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

Public Review Draft

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

First Public Review (May 2025)
(Draft Shows Proposed Changes to Current Standard)

This draft has been recommended for public review by the responsible project committee. To submit a comment on this proposed standard, go to the ASHRAE website at www.ashrae.org/standards-research--technology/public-review-drafts and access the online comment database. The draft is subject to modification until it is approved for publication by the Board of Directors and ANSI. Until this time, the current edition of the standard (as modified by any published addenda on the ASHRAE website) remains in effect. The current edition of any standard may be purchased from the ASHRAE Online Store at www.ashrae.org/bookstore or by calling 404-636-8400 or 1-800-727-4723 (for orders in the U.S. or Canada).

This standard is under continuous maintenance. To propose a change to the current standard, use the change submittal form available on the ASHRAE website, www.ashrae.org.

The appearance of any technical data or editorial material in this public review document does not constitute endorsement, warranty, or guaranty by ASHARE of any product, service, process, procedure, or design, and ASHRAE expressly disclaims such.

ASHRAE, 180 Technology Parkway NW, Peachtree Corners, GA 30092

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

This addendum addresses efficiency improvements to dehumidification systems. This addendum is in part to address how to efficiently meet the humidity limits prescribed in Standard 62.1 per Addendum k to 62.1-2022 which modified section 5.12 as follows:

> **5.12 Mechanical~~ly~~ and~~or~~ Indirect~~ly~~ Evaporative~~ly Cooled Buildings~~Cooling Systems.** Systems that cool by mechanical means or indirect evaporation shall be designed in accordance with the following sections:
>
> **5.12.1 Humidity Limit.** ~~to limit the~~ The indoor humidity shall not exceed a ~~to a maximum~~ dew point temperature of 60°F (15°C) during both occupied and unoccupied hours in any zone. ~~whenever the outdoor air dew point is above 60°F (15°C). The dew point limit shall not be exceeded when system performance is analyzed with outdoor air at the dehumidification design condition (that is, design dew point and mean coincident dry-bulb temperatures) and with the space interior loads (both sensible and latent) at cooling design values and space solar loads at zero.~~
>
> **5.12.2 Controls.** Devices and controls shall be provided to maintain the humidity at or below the limit defined in section 5.12.1.
>
> **Exceptions to 5.12:**
> 1. Systems in locations where the outdoor dew point temperature is below 68°F (20°C) at the ASHRAE 2% annual dehumidification design condition.
> ~~1~~2. ~~Spaces~~Zones equipped with materials, assemblies, coatings, and furnishings that resist microbial growth and that are not damaged by continuously high indoor air humidity.
> ~~2. During overnight unoccupied periods not exceeding 12 hours, the 60°F (15°C) dew point limit shall not apply, provided that indoor relative humidity does not exceed 65% at any time during those hours.~~
> 3. Indoor humidity shall be allowed to exceed the section 5.12.1 humidity limit continuously for a period of up to 60 hours provided the 30-day average humidity remains below the limit.

Key requirements of this addendum include:

1. Humidity limits are expressed in terms of dewpoint temperature, rather than relative humidity, which was referenced in versions of Standard 62.1 prior to 2022. The rationale was that dewpoint temperature is more indicative of the risk of condensation on surfaces resulting in mold and other microbial growth.
2. The dewpoint temperature limit applies to actual space humidity, not to a theoretical humidity calculated based on load calculations, as was required by this section prior to 2022.
3. The dewpoint temperature limit applies to all spaces on a 24/7 year-round basis, not just to occupied hours.
4. This addendum added two important exceptions:
    a. Exception 1 exempts locations where the 2% ASHRAE annual outdoor air dewpoint temperature is below 68°F. This limit of 68°F (which is well above the space dewpoint limit of 60°F) recognizes that for spaces with mechanical cooling, which is what this section applies to, space humidity will generally be below outdoor air humidity due to the dehumidification provided by the mechanical cooling system. It was also selected to eliminate almost all of the “B” (dry) climate zones and “C” (coastal) climate zones where humidity issues in buildings caused by high outdoor air humidity are very rare.

b. Exception 3 allows excursions above the 60°F high limit provided they are for a limited period of time, recognizing that microbial growth occurs only after surface humidity is sustained at high levels for long periods of time. The 30-day period in the exception is based on the ASHRAE Handbook Applications chapters on humidity and mold.

