ADDENDA

ANSI/ASHRAE/IES Addendum ar to
ANSI/ASHRAE/IES Standard 90.1-2013

Energy Standard for Buildings Except Low-Rise Residential Buildings

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FOREWORD

How Standard 90.1 defines "effectiveness"—with respect to an air-to-air heat (or energy) exchanger—differs from how it is calculated by ASHRAE Standard 84, "Method of Testing Air-to-Air Heat/Energy Exchangers," and the corresponding AHRI Standard 1060, "Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation." Following is the Standard 84 language for how to calculate effectiveness:

9.2 Effectiveness

9.2.1 The effectiveness of the heat/energy exchanger shall be calculated form the following equation:

$$\varepsilon = \frac{\dot{m}_s(X_1 - X_2)}{\dot{m}_{min}(X_1 - X_3)} \qquad (30)$$

where

ε	=	sensible, latent, or total heat effectiveness
X	=	dry-bulb temperature, T, humidity ratio, W, or total enthalpy, h, respectively, at the locations indicated in Figure 1
$\dot{m}_s$	=	mass flow rate of the supply, mass of dry air per unit time
$\dot{m}_e$	=	mass flow rate of the exhaust, mass of dry air per unit time
$\dot{m}_{min}$	=	minimum value of either $\dot{m}_s$ or $\dot{m}_e$.

Standard 90.1, in Sections 3.2 and 6.5.6.1, uses a different definition for effectiveness, which does not account for the mass flow rates through the two sides of the heat exchanger:

$$\varepsilon = \frac{(X_1 - X_2)}{(X_1 - X_3)}$$

This difference causes confusion among HVAC design engineers and code officials. (The two definitions would be the same if the supply-side and exhaust-side mass flow rates were equal, but this is rarely the case.)

Because ASHRAE Standard 84 and AHRI Standard 1060 are used by manufacturers to certify the performance of such devices, this addendum changes Standard 90.1 to avoid using the term "effectiveness", while keeping the same performance requirement ("a change in the enthalpy of the outdoor air supply equal to 50% of the difference between the outdoor air and exhaust air enthalpies at design conditions"). This can be done by replacing the term "effectiveness" with either "enthalpy recovery ratio" and "sensible energy recovery ratio" where they apply, as indicated below.

The purpose of the proposed changes to the first sentence of Section 6.5.6.1 is to make the wording consistent with the wording used in Table 6.5.6.1

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Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum ar to 90.1-2013

Modify the standard as follows (IP and SI Units).

Modify Section 3.2:

sensible energy recovery ratio ~~effectiveness~~: change in the dry-bulb temperature of the outdoor air supply divided by the difference between the outdoor air and ~~return~~ entering exhaust air dry-bulb temperatures, expressed as a percentage.

enthalpy recovery ratio: change in the enthalpy of the outdoor air supply divided by the difference between the outdoor air and entering exhaust air enthalpy, expressed as a percentage.

Modify Section 6 as follows:

TABLE 6.5.3.1-2 Fan Power Limitation Pressure Drop Adjustment (IP)

Device	Adjustment
Credits	
…	
Energy recovery device, other than coil runaround loop	(2.2 × enthalpy ~~energy~~ recovery ratio ~~Recovery Effectiveness~~) – 0.5 in. wc for each airstream
…	

TABLE 6.5.3.1-2 Fan Power Limitation Pressure Drop Adjustment (SI)

Device	Adjustment
Credits	
…	
Energy recovery device, other than coil runaround loop	(550 × enthalpy ~~energy~~ recovery ratio ~~Recovery Effectiveness~~) – 125 Pa for each airstream

…

6.5.6.1 Exhaust Air Energy Recovery. Each fan system shall have an energy recovery system when the design ~~system's~~ supply fan airflow rate exceeds the value listed in Table 6.5.6.1 based on the climate zone and percentage of outdoor air ~~flow rate~~ at design airflow conditions.

Energy recovery systems required by this section shall ~~have~~ result in an enthalpy recovery ratio of at least 50~~%~~ percent ~~energy recovery effectiveness~~. A fifty percent enthalpy recovery ratio ~~energy recovery effectiveness~~ shall mean a change in the enthalpy of the outdoor air supply equal to 50% of the difference between the outdoor

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air and ~~return~~ entering exhaust air enthalpies at design conditions. Provision shall be made to bypass or control the energy recovery system to permit air economizer operation as required by 6.5.1.1.

6.5.7.1.4. If a kitchen/dining facility has a total kitchen hood exhaust airflow rate greater than 5,000 cfm then it shall have one of the following:

a. At least 50% of all replacement air is transfer air that would otherwise be exhausted.
b. Demand ventilation system(s) on at least 75% of the exhaust air. Such systems shall be capable of at least 50% reduction in exhaust and replacement air system airflow rates, including controls necessary to modulate airflow in response to appliance operation and to maintain full capture and containment of smoke, effluent and combustion products during cooking and idle.
c. Listed energy recovery devices that result in a sensible energy recovery ratio ~~with a sensible heat recovery effectiveness~~ of not less than 40% on at least 50% of the total exhaust airflow. A forty percent sensible energy recovery ratio shall mean a change in the dry-bulb temperature of the outdoor air supply equal to 40% of the difference between the outdoor air and entering exhaust air dry-bulb temperatures at design conditions.

6.5.7.2 Laboratory Exhaust Systems. Buildings with laboratory exhaust systems having a total exhaust rate greater than 5000 cfm shall include at least one of the following features:

a. VAV laboratory exhaust and room supply system capable of reducing exhaust and makeup airflow rates and/or incorporate a heat recovery system to precondition makeup air from laboratory exhaust that shall meet the following:

$$A + B \times (E/M) \geq 50\%$$

Where

A = percentage that the exhaust and makeup airflow rates can be reduced from design conditions

B = ~~percentage~~ sensible energy recovery ratio ~~recovery effectiveness~~

E = exhaust airflow rate through the heat recovery device at design conditions

M = makeup airflow rate of the system at design conditions.

b. VAV laboratory exhaust and room supply systems that are required to have minimum circulation rates to comply with code or accreditation standards shall be capable of reducing zone exhaust and makeup airflow rates to the regulated minimum circulation values or the minimum required to maintain pressurization relationship requirements. Nonregulated zones shall be capable of reducing exhaust and makeup airflow rates to 50% of the zone design values or the minimum required to maintain pressurization relationship requirements.
c. Direct makeup (auxiliary) air supply equal to at least 75% of the exhaust airflow rate, heated no warmer than 2°F below room setpoint, cooled to no cooler than 3°F above room setpoint, no humidification added, and no simultaneous heating and cooling used for dehumidification control.

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

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