AHRI Guideline W (I-P)

2014 Guideline for

Selecting, Sizing, & Specifying Packaged Air-to-Air Energy Recovery Ventilation Equipment

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Note:

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For SI, see AHRI Guideline W (SI)-2014.

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SELECTING, SIZING, & SPECIFYING PACKAGED AIR-TO-AIR ENERGY RECOVERY VENTILATION EQUIPMENT

Section 1. Purpose

1.1 *Purpose.* The purpose of this guideline is to provide information to support the application of Air-to-Air Energy Recovery Ventilation Equipment (AAERVE). This guideline supports AAERVE that is manufactured using Air-to-Air Heat Exchangers (energy recovery components) rated in accordance with AHRI Standard 1060 (I-P). These energy recovery components include Heat Pipe Heat Exchangers, Plate Heat Exchangers, and Rotary Heat Exchangers.

1.1.1 *Intent.* This guideline is intended for the guidance of the industry, including architects, engineers, contractors, manufacturers, and end users.

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

Section 2. Scope

2.1 *Scope.* This guideline applies only to AAERVE.

2.2 *Applications.* This guideline is intended to apply primarily to commercial and institutional applications.

2.3 *Exclusions.* This guideline does not apply to heat exchangers joined by circulated heat transfer medium (run-around loop). A run-around loop employs liquid-containing coils connected in a closed loop and placed in each of two or more airstreams.

Section 3. Definitions

All terms in this document will 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 *Air-to-Air Energy Recovery Ventilation Equipment (AAERVE).* Energy recovery components and packaged energy recovery ventilation units which employ Air-to-Air Heat Exchangers to recover energy from exhaust air for the purpose of pre-conditioning outdoor air prior to supplying the conditioned air to the space, either directly or as part of an air-conditioning (to include air heating, air cooling, air circulating, air cleaning, humidifying and dehumidifying) system.

3.2 *Air-to-Air Heat Exchanger.* A device that transfers heat from an exhaust airstream to a separated supply airstream. Air-to-Air Heat Exchangers are also referred to as energy recovery components.

3.2.1 *Heat Pipe Heat Exchanger.* A device employing tubes charged with a fluid for the purpose of transferring sensible energy from one airstream to another. Heat transfer takes place through the vaporization of the fluid exposed to the warmer airstream and condensation of the fluid in the cooler airstream.

3.2.2 *Plate Heat Exchanger.* A device for the purpose of transferring energy (sensible or total) from one airstream to another with no moving parts. This exchanger may incorporate parallel, cross or counter flow construction or a combination of these to achieve the energy transfer.

3.2.3 *Rotary Heat Exchanger.* A device incorporating a rotating cylinder or wheel for the purpose of transferring energy (sensible or total) from one airstream to the other. It incorporates heat transfer material, a drive mechanism, a casing or frame, and includes any seals, which are provided to retard the bypassing and leakage of air from one air stream to the other.

3.3 *Airflow.*

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3.3.1 *Entering Supply Airflow (OA).* The supply airstream (outdoor air) before passing through the Exchanger, also referred to as outdoor air, indicated in Figure 1 as Station 1. Sometimes referred to as the outdoor Airflow.

3.3.2 *Leaving Supply Airflow (SA).* The supply airstream (outdoor air) after passing through the Exchanger, indicated in Figure 1 as Station 2. Sometimes referred to as the supply Airflow.

3.3.3 *Entering Exhaust Airflow (RA).* The exhaust airstream (indoor air) before passing through the Exchanger, indicated in Figure 1 as Station 3. Sometimes referred to as the return Airflow.

3.3.4 *Leaving Exhaust Airflow (EA).* The exhaust airstream (indoor air) after passing through the Exchanger, indicated in Figure 1 as Station 4. Sometimes referred to as the exhaust Airflow.