Consistent with the scope of Standard 62.1, this section makes no mention of how to achieve the dewpoint limits in an energy efficient manner. Designers could simply take the simplest, but most energy intensive, approach of supplying air to all zones 24/7 year-round at a dewpoint temperature that is low enough to ensure space dewpoint temperatures remain below 60°F even when spaces experience their highest latent loads (typically at full occupancy) even though those peak conditions are rare. This addendum to Standard 90.1 is intended to prevent that solution and instead mandate efficient dehumidification systems that operate the fewest possible hours to achieve compliance with this section of Standard 62.1.

This addendum is supported by Addendum b to ASHRAE Guideline 36-2024 which provides control sequences designed to comply with Exception 3 above. Compliance with this exception is not straightforward; it requires keeping running tally of space dewpoint temperature excursions above 60°F and running averages of the dewpoint temperature in each space, as well as defining a strategy for lowering space dewpoint temperature when the 62.1 limits are approaching. It is anticipated that this will require digital control systems, at least initially until manufacturers of smart single zone thermostats develop new capabilities, so this addendum only mandates using Exception 3 for HVAC systems with DDC.

This addendum is based on the following concepts:

1. Humidity limits currently expressed as relative humidity are changed to dewpoint temperature to match Standard 62.1. Therefore, to meet Standard 62.1 and this addendum, humidity sensors must have the capability of directly measuring dew point temperature (which is currently unusual), or using psychometric routines to calculate dewpoint temperature from relative humidity and drybulb temperature. The latter is standard for DDC systems, but manufacturers of programmable thermostats will have to enhance their firmware to measure dewpoint temperature instead of, or in addition to, relative humidity. Note that this is a requirement initially promulgated by Standard 62.1, not 90.1, so firmware revision costs need not to be considered in this addendum.
2. The most efficient way to meet the Standard 62.1 limit on a 24/7 basis is to require humidity sensors in each HVAC zone, or perhaps groups of similar zones that operate on the same schedule and have similar internal latent loads. Otherwise, there would be no way of knowing if the dewpoint limit is being met or, in the case of meeting Exception 3, how many consecutive hours the dewpoint limit is exceeded or whether the running average dewpoint temperature limit is being maintained, especially when HVAC systems are shut off during unoccupied hours. Having dewpoint temperature sensors in each zone also allows systems with central dehumidification (e.g. DOAS or VAV systems) to dehumidify supply air only to the extent needed to maintain the space humidity limit at actual load conditions. Without these sensors, supply air dewpoint setpoints would have to be set for the most extreme space latent loads, e.g. when fully occupied, wasting energy when spaces latent loads are lower.
    a. Note that humidity sensors have a reputation of being inaccurate and requiring frequent recalibration. However, the research supporting this reputation (e.g. National Building Controls Information Program. 2004. “Product Testing Report: Duct-Mounted Relative Humidity Transmitters.” 2004) is out of date. Humidity sensors are now much more common – they are provided as standard on almost all commercial and residential smart programmable thermostats and available as a relatively low cost option ($<100 to $300) for DDC zone sensors, and standard from at least one major DDC manufacturer. Some recent research studies suggest that the accuracy of humidity sensors in commercial control systems has improved significantly. For example, a review https://pubs.acs.org/doi/pdf/10.1021/acsaelm.2c00721, published in 2022, highlights advancements in sensor materials, including polymers, composites, and carbon-based materials, which have contributed to better performance and accuracy. These advancements suggest that modern humidity sensors may be more reliable and require less frequent calibration compared to earlier products. More research is required to fully establish just how reliable and accurate commonly used sensors supplied with DDC systems actually are, but SSPC 90.1 sees no alternative to requiring them to meet energy goals for dehumidification systems.
3. Dehumidification requirements are broken into those that apply during normal occupied mode and those that apply during off-hours. The former is already largely covered by Standard 90.1 and this addendum only includes relatively minor changes, such as the change to humidity sensor type and high limit. Sections limiting dehumidification during off-hours are new, and the intent is to prevent continuous HVAC system operation and require that dehumidification systems be cycled on only to meet the Standard 62.1 limits, including taking advantage of Exception 3 above to the extent possible for systems with DDC. An informative comment is made to ASHRAE Guideline 36-2024 Addendum b which provides detailed control sequences for how to meet Exception 3.
4. Notes on specific changes:
    a. A definition of “mechanical dehumidification” is added in part to distinguish cooling for the purpose of reducing humidity from cooling for thermal comfort and also to ensure desiccant systems are included.
    b. Sections that allow unoccupied operation for the purpose of humidity control are revised to reference the new section on how unoccupied dehumidification must be controlled.

