ADDENDA

ANSI/ASHRAE/IES Addendum aj to
ANSI/ASHRAE/IES Standard 90.1-2022

Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings

Approved by ASHRAE and the American National Standards Institute on April 30, 2025, and by the Illuminating Engineering Society on March 31, 2025.

This addendum was approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. Instructions for how to submit a change can be found on the ASHRAE® website (https://www.ashrae.org/continuous-maintenance).

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FOREWORD

The 2016 version of Standard 90.1 introduced pool dehumidifier requirements and provided a method to exempt pool room dehumidifiers from the primary exhaust air energy recovery (Section 6.5.6) in lieu of three more appropriate energy recovery measures (Section 6.5.6.4). A recent continuous maintenance proposal (CMP) identified issues between typical design practice and some of these energy recovery measures, namely that sensible energy recovery only (Section 6.5.6.4a) is not appropriate for winter conditions where exhaust air with a typical dew point of 62°F would condense when used to warm the incoming outdoor air. In addition, using 100% of the heat generated through dehumidification to heat the pool water (Section 6.5.6.4b) would overheat the pool water resulting in wasted energy. Addendum aj addresses those issues as well as sets requirements for energy recovery by minimum ventilation rate for a given climate zone and pool water temperature.

The addendum requires that:

a. *Dehumidification systems for pools greater than 400 ft^2 are required to use all of the condenser heat toward providing required pool water heating, space heating, or both before other means are used to meet those heating loads. This provides a means to recover waste energy without inferring that there is a load to recover 100% of that energy, which was the main point being made in the CMP. It also expands the range from 500 ft^2 down to 400 ft^2 based on financial payback well below the scalar limit for this equipment.*
b. *Ventilation systems for pools in a given climate zone with ventilation rates greater than minimum values also require exhaust air energy recovery systems with an energy recovery ratio at heating design conditions of at least 50%. Given pool design space temperatures are 80°F or higher, exhaust air energy recovery is generally only feasible for heating conditions.*

This addendum employs a new definition that was approved in Addendum p to Standard 90.1-2022:

outdoor air rate, design minimum: *the lowest quantity of outdoor air an HVAC system is designed to supply to the space(s) it serves when these space(s) are occupied at design occupancy levels.*

Cost Justification for Condenser Waste Energy Recovery using Pool Water Heating Example

The energy recovery potential and cost for pool water heating is based on the size of the pool. Costs and scalar ratios for small and large pools are shown in the table below and the scalar ratios are acceptable.

Pool type	Hotel	Olympic
Pool size (ft^2)	450	13,448
Pool water heater type	Natural gas	Natural gas
Fuel cost (Standard 90.1 standard work)	$0.8243/therm	$0.8243/therm
Consumer costs for packaged pool dehumidification system:		
for adding pool water heating	$1200	$16,700
for associated field installed pool water heating piping and accessories	$1200	$20,000
for annual maintenance	$400	$2000
total consumer cost for measure	$2400	$36,700
Annual maintenance [a]	$400	$2,000
Annual cost savings	$824	$28,438
Equipment design life	15	15
Scalar ratio limit	12.8	12.8
Measure scalar ratio: total cost/annual energy savings	5.7	1.4
Meets scalar	Yes	Yes

a. Estimated maintenance costs clean coils, replace filters, inspect pumps
Small pool 4× per year × 2 hrs × $50/hr = $400
Large pool 8× per year × 5 hrs × $50/hr = $2000

Cost Justification for Outdoor Air Energy Recovery

The requirement for energy recovery is based on the design outdoor airflow for the facility. The difference in enthalpy between the indoor and outdoor air was calculated using the Standard 90.1 TMY3 weather files. The assumptions were as follows:

- *Three indoor air design temperatures: 80°F/62% RH, 85°F/59% RH, and 90°F/55% RH.*
- *The space is occupied from 6:00 a.m. to 10:00 p.m. seven days per week.*
- *There is no call for heating when the outdoor air temperature is 65°F or more.*

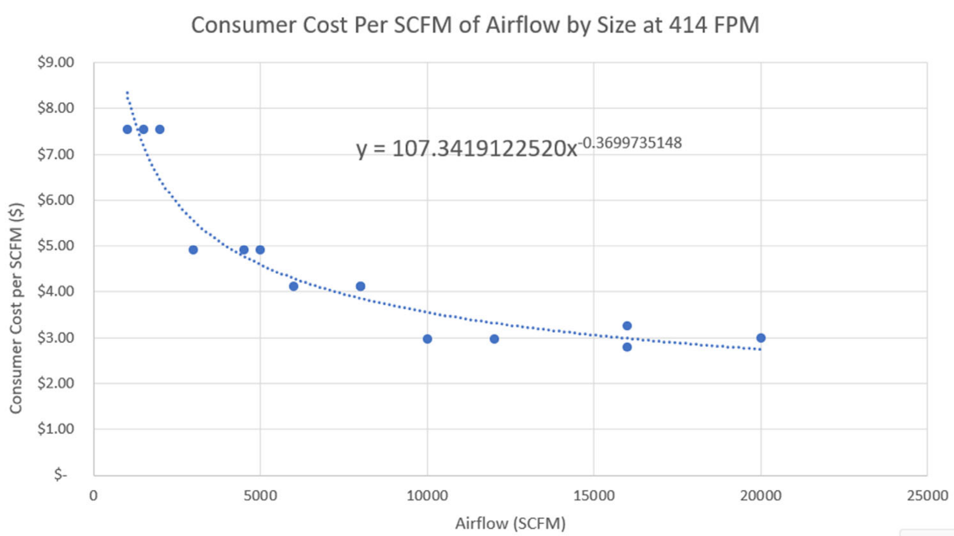
The reduction in heating load per 1000 scfm was calculated using the required 50% enthalpy recovery ratio.