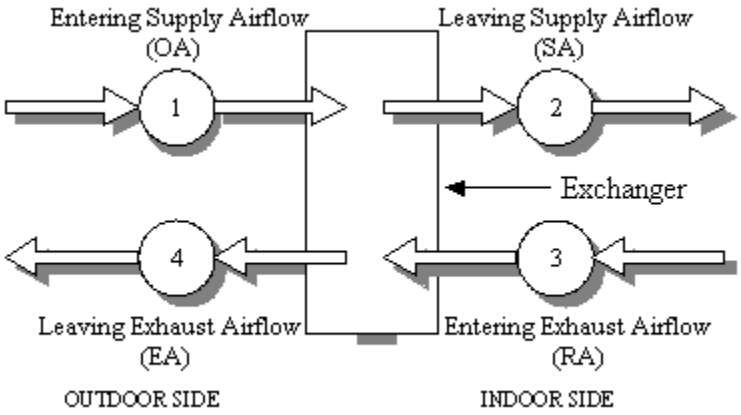


Figure 1. Scheme of Airflows for Exchangers

3.4 *Economizer.* A system of controls and dampers that introduces outside air to a space when the space requires cooling, and the heat of the outside air is lower than the heat of the space.

3.4.1 *Sensible Only.* A system that utilizes an outdoor air sensor that measures outdoor dry-bulb temperature only. If the space has a cooling requirement, outside air will be used if the outdoor dry-bulb temperature is less than or equal to the control setpoint.

3.4.2 *Enthalpy.* A system that utilizes an outdoor sensor that measures the total heat (both the sensible and latent) of the outside air. If the space has a cooling requirement, outside air will be used to cool the space if the total heat of the outside air is less than or equal to the control setpoint.

3.5 *Effectiveness.* A ratio of the actual energy transfer (sensible, latent, or total) to the product of the minimum energy capacity rate and the maximum difference in temperature, humidity ratio, or enthalpy (refer to AHRI Standard 1060 (I-P)).

3.6 *Entering Air Conditions.* The dry-bulb and wet-bulb temperature that is entering the space on a standalone system, or entering the air-conditioning system on integrated, standalone-coupled or unitized systems. These conditions typically replace the "outdoor air conditions" in most design load software programs. These are also referred to as the Tempered Outside Air conditions. On standalone systems these are also referred to as Supply Airflow conditions.

3.7 *Exhaust Air Transfer Ratio (EATR).* The tracer gas concentration difference between the Leaving Supply Airflow and the Entering Supply Airflow divided by the tracer gas concentration difference between the Entering Exhaust Airflow and the Entering Supply Airflow at the 100% rated Airflows, expressed as a percentage (refer to AHRI Standard 1060 (I-P)).

3.8 *Net Building Load.* The total calculated space conditioning energy required for a building including the impact of energy recovery. This is the total building load less the total energy recovered from the exhaust air. The Net Building Load may be calculated for both heating and cooling design conditions.

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3.8.1 *Example.* Total building cooling load is 200 tons including outside air without the AAERVE. The AAERVE reduced the outdoor air load by 75 tons. The Net Building Load is 125 tons (200 tons -75 tons).

3.9 *Net Effectiveness*. The Effectiveness adjusted to account for that portion of the psychrometric change in the Leaving Supply Airflow that is the result of leakage of Entering Exhaust Airflow rather than exchange of heat or moisture between the airstreams. The derivation of Net Effectiveness is given in AHRI Standard 1060 (I-P) Appendix C.

3.10 *Net Zone Load.* The total space conditioning energy required for a particular Zone of a building including the impact of energy recovery. This is the Total Zone Load less the total energy recovered from the exhaust air for the Zone by the AAERVE. The Total Zone Load may be calculated for both cooling and heating design conditions.

3.10.1 *Example.* Total zone cooling load is 20 tons including outside air without the AAERVE. The AAERVE reduced the outdoor air load by 7.5 tons. The Net Zone Load is 12.5 tons (20 tons -7.5 tons).

3.11 *Net Supply Airflow*. That portion of the Leaving Supply Airflow that originated as Entering Supply Airflow. The Net Supply Airflow is determined by subtracting air transferred from the exhaust side of the heat exchanger from the gross airflow measured at the Supply Airflow leaving the heat exchanger as shown in AHRI Standard 1060 (I-P).

3.12 *Outdoor Air Correction Factor (OACF)*. The ratio of the Entering Supply Airflow to the measured (gross) Leaving Supply Airflow.

3.13 *Published Rating*. A statement of the assigned values of those performance characteristics at stated Rating Conditions, by which a unit may be chosen for its application. These values apply to all AAERVE of like size and type (identification) produced by the same manufacturer. The term Published Rating includes the rating of all performance characteristics shown on the unit or published in specifications, advertising or other literature controlled by the manufacturer, at stated Rating Conditions.

