✓	✓
	EER (Btu/h/Watt)	✓	✓
	Fluid Flow Rate (Gpm)	✓	✓
AHRI Type		✓	✓
Eligible for Tax Credit		✓	✓

Notes:
1. If applicable
2. Participants may list up to three (3) Part-load rating points (Capacities and efficiencies) for models with variable capacity.

6. Assessment and Payment of Certification Fees

Refer to Section 9 and 12 of the AHRI General Operations Manual.

7. Issuance of Violations and/or Termination

Refer to Section 14 of the AHRI General Operations Manual.

8. Program Hierarchy, Complaints, and the Appeals Process

Refer to Section 15 of the AHRI General Operations Manual.

9. Proper Use of the AHRI Certification Mark and Claims to Certification

9.1 *Publication of Non-Certified Ratings (Application Ratings)*. Manufacturer's publications may contain Application Ratings. However, certification can only be implied for products operating at Standard Rating Conditions. Where ratings are included that are outside the scope of the certification program, they shall be accompanied by the following statement: "Ratings outside of the scope of the AHRI WSHP Certification Program for 60 Hz Products."

9.2 *Part-load Data*. Whenever ratings are shown, both Full-load and Part-load Ratings shall be clearly listed in all published literature.

APPENDIX A:
Commissioning, Setup, And Start–up Procedure for Water-Source Heat Pumps

A1 *Setup*. The manufacturer shall specify in the installation instructions any special requirements for the certification test. Special care shall be taken for installation of the bottom return samples to ensure proper return airflow. The Laboratory shall provide, to the manufacturer, a photograph of the test setup to be included in the test report. Manufacturers are encouraged to document the external static pressure in the "comments" section of the AHRI Data Submittal Sheet; and again in the required AHRI Testing Punch List.

A2 *Airflow – Fixed Speed Fan Motors*. Ducted heat pumps with integral fans, or those tested in combination with a manufacturer supplied device employing a fixed speed fan, shall be tested at the manufacturer's specified airflow rate when operating against an External Static Pressure (ESP) determined by the test, to obtain the rated airflow. If during the test, the fan fails to stabilize at the specified ESP, the ESP shall be increased in minimal increments closest to those specified by the manufacturer until stable operation, regardless of airflow rate.

Ducted heat pumps which have fixed speed integral fans, or those tested in combination with a manufacturer supplied device employing a fixed speed fan, shall be tested at the airflow rates specified by the manufacturer, or those obtained at zero external static pressure difference, whichever provides the lower airflow rate.

A3 *Airflow – Constant CFM Fan Motors*. Ducted heat pumps with integral fans, or those tested in combination with a manufacturer supplied device employing an Electronically Commutated Motor (ECM) fan, which are capable of maintaining a programmed speed over a range of operating conditions, shall be tested when operating against an ESP defined by the manufacturer. If during the test, the fan fails to stabilize at the specified ESP, the ESP shall be increased or decreased in minimal increments closest to those specified by the manufacturer until stable operation, regardless of airflow rate.

A4 *Variable Capacity/Electronically Driven Compressor Products.* The manufacturer shall make a provision for manual test operation on electronically driven variable capacity compressor product to disable automatic compressor speed change algorithms to allow steady state AHRI certification testing at appropriate certification testing points and capacity levels. If a separate control/component is required, it shall be provided to the testing facility prior to the certification testing date. The product shall maintain steady state conditions at the certified point throughout the duration of the data acquisition.

A5 *Fan Power Correction Factor*. The fan power correction factor as calculated in accordance with the Standard for a sample shall be limited to no more than three percent (3%) of the sample's tested Capacity at Rating Conditions.

A6 *Test Liquids*. Test liquids for water-loop and ground water heat pumps shall be water. The test liquid for ground-loop heat pumps shall be either a 15% solution by mass of sodium chloride in water or a 15% solution by mass of methanol in water. The specific gravity of the methanol in water shall be 0.976 at a solution temperature of 68°F [20°C].

A7 *Airflow*. Ducted heat pumps with integral fans, or those tested in combination with a manufacturer supplied device employing a fan, which are capable of maintaining a programmed speed over a range of operating conditions, shall be tested at the manufacturer's specified airflow rate when operating against an ESP defined by the manufacturer. If during the test, the fan fails to stabilize at the specified ESP, the ESP shall be increased in minimal increments closest to those specified by the manufacturer until stable operation, regardless of airflow rate.