The heating load reduction was calculated for various airflows for each climate zone. The annual savings are based on a blended heating cost of $10.74 per million Btu per the Standing Standard Project Committee (SSPC) 90.1 2025 work plan.

There following costs are included in the analysis in addition to the equipment's first cost to the consumer:

- *The additional fan power required is based on the supply and exhaust stream watts per cfm allowances, along with a MERV-8 filter allowance per addendum bo, multiplied by 5840 hours of operation.*
- *The annual cost for filters and fan maintenance. These were estimated by determining the cost of a MERV-8 filter changed twice annually and the associated labor for units of different size. A curve fit was created to estimate the cost for other unit sizes.*
- *Pumping power based on the flow and hours of operation.*

The first cost of the equipment is based on actual pricing from a manufacturer to a manufacturer's representative and then to a consumer. The total markup is 35%. The system is a run-around coil using a 30% propylene glycol mixture. A 35% margin for the rep was added to arrive at the consumer cost. Regression curves based on varying airflows were created. The first cost per scfm to the consumer was determined for various airflows for each size unit. An example is shown in the figure below:



As there is no cost data for units smaller than 1000 scfm, the minimum air for the analysis is set to 800 scfm.

The typical lifetime of this equipment is 15 years, so the 2025 heating scalar of 12.8 is applied. That is, one year of savings is multiplied by 12.8; if that value is greater than the first cost, the measure is cost-justified. The first cost was compared to the annual savings at various airflows for each climate zone. The lowest airflow at which the first cost was less than the scalar was selected for each indoor condition.

Informative 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 aj to Standard 90.1-2022

Modify Section 3.2 as follows.

heat pump exhaust air energy recovery: *energy* recovery based on reversible heat pump technology that employs exhaust air as a heat source or sink by diverting the exhaust air to the DX coil before it is ejected outdoors by means of an additional DX coil integrated in the main refrigerant circuit or a dedicated refrigerant circuit to optimize the free cooling or free heating mode.

Modify the exceptions to Section 6.5.6.1.2 as follows (IP and SI).

6.5.6.1.2 Spaces Other than Nontransient Dwelling Units. Each fan *system* serving *spaces* other than *nontransient dwelling units* shall have an *energy* recovery *system* where the design supply fan airflow rate exceeds the value listed in Tables 6.5.6.1.2-1 and 6.5.6.1.2-2, based on the climate zone and percentage of *outdoor air* at design airflow conditions. Table 6.5.6.1.2-1 shall be used for all *ventilation systems* that operate less than 8000 hours per year, and Table 6.5.6.1.2-2 shall be used for all *ventilation systems* that operate 8000 or more hours per year.

Exceptions to 6.5.6.1.2:

[. . .]

9. ~~*Indoor pool dehumidifiers* meeting Section 6.5.6.4~~Natatoriums.

Informative Note: Requirements for natatorium exhaust air *energy* recovery are provided in Section 6.5.6.4.

Modify Section 6.5.6.4 as follows (IP and SI).

~~**6.5.6.4 Indoor Pool Dehumidifier Energy Recovery.** An indoor pool dehumidifier serving a natatorium with a heated indoor pool over 500 ft2 in size shall include one of the following:~~

~~a. a. An exhaust air sensible energy recovery *system* with a sensible *energy* recovery ratio of at least 50%~~
~~b. b. A condenser heat recovery *system* capable of and configured to use 100% of the heat generated through dehumidification to heat the pool water when there is a pool water heating load~~
~~c. c. An exhaust air energy recovery *system* that results in an *enthalpy recovery ratio* of at least 50%~~

~~**Exception to 6.5.6.4:** Natatoriums heated by on-site renewable *energy* or site recovered *energy* capable of and configured to provide at least 60% of the annual heating *energy* required.~~

6.5.6.4 Energy Recovery for Indoor Pools

6.5.6.4.1 Dehumidification Energy Recovery. Space dehumidification systems using mechanically cooled *indoor pool dehumidifiers* where the total surface area of indoor *pool* water heated to 94°F (34°C) or less is greater than 400 ft^2 (37 m^2) shall be capable of and configured to use condenser heat for *pool* water heating or natatorium space heating. Other equipment for heating indoor *pool* water to 94°F (34°C) or less or for natatorium space heating shall not be used until 100% of the available condenser heat rejection *energy* is being used.