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

3.13.2 *Standard Rating*. A rating based on tests performed at Standard Rating Conditions as defined in AHRI Standard 1060 (I-P).

3.14 *Purge.* The removal of exhaust air that may be carried to the supply (intake) airstream by a Rotary Heat Exchanger. It is accomplished by shunting a portion of the supply air back into the exhaust air.

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

3.15.1 *Standard Rating Conditions*. Rating conditions used as the basis for comparison for performance characteristics.

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

3.17 *Station*. The location in the test apparatus at which conditions such as temperature, humidity, pressure, or Airflow are measured for each of the Airflows defined in Section 3.3 and shown in Figure 1. These locations are identified as "Station 1", "Station 2", "Station 3" and "Station 4".

3.18 *Tempered Outside Air*. The leaving supply air from the Air-to-Air Heat Exchanger. The Tempered Outside Air conditions typically replace the "outdoor air conditions" in most design load software programs. This is also referred to as *Entering Air*.

3.19 *Total Building Load.* The total calculated space conditioning requirements for a building.

3.20 *Total Zone Load*. The total calculated space conditioning requirements for a specific Zone, including its interior heat sources and sinks (people, lights, computers, refrigerated cases, etc.), infiltration, outdoor air ventilation load, solar load, and orientation. The Total Zone Load may be calculated for both cooling and heating design conditions.

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3.21 *Zone.* A space or group of spaces, within a building with heating, cooling, and ventilating requirements, that are sufficiently similar so that desired conditions (e.g., temperature) can be maintained throughout using a single sensor (e.g., thermostat or temperature sensor).

Section 4. Air-to-Air Energy Recovery Ventilation Equipment (AAERVE) Classifications

4.1 *Integrated Systems.*

4.1.1 *Air-handling System.* An integrated air-handling system has the air-handling unit manufactured with the Air-to-Air Heat Exchanger installed as part of the air handler. This system does not require a separate duct system because it utilizes the air-conditioning unit's duct system.

4.1.2 *Packaged System.* An integrated packaged system has the air-conditioning unit manufactured with the Air-to-Air Heat Exchanger component installed as part of the unit. This system does not require a separate duct system because it utilizes the air-conditioning unit's duct system.

4.2 *Standalone System.* A standalone system utilizes the AAERVE in a configuration that has a totally separate duct system (for the supply air and the exhaust air) from any other air-conditioning system in the building.

4.3 *Standalone Coupled System.* A standalone coupled system utilizes the AAERVE in a configuration that has part or all of the AAERVE air (supply or exhaust) ducted to the duct system of an air-conditioning system.

4.4 *Unitized System.* A unitized system has an AAERVE accessory attached directly to the air-conditioning equipment, typically in the field. This system does not require a separate duct system.

Section 5. Frost and Condensation

5.1 *Frost Control.* In cold climates, means of avoiding frost or removing frost from the Air-to-Air Heat Exchanger may be required.

5.1.1 *Exhaust Only.* When frost is indicated on the component, the intake blower is de-energized for a period of time to allow exhaust air to warm component, melt frost, and drain or evaporate condensate. Alternately, exhaust-only operation is determined based on outside air temperature to avoid frosting.

5.1.2 *Preheat.*

5.1.2.1 *Outdoor Air Preheat.* Heat is provided in the outdoor air intake to heat the air to a temperature above the Air-to-Air Heat Exchanger frost threshold before it enters the component.

5.1.2.2 *Return Air Preheat.* Heat is provided in the return air before it enters the Air-to-Air Heat Exchanger to prevent frost from forming.

5.1.3 *Re-circulation.*

5.1.3.1 *Return Air Re-circulation.* Return air is substituted, in whole or in part, for outside air passing through the Air-to-Air Heat Exchanger for defrost purposes.

5.1.3.2 *Exhaust Air Re-circulation.* Exhaust air leaving the Air-to-Air Heat Exchanger is substituted, in whole or in part, for outside air passing through the Air-to-Air Heat Exchanger for defrost purposes.

5.1.4 *Modulated Effectiveness.*

5.1.4.1 *Bypass.* A portion of the outdoor air is bypassed around the heat exchanger until the frost threshold is avoided.

5.1.4.2 *Variable Speed.* For Rotary Heat Exchangers the speed of rotation is slowed, reducing Effectiveness, until the frost threshold is avoided.

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