AHRI Guideline V
(formerly ARI Guideline V)

2003 Guideline for

Calculating The Efficiency Of Energy Recovery Ventilation And Its Effect On Efficiency And Sizing Of Building Hvac Systems

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CALCULATING THE EFFICIENCY OF ENERGY RECOVERY VENTILATION AND ITS EFFECT ON EFFICIENCY AND SIZING OF BUILDING HVAC SYSTEMS

Section 1. Purpose

1.1 *Purpose.* The purpose of this guideline is to establish a method of calculating the energy efficiency of applied Energy Recovery Ventilation components and of heating, ventilating, and/or air-conditioning systems utilizing such components at selected operating conditions. It also provides guidance on proper sizing of cooling and heating equipment when such energy recovery components are applied.

1.1.1 *Intent.* This guideline is intended for the guidance of the industry, including engineers, installers, contractors and users. It provides a means for calculating the impact of applied energy recovery equipment on the energy efficiency of the heating, ventilating and air-conditioning system at a single selected operating condition. The guideline is not a rating system for Energy Recovery Ventilation (ERV) Equipment, nor does it provide a means of estimating annual energy use.

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

Section 2. Scope

2.1 *Scope.* This guideline applies to energy recovery ventilation component applications and combinations of energy recovery components with unitary heating, ventilating, and air-conditioning equipment incorporating mechanical ventilation with outside air.

2.1.1 This guideline applies only to energy recovery applications utilizing components tested and rated in accordance with ARI Standard 1060.

2.1.2 Because non-certified data is required for the calculations, the results should not be considered to be “certified”.

Section 3. Definitions

All terms in this document follow the standard industry definitions in the current edition of *ASHRAE Terminology of Heating, Ventilation, Air Conditioning and Refrigeration* and ASHRAE Standard 84, unless otherwise defined in this section.

3.1 *Coefficient of Performance (COP).* A ratio of the cooling/heating capacity in watts [W] to the power input values in watts [W] at any given set of Rating Conditions expressed in watts/watt [W/W].

3.2 *Combined Efficiency (CEF).* The efficiency of a system incorporating an ERV component with a unitary packaged air conditioner, heat pump, etc. Units vary according to the application. CEF may be expressed in Btu/(W·h) or in W/W.

3.3 *Effectiveness*. The measured energy recovery Effectiveness not adjusted to account for that portion of the psychrometric change in the leaving supply air (Figure 1, Station 2) that is the result of leakage of entering exhaust air (Figure 1, Station 3) rather than exchange of heat or moisture between the airstreams. The equation for determining Effectiveness is given in ARI Standard 1060, Appendix C.

3.4 *Energy Efficiency Ratio (EER*). A ratio of the cooling capacity in Btu/h to the power input values in watts at any given set of Rating Conditions expressed in Btu/(W·h).

3.5 *Energy Recovery Ventilation (ERV) Equipment*. 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. Also referred to as the air-to-air heat exchanger (AAHX).

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

3.5.2 *Plate Heat Exchanger*. A device for the purpose of transferring energy (sensible or total) from one air stream 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.

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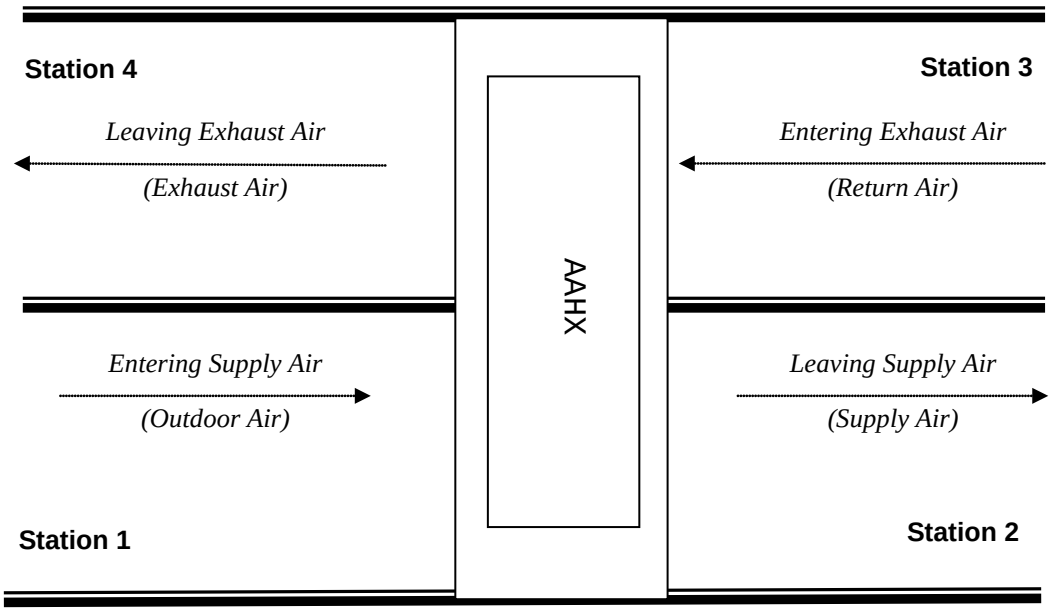


Figure 1. Generic Configuration of an Air-to-Air Heat Exchanger Used for Energy Recovery in Ventilation Applications

3.5.3 *Rotary Heat Exchanger.* A device incorporating a rotating cylinder or wheel for the purpose of transferring energy (sensible or total) from one air stream 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.

3.6 *Exhaust Air Transfer Ratio (EATR).* The tracer gas concentration difference between the leaving supply air (Figure 1, Station 2) and the entering supply air (Figure 1, Station 1) divided by the tracer gas concentration difference between the entering exhaust air (Figure 1, Station 3) and the entering supply air (Figure 1, Station 1) at the 100% rated air flow rate, expressed as a percentage.

3.7 *Fan/Motor Efficiency, $\eta_{Fan/Motor}$.* The product of the fan efficiency and the motor efficiency including drive losses (mechanical, electrical and/or electronic as applicable) for each airstream.

3.8 *Net Effectiveness.* The measured energy recovery Effectiveness adjusted to account for that portion of the psychrometric change in the leaving supply air (Figure 1, Station 2) that is the result of leakage of entering exhaust air (Figure 1, Station 3) rather than exchange of heat or moisture between the airstreams. The derivation of Net Effectiveness is given in ARI Standard 1060, Appendix C.

3.9 *Net Supply Air Flow.* That portion of the leaving supply air (Figure 1, Station 2) that originated as entering supply air (Figure 1, Station 1). The Net Supply Air Flow is determined by subtracting air transferred from the exhaust side of the AAHX from the gross air flow measured at the supply air leaving the heat exchanger and is given by the equation:

$$\begin{pmatrix}\text{Net Supply}\\ \text{Air Flow}\end{pmatrix} = \begin{pmatrix}\text{Leaving supply}\\ \text{air flow}\end{pmatrix}(1 - \text{EATR})$$

3.10 *Outdoor Air Correction Factor.* The entering supply air flow (Figure 1, Station 1) divided by the measured (gross) leaving supply air flow (Figure 1, Station 2).

3.11 *Pressure Drop.* The difference in static pressure between the entering air and the leaving air for a given airstream.

3.11.1 *Exhaust Pressure Drop.* The difference in static pressure between the entering exhaust air (Figure 1, Station 3) and the leaving exhaust air (Figure 1, Station 4).

3.11.2 *Supply Pressure Drop.* The difference in static pressure between the entering supply air (Figure 1, Station 1) and the leaving supply air (Figure 1, Station 2).

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