6.5.6.4.2 Exhaust Air Energy Recovery. Ventilation systems for spaces where the design exhaust airflow is greater than the values in Table 6.5.6.4 for the indoor dry bulb air design temperature shall employ an exhaust air *energy* recovery system that complies with the following:

a. Has *energy* recovery of at least 50% when calculated at design conditions as the change in the dry-bulb temperature of the outdoor air supply divided by the difference between the outdoor air and entering exhaust air dry-bulb temperatures, expressed as a percentage, or uses *heat pump exhaust air energy recovery*.
b. Does not transfer moisture to the outdoor airstream in the A and C climate zones.
c. Is capable of managing condensate from the exhaust air stream in the A and C climate zones.

Informative Note: Moisture transfer to the outdoor airstream is permitted in Climate Zone 7, Climate Zone 8, and all B climate zones.

Add Table 6.5.6.4 as follows (I-P).

Table 6.5.6.4 Design Minimum Outdoor Air Rate for which Indoor Pool Energy Recovery is Required (cfm)

	Indoor Dry Bulb Design Temperature		
Climate Zone	**Less Than 81.5°F**	**81.5°F to 88.5°F**	**Greater Than 88.5°F**
0A,1A, 0B, 1B, 2A, 2B	NR	NR	NR
3A	NR	5000 cfm	1600 cfm
3B	NR	9000 cfm	2400 cfm
3C	NR	5500 cfm	1200 cfm
4A	4500 cfm	1100 cfm	800 cfm
4B	6500 cfm	1900 cfm	800 cfm
4C	2800 cfm	800 cfm	800 cfm
5A	2000 cfm	800 cfm	800 cfm
5B	2800 cfm	800 cfm	800 cfm
5C	1700 cfm	800 cfm	800 cfm
6A	1400 cfm	800 cfm	800 cfm
6B	1500 cfm	800 cfm	800 cfm
7	1000 cfm	800 cfm	800 cfm
8	800 cfm	800 cfm	800 cfm

Add Table 6.5.6.4 as follows (SI).

Table 6.5.6.4 Design Minimum Outdoor Air Rate for which Indoor Pool Energy Recovery is Required (L/s)

	Indoor Dry Bulb Design Temperature		
Climate Zone	**Less than 27.5°C**	**27.5°C to 31.4°C**	**Greater than 31.4°C**
0A,1A, 0B, 1B, 2A, 2B	NR	NR	NR
3A	NR	2400 L/s	800 L/s
3B	NR	4200 L/s	1100 L/s
3C	NR	2600 L/s	600 L/s
4A	2100 L/s	500 L/s	400 L/s
4B	3100 L/s	900 L/s	400 L/s
4C	1300 L/s	400 L/s	400 L/s
5A	900 L/s	400 L/s	400 L/s
5B	1300 L/s	400 L/s	400 L/s
5C	800 L/s	400 L/s	400 L/s
6A	700 L/s	400 L/s	400 L/s
6B	700 L/s	400 L/s	400 L/s
7	500 L/s	400 L/s	400 L/s
8	400 L/s	400 L/s	400 L/s

Modify Table 12.5.1(12) as follows (IP and SI).

Receptacle, motor, and *process loads* shall be modeled and estimated based on the *building* area type or *space* type category and shall be assumed to be identical in the proposed and *budget building designs*. These loads shall be included in simulations of the *building* and shall be included when calculating the *energy cost budget* and *design energy cost*. All end-use load components within and associated with the *property* shall be modeled, unless specifically excluded by Table 12.5.1(14), including, but not limited to, exhaust fans, parking garage *ventilation* fans, exterior *property* lighting, ~~swimming~~ *pool* heaters and *pumps*, <u>*indoor pool dehumidifiers*</u>, elevators and escalators, and cooking *equipment*.

Modify Table G3.1(1)(a) as follows (IP and SI).

a. The simulation model of the *proposed design* shall be consistent with the design documents, including proper accounting of *fenestration* and *opaque building envelope* types and areas; interior lighting power and controls; *HVAC system* types, sizes, and controls; and *service water-heating systems* and controls. All end-use load components within and associated with the *property* shall be modeled, including but not limited to exhaust fans, parking garage *ventilation* fans, snow-melt and freeze-protection *equipment*, facade lighting, ~~swimming~~ *pool* heaters and *pumps*, <u>*indoor pool dehumidifiers*</u>, elevators and escalators, refrigeration, and cooking. Where the *simulation program* does not specifically model the functionality of the installed *system*, spreadsheets or other documentation of the assumptions shall be used to generate the power *demand* and operating schedule of the *systems*.

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.

ASHRAE · 180 Technology Parkway · Peachtree Corners, GA 30092 · www.ashrae.org

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