

Software Verification Process

This document is intended for use with the ERV Operations Manual.

1. *The Participant's software shall reflect the following participant decisions:*

- a. **Min and max airflow (SCFM) for the component Q_{\min} and Q_{\max}**
 - i. Software may not generate outputs beyond that range:
Example: Q_{\min} declared as 1500 SCFM, and Q_{\max} declared as 4000 SCFM -- the software may not produce output for 1400 or 4100 SCFM.
 - ii. Participant need not explicitly state Q_{\min} and Q_{\max} in the software interface.
 - iii. Participant does not need to provide Q_{\min} and Q_{\max} to AHRI, except when asked by staff during the verification selection process.

- b. **Min and max Supply Flow Ratio for the component SFR_{\min} and SFR_{\max}**
 - i. Supply flow ratio is defined in AHRI 1060 (I-P/2018) as Station 2 Airflow divided by Station 3 Airflow.
 - ii. Software may not generate outputs below SFR_{\min} or above SFR_{\max} .
 - iii. Table 1 of AHRI 1060 (I-P/2018) defines the range of Standard Rating Conditions for Supply Flow Ratio as 0.5 to 2.0.
 1. Software may generate outputs below that range only if SFR_{\min} is declared at lower than 0.5; these outputs must be identified as application ratings.
 2. Software may generate outputs above that range only if SFR_{\max} is declared at higher than 2.0; these outputs must be identified as application ratings.
 - iv. Participant need not explicitly state SFR_{\min} and SFR_{\max} in the software interface.
 - v. Participant does not need to provide SFR_{\min} and SFR_{\max} to AHRI, except when asked by staff during the verification selection process.

- c. **Max positive and max negative Pressure Differential for the component dp_{\min} and dp_{\max}**
 - i. Software may not generate outputs below dp_{\min} or above dp_{\max}
 - ii. Table 1 of AHRI 1060 (I-P/2018) defines the range of standard rating conditions for Pressure Differential as -5.0 to +5.0 in H₂O.
 1. Software may generate outputs below that range only if dp_{\min} is declared at lower than -5.0 in H₂O; these outputs must be identified as application ratings.
 2. Software may generate outputs above that range only if dp_{\max} is declared at higher than +5.0 in H₂O; these outputs must be identified as application ratings.
 - iii. Participant need not explicitly state dp_{\min} and dp_{\max} in the software interface.
 - iv. Participant does not need to provide dp_{\min} and dp_{\max} to AHRI, except when asked by staff during the verification selection process.

- d. **Bounds of psychrometric conditions within which software outputs can be considered certified are defined in AHRI 1060 (I-P/2018) Table 1.**
 - i. Participant may elect to certify in a smaller contiguous range of conditions, but its software may not provide outputs beyond that smaller range.
 - ii. Software may generate outputs beyond a boundary of the standard bounds but only if its rating zone extends completely to that boundary; those ratings shall be identified as application ratings.
 - iii. Participant need not explicitly state the boundaries in the software interface.

- iv. Participant does not need to provide the boundaries to AHRI, except when asked by staff during the verification selection process.
- e. Participant may elect to limit the software to discrete rating points rather than a continuous map. Only the rating points that can be generated from the software are certified, and the participant is not allowed to publish or provide ratings at any other points by any means.

2. AHRI Staff shall make the following selection decisions on an annual basis:

- a. Staff selects a wildcard thermal point **TP_{WILD}** from either the winter or summer verification zone (used for all verification tests that year).
 - i. Exception: An alternate wildcard thermal point may be selected when the participant's range of software input does not include the selected wildcard thermal point, per section 1.d.
- b. Staff confidentially selects the **Verification Airflow Fraction (VAF)** for use in verification tests that year to determine the **Basic Airflow**. VAF is a number between 0.0 and 1.0.