c. Section 6.4.3.6.1 is revised to use only dewpoint temperature as the humidity variable and revised so the actual setpoint is a default, not mandatory.
d. A humidity sensor accuracy and drift requirement is added to help address the concern about humidity sensor accuracy and reliability.
e. The first exception to Section 6.5.2.3 is made more stringent and simplified by referencing Section 6.5.3.2.1 which establishes turndown capability of all cooling systems. This made former exceptions 2 and 3 unnecessary.
f. A new exception to Section 6.5.2.3 is added for multiple zone HVAC systems if they comply with Section 6.5.3.5. Strictly speaking, these systems cannot meet Section 6.5.2.3 so an exception is needed.
g. Section 6.5.2.3.1 is added to address unoccupied dehumidification limitations. In this case, the Standard 62.1 dewpoint limit is strictly required, not a default as in Section 6.4.3.6.1.
h. Section 6.5.3.5 is revised to mandate zone humidity sensors be used to reset supply air temperature to limit zone humidity to be sure the reset is no more than needed.
i. The reference to Guideline 36 in Section 6.5.3.5 is expanded to make it clear that the most recent version (2024) now addresses zone humidity control sequences. As with Standard 62.1, humidity in Guideline 36 is measured as dewpoint temperature, not relative humidity.

This addendum has the following cost impacts:

- Humidity sensors are required to measure dewpoint temperature rather than only relative humidity. But this requirement is really incurred to meet Standard 62.1 which expresses humidity in terms of dewpoint temperature. Hence, the cost to add software or firmware to convert drybulb temperature and relative humidity to dewpoint temperature is not considered here.
- This addendum effectively requires humidity sensors in all HVAC zones (or a single zone representative of multiple zones) for systems where zone humidity is being directly controlled. This is primarily to address the Standard 62.1 Section 5.12 requirement. A common humidity control design resets supply air temperature based on return air humidity, but that cannot ensure 60°F dewpoint temperature is maintained in every zone since the return air is an average of all zones served by the system, and it only works when the system is already on – it cannot provide feedback of zone dewpoint temperature when the system is off. Since the 60°F high limit required by Standard 62.1 applies continuously, there does not appear to be a means to demonstrate compliance without providing humidity sensors in each zone, unless the system is required to operate continuously in which case this addendum would allow a single return air humidity sensor (per new Exception 1 to 6.4.3.6.1). Hence for systems complying with Standard 62.1, this addendum does not require additional humidity sensors not already required by Standard 62.1.
- For systems that are not required to meet Standard 62.1 humidity limits but are still actively dehumidifying anyway, this addendum acts as a clarification: the existing requirement already limits humidistatic controls reducing zone humidity below 55°F dewpoint temperature in each zone, which means zone humidity has to be measured in some way. This addendum clarifies that the sensor has to measure zone humidity in each zone, with (per new Exception 1 to 6.4.3.6.1) one sensor allowed to represent multiple zones if they operate on the same schedule and have similar latent loads. Note that for either the base requirement or Exception 1, a sensor in the return air is acceptable– a sensor mounted in the space is not required as long as the sensor reflects zone humidity. So, it is the SSPC's opinion that this addendum does not require additional humidity sensors not already effectively required by this Section 6.4.3.6.1.
- The addendum includes humidity sensor accuracy and drift limits to address the common concern that humidity sensors are inaccurate and require excessive recalibration. But the accuracy and drift limits proposed are based on what is already provided by typical control systems based on a large web search of OEM humidity sensors and those provided with DDC zone controls. Hence, these requirements are not expected to increase costs. Note that it is expected that ASHRAE will develop a test standard in the future to ensure this performance will be met in real HVAC applications. In the meantime, sensor accuracy and drift are as claimed by the manufacturer.
- Systems with DDC that are meeting Standard 62.1 humidity limits during unoccupied hours are required to implement Exception 3 to 5.12 of Standard 62.1, i.e. humidity is allowed to exceed the 60°F dewpoint limit provided the 30-day average meets the limit. This cost is minor given detailed sequences have been developed as part of a Guideline 36 addendum. The energy savings are substantial, and cost effectiveness is obvious, if the baseline is a system that operates 24/7 maintaining 60°F dewpoint temperature, as is currently allowed by Standard 90.1.

