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

Public Review Draft

Proposed Addendum aj to Standard 90.1-2022, Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings

First Public Review (July 2024)
(Draft Shows Proposed Changes to Current Standard)

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FOREWORD

Standard 90.1 pool dehumidifier requirements were introduced with addendum am to the 2016 version and provided a method to exempt pool room dehumidifiers from the primary exhaust air energy recovery (6.5.6) in lieu of three more appropriate energy recovery measures (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 <u>sensible</u> energy recovery only (6.5.6.4a) is not appropriate for winter conditions where exhaust air with a typical dew point of 62F 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 (6.5.6.4b) would overheat the pool water resulting in wasted energy. This addendum 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:

1. Dehumidification systems for pools greater than 400 ft^2 are required to use all of the condenser heat towards 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.
2. 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 80F or higher, exhaust air energy recovery is generally only feasible for heating conditions.

The addendum employs a new definition that was approved in addendum p:

<u>*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.</u>

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 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 (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 **	$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

**Estimated maintenance costs clean coils, replace filters, inspect pumps
Small pool 4x per year x 2 hrs x $50/hr = $400
Large pool 8x per year x 5hrs x $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 ASHRAE 90.1 TMY3 weather files. The assumptions were:

- Three indoor air design temperatures: 80 ºF/62% RH, 85 ºF/59% RH, and 90 ºF/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 65ºF or more.

The reduction in heating load per 1,000 SCFM was calculated using the required 50 percent 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 SSPC 90.1 2025 work plan.

There are three costs included in the analysis in addition to the equipment's first cost to the counsumer:

- 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.

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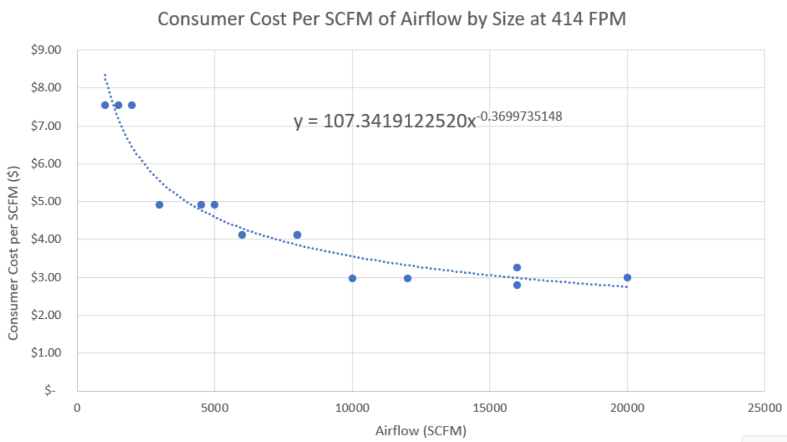
The first cost of the equipment is based on actual pricing from a manufacturer to a manufacturer's representative and then to a consumer. The total markup is 35 percent. The system is a run-around coil using a 30 percent propylene glycol mixture A 35 percent margin for the rep was added to arrive at 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 below:



As there is no cost data for units smaller than 1,000 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.

[Note to Reviewers: This addendum makes proposed changes to the current standard. These changes are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Only these changes to the current standard are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed changes.]

Addendum aj to 90.1-2022

Modify Section 6.5.6.4 as follows (IP and SI units):

~~**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. An exhaust air sensible energy recovery system with a sensible energy recovery ratio of at least 50%~~
~~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. 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 94ºF (34ºC) 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 94ºF (34ºC) or less, or for natatorium space heating shall not be used until 100 percent of the available condenser heat rejection energy is consumed.

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:
1. 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.
2. Does not transfer moisture to the outdoor airstream in the A and C climate zones.
3. Is capable of managing condensate from the exhaust air stream in the A and C climate zones.

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)

Climate Zone	Indoor Dry Bulb Design Temperature		
	Less Than 81.5 ºF	81.5 ºF to 88.5ºF	Greater Than 88.5ºF
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)

Climate Zone	Indoor Dry Bulb Design Temperature		
	Less than 27.5ºC	27.5ºC to 31.4ºC	Greater than 31.4ºC
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 the exceptions to Section 6.5.6.1.2 as follows (IP and SI units):

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:

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9. ~~*Indoor pool dehumidifiers* meeting Section 6.5.6.4~~Natatoriums.
   Informative note: requirements for natatorium exhaust air energy recovery are in Section 6.5.6.4.

Modify Table 12.5.1(12) as follows (IP and SI units):

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*, *indoor pool dehumidifiers*, elevators and escalators, and cooking *equipment*.

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

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*, *indoor pool dehumidifiers*, 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*.