$$\text{Basic Airflow} = Q_{\min} + \text{VAF} \times (Q_{\max} - Q_{\min})$$

- i. Exception: for a specific model, AHRI staff may select a different VAF, if required due to testing limitations.
 - ii. Examples: Staff has selected a VAF of 0.75.
 - 1. If a participant's declared min and max are $Q_{\min} = 250$ and $Q_{\max} = 1000$ SCFM, the Basic Airflow for this verification test is 813 SCFM.
 - 2. If a participant's declared min and max are $Q_{\min} = 500$ and $Q_{\max} = 1000$ SCFM, the Basic Airflow for this verification test is 875 SCFM.
- c. Staff selects the **Supply Flow Ratio (SFR)** for use in verification tests that year.
 - i. Exception: If a specific sample cannot be tested at that SFR, staff will pick a different SFR for use with that sample. (This could occur because the selected SFR is beyond the range declared by the participant, or because application of the SFR to the Basic Airflow results in a test airflow less than Q_{\min} or greater than Q_{\max} .)
- d. Staff selects the **Verification Differential Pressure Fraction (VdPF)** for use in verification tests that year. VdPF is a value between 0.0 and 1.0.
 - i. Each sample is tested at $dP_{\text{test}} = dP_{\min} + \text{VdPF} \times (dP_{\max} - dP_{\min})$
 - ii. Exception: for a specific model, staff may select a different VdPF if testing limitations require or if the resulting $dP_{\text{test}} = 0.0$ in H₂O.
- e. After model selection, staff will request the participant to provide: Q_{\min} , Q_{\max} , SFR_{\min} , SFR_{\max} , dP_{\min} , dP_{\max} , and bounds of psychrometric conditions supported by software.
 - i. Staff will subsequently confirm these values are aligned with the software.
 - ii. A standardized spreadsheet will be used for data submittal.
- f. If the software provides ratings at discrete points per section 1.e, AHRI staff will adjust the selected test conditions to match the nearest point at which ratings are available. This may require adjustments to **VAF**, **SFR**, **VdPF**, or **TP_{WILD}**. Interpolation between rating points will not be used.

3. Verification Tests shall be performed as follows:

- a. All thermal tests are performed with room air at the current standard conditions (specified in the OM).
- b. Thermal test conditions if TP_{WILD} is from the summer zone:
 - i. Verification test 1 (wildcard): performed at TP_{WILD} (summer) at the **Basic Airflow** and the selected **SFR**.
 - ii. Verification test 2 (standard): performed at the standard winter point, at the **Basic Airflow** and with **SFR = 1.0**.
- c. Thermal test conditions if TP_{WILD} is from the winter zone:
 - i. Verification test 1 (wildcard): performed at TP_{WILD} (winter) at the **Basic Airflow** and the selected **SFR**.
 - ii. Verification test 2 (standard): performed at the standard summer point, at the **Basic Airflow** and with **SFR = 1.0**.
- d. All thermal tests are performed with a static pressure differential of zero.
- e. Leakage test conditions:
 - i. 1st EATR test with tracer gas, OACF is also measured: performed at **pressure differential $dP = 0.0$ in H_2O** , at the **Basic Airflow**.
 - ii. 2nd EATR test with tracer gas, OACF is also measured: performed at **pressure differential $dP = 0.0$ in H_2O** , performed at the airflows at which the wild card thermal test was performed.
 - iii. 3rd EATR test with tracer gas, OACF is also measured: performed at the differential test pressure determined in 2.d, at the Basic Airflows.
 - iv. All leakage verification tests are performed at lab ambient temperature.
- f. Pressure drop verification: supply and exhaust pressure drops measured in the “standard conditions” thermal test will be verified against the software output at that psychrometric condition and airflow.
- g. After the tests are performed, the actual conditions (temperatures, humidities, airflows, pressure differentials, and pressure/altitude) at which the tests were performed will be entered by staff into the software, to generate the ratings to which the measured values are compared.

4. Summary of Metrics Measured (12 total metrics, in 5 tests)

- a. Thermal test at wildcard psychrometric condition picked from the summer or winter zone, static pressure differential of zero, unbalanced flows as determined by the SFR.
 - i. Sensible Effectiveness
 - ii. Latent Effectiveness
- b. Thermal test at standard condition picked from the other zone, balanced flow, static pressure differential of zero, at Basic Airflows.
 - i. Sensible Effectiveness
 - ii. Latent Effectiveness
 - iii. Supply Pressure Drop
 - iv. Exhaust Pressure Drop
- c. Leakage test at 0.0 in H_2O static pressure differential, same Basic Airflows as standard thermal test.
 - i. EATR
 - ii. OACF

- d. Leakage test at 0.0 in H₂O static pressure differential, same unbalanced flows as wildcard thermal test.
 - i. EATR
 - ii. OACF
- e. Leakage test at a wildcard static pressure differential, same Basic Airflows as standard thermal test.
 - i. EATR
 - ii. OACF