[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 cy to 90.1-2022

Add a definition to Section 3.2 as follows:

mechanical dehumidification: reducing the moisture content of air using *mechanical cooling*, active desiccant, or another *energy*-driven process. Passive desiccant regenerated from unheated exhaust air is not considered *mechanical dehumidification*.

Revise Section 6.4.3.3.2 as follows:

6.4.3.3.2 Setback Controls. Heating *systems* shall be equipped with controls capable of and configured to *automatically* restart and temporarily operate the *system* as required to maintain zone temperatures above an adjustable heating *set point* at least 10°F below the occupied heating *set point*. Cooling *systems* shall be equipped with controls capable of and configured to *automatically* restart and temporarily operate the *mechanical cooling system* at the lowest practical fan speed as required to maintain zone temperatures below an adjustable cooling *set point* at least 5°F above the occupied cooling *set point,* or to prevent maximum *space* humidity levels ~~as required by Standard 62.1~~in accordance with Section 6.5.2.3.1.

Revise exception 2 to Section 6.4.3.3.5.1 as follows:

Exceptions to 6.4.3.3.5.1:

1. A *networked guest room control system* shall be permitted to return the *thermostat set points* to their default occupied *set points* 60 minutes prior to the time the room is scheduled to be occupied.
2. Dehumidification shall be permitted to limit the *space* humidity levels ~~as required by Standard 62.1~~ in accordance with Section 6.5.2.3.1 during unoccupied mode for both rented and unrented periods.

Revise Section 6.4.3.6.1 as follows:

6.4.3.6.1 Dehumidification. *Humidistatic controls* shall not ~~use~~ cause *mechanical* ~~*cooling*~~*dehumidification* to reduce ~~the~~zone humidity below ~~the lower of~~ a dew point temperature limit that is capable of and initially configured to 55°F [13°C]~~or relative humidity of 60%~~ in ~~the coldest~~ any zone served by the *mechanical dehumidification system*. Humidity sensors controlling *mechanical dehumidification systems* shall measure the dew point temperature of each *HVAC zone* served by the *mechanical dehumidification system* and shall be capable of measuring space dew point temperature with an accuracy of ±2°F (1.1°C) in the dew point temperature range of 50°F to 70°F [10°C to 21°C] with a maximum annual drift of ±0.3°F (0.17°C).

Exceptions to 6.4.3.6.1:

1. A single humidity sensor shall be permitted to be used to represent the humidity of a group of *HVAC zones* provided the zones have the same occupancy schedule and similar internal latent loads.
2. For zones where the applicable code or standard expresses humidity limits in terms of relative humidity, such as healthcare under ASHRAE Standard 170, zone humidity sensors shall be capable of measuring relative humidity with an accuracy of ±3% RH in the range of 20% to 70% RH and maximum annual drift of 1% RH, and the humidity high limit shall be in accordance with the applicable code or standard.

Informative Note: ~~Lower humidity is permitted when operating *mechanical cooling* for temperature control.~~The required dew point temperature accuracy and drift are based on dew point calculated by standard psychrometric algorithms using a relative humidity sensor with an accuracy of ±3% RH and maximum drift of 1% RH per year, typical of a capacitive polymer type, and a temperature sensor with an accuracy of ±0.6°F (0.3°C) and maximum drift of 0.04°F (0.02°C) per year, typical of thermistors.