Ducted heat pumps which have fixed speed integral fans, or those tested in combination with a manufacturer supplied device employing a fixed speed fan, shall be tested at the airflow rates specified by the manufacturer, or those obtained at zero external static pressure difference, whichever provides the lower airflow rate. Refer to Appendix B for additional instructions.

Appendix B:
WSHP Airflow and External Static Pressure (ESP) Determination Procedure for Ducted Test Samples

B1 *Required Fan Setup Information*

B1.1 *Electronically Commutated Motor-type (ECM) Constant CFM-type Fans.* For Water-to-Air test samples with ECM fans, the manufacturer shall provide to the Laboratory all instructions required to install the equipment and reach the rated AIRFLOW. The manufacturer shall also provide test-specific setup instructions on the WSHP Punch List, if applicable to the model. Where instructions on either the Punch List or the manufacturer's instructions conflict with the AHRI Directory, the AHRI Directory shall take precedence. For all ECM-type Water-to-Air samples, the manufacturer shall provide the following:

- Fan settings required to reach the rated AIRFLOW for all test points;
- ESP for all modes of operation. This shall be added to the "Comments" section of the AHRI Directory listing; and

B1.1.1 If, after verifying that the installation is consistent with the Installation and Operations Manual (IOM) and contacting the manufacturer, a WSHP test sample with ECM fan motor is still unable to achieve and/or maintain the rated airflow at the specified fan speed setting, then the Laboratory shall adjust the ESP in order to achieve the rated airflow within the tolerance specified in Section B2.1. The adjusted ESP shall not be lower than the corresponding value in Section B2.2.

B1.2 *Permanent-Split Capacitor Motor-Type (PSC) Fans and Constant Torque ECM-type*. For Water-to-Air test samples with PSC fans, the manufacturer shall provide to the Laboratory all instructions required to install the equipment and reach the rated airflow. The manufacturer shall also provide test-specific setup instructions on the WSHP Punch List, if applicable to the model. Where instructions on either the Punch List or the manufacturer's instructions conflict with the AHRI Directory, the AHRI Directory shall take precedence. For all PSC-type Water-to-Air samples, the manufacturer shall provide the following:

- Fan settings required to reach the rated airflow for all test points;
- Airflow for all modes of operation.

B1.2.1 If, after verifying that the installation is consistent with the IOM and contacting the manufacturer, a WSHP test sample with PSC fan motor is still unable to achieve and/or maintain the specified airflow at the specified fan speed setting, then the Laboratory shall adjust the ESP to achieve the rated airflow within the tolerance specified in Section B2. If the Laboratory cannot achieve the rated airflow within the specified tolerance, then the sample will be run at the corresponding minimum ESP specified in Table B2.

B2 *airflow and ESP Requirements.*

B2.1 Airflow and ESP shall not exceed the tolerances specified in Table B1.

Table B1. Variations Allowed in Airflow and ESP Readings

Blower Motor Type	Readings	Maximum variation of individual reading from rating conditions	Variations of arithmetical average values from specified test conditions
ECM Constant Airflow	Air volume flow rate	±20%	±10%
	ESP	±10%	±5%
PSC[1] Constant Torque	Air volume flow rate	±10%	±5%
	ESP[2]	±10%	±5%

Note:
1. PSC motor airflow and ESP conditions are derived from the Standard.
2. If provided by the manufacturer

B2.2 Minimum ESPs for ducted ECM blower-type samples are shown in Table B2.

Table B2: Minimum ESP for ECM-type Water-to-Air Test Samples

Rated Capacity** (Btu/h x 1000)	Minimum External Resistance (in H_2O)
≤ 28.9	0.10
29 ≤ capacity ≤ 42.9	0.15
43 ≤ capacity ≤ 70.9	0.20
71 ≤ capacity ≤ 105.9	0.25
106 ≤ capacity ≤ 135	0.30
** At the respective mode (heating or cooling) and stage of operation (Full or Part-load) being tested.	

B2 *Setup and Startup Procedure.* For Ducted Water-to-Air test samples, the Laboratory shall follow the procedure shown in Figure B-1.

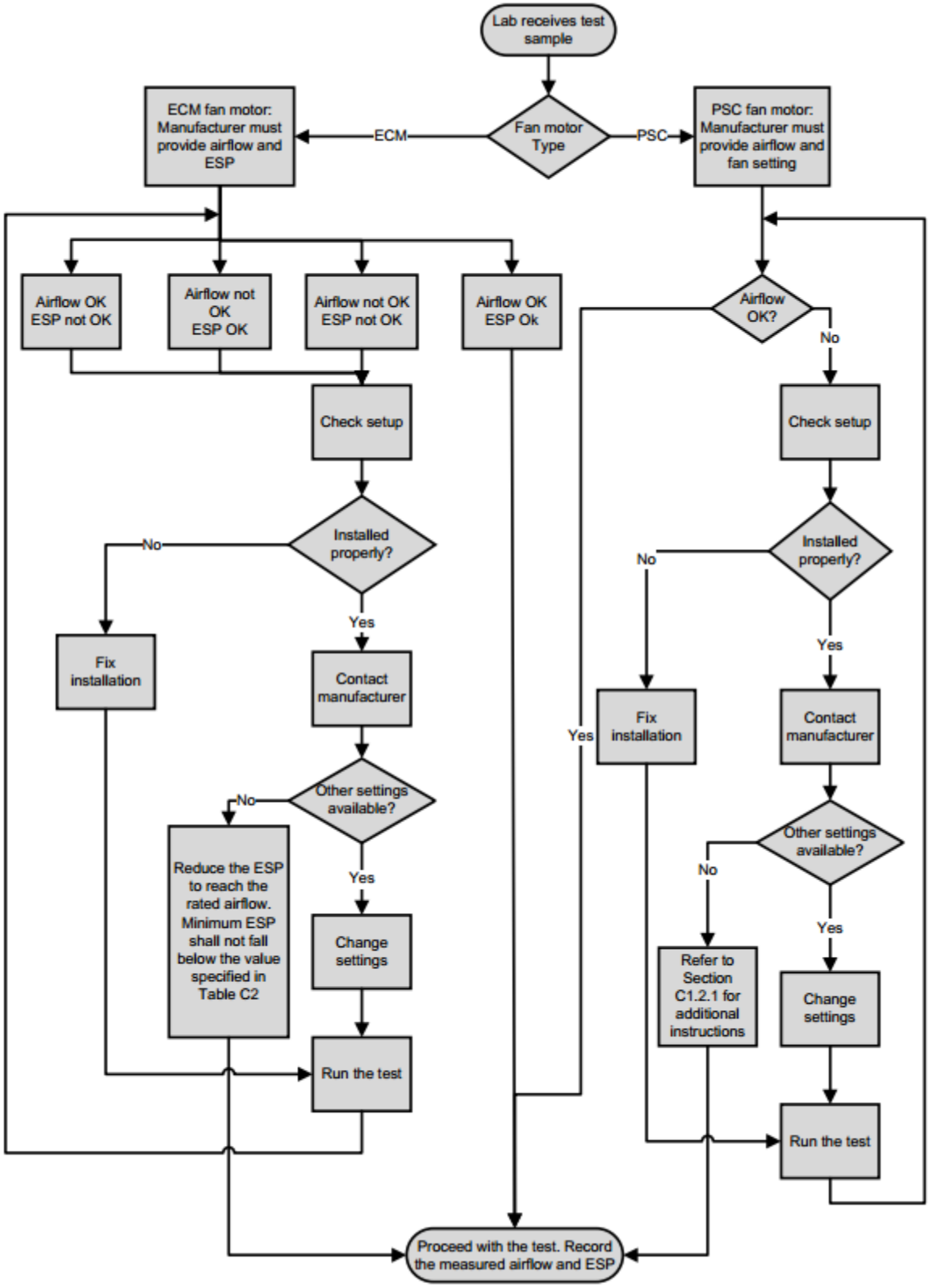

Figure B-1: WSHP airflow and ESP Determination Procedure.

Note that “OK” indicates that the setting is within the tolerance specified in Table B1.