Revise Section 6.5.2.3 as follows:

6.5.2.3 Dehumidification. Where *humidistatic* ~~humidity~~ *controls* are provided to control *mechanical dehumidification systems*, such controls shall prevent *reheating*, mixing of hot and cold airstreams, or other means of simultaneous heating and cooling of the same airstream.

Exceptions to 6.5.2.3:

1. The *system* is capable of and configured to reduce supply air volume to the minimum airflow rate required by Section 6.5.3.2.1 ~~50% or less of the design supply airflow r~~or to the *design minimum outdoor air rate*, whichever is larger, before simultaneous heating and cooling takes place.

~~2. The individual fan cooling unit has a design cooling capacity of 65,000 Btu/h or less and is capable of and configured to unload to 50% capacity before simultaneous heating and cooling takes place.~~

~~3. The individual *mechanical cooling* unit has a design cooling capacity of 40,000 Btu/h or less. An individual *mechanical cooling* unit is a single *system* comprising a fan or fans and a cooling coil capable of providing *mechanical cooling*.~~

2. Multiple zone *HVAC systems* meeting the requirements of Section 6.5.3.5.

3. *Systems* serving *spaces* where specific humidity levels are required to satisfy *process application* needs, such as vivariums; museums; surgical suites; pharmacies; and *buildings* with refrigerating *systems*, such as supermarkets, refrigerated warehouses, and ice arenas, and where the *building* includes *site-recovered energy* or *on-site renewable energy* that provides *energy* equal to at least 75% of the annual *energy* for *reheating* or for providing warm air in mixing *systems*. This exception does not apply to *computer rooms*.

4. At least 90% of the annual *energy* for *reheating* or for providing warm air in mixing *systems* is provided from *site-recovered energy* (including condenser heat) or *on-site renewable energy*.

5. *Systems* where the heat added to the airstream is the result of the use of a desiccant *system*, and 75% of the heat added by the desiccant *system* is removed by a heat exchanger, either before or after the desiccant *system*, with *energy* recovery.

6.5.2.3.1 Unoccupied Dehumidification. *Mechanical dehumidification systems* that are operated to meet the humidity limits of Section 5.12 of Standard 62.1 during periods when zones are not scheduled or indicated to be occupied by a device meeting the requirements of Section 6.4.3.3.1 shall meet all of the following:

a) Zone dew point temperature shall be measured per Section 6.4.3.6.1.
b) The *mechanical dehumidification system* shall be operated and controlled only as required to maintain the high limit dew point temperature required by Section 5.12 of Standard 62.1.
c) If the *system* is located in a climate not exempted by Exception 1 to Section 5.12 of Standard 62.1, the system shall be provided with *DDC* and meet Section 6.5.2.3.1(d).
d) Where the *mechanical dehumidification system* and associated zones are controlled by *DDC*, the *mechanical dehumidification system* shall be controlled to operate as few hours as possible while meeting Exception 3 to Section 5.12 of Standard 62.1.

Informative Note: ASHRAE Guideline 36 includes detailed sequences of control for meeting Exception 3 to Section 5.12 of Standard 62.1.

e) Outdoor air shall be shut off in accordance with Section 6.4.3.4.2.

Revise Section 6.5.3.5 as follows:

6.5.3.5 Supply Air Temperature Reset Controls. Multiple zone *HVAC systems* shall include controls that are capable of and configured to *automatically reset* the supply air temperature in response to representative *building* loads or *outdoor air* temperature. The controls shall *reset* the supply air temperature at least 25% of the difference between the design supply air temperature and the design room air temperature. Controls that adjust the *reset* based on zone humidity are allowed in Climate Zones 0B, 1B, 2B, 3B, 3C, and 4 through 8 provided reset is based on zone humidity measured in accordance with Section 6.4.3.6.1 for the zone requiring the most dehumidification. *HVAC zones* that are expected to experience relatively constant loads shall have maximum airflow designed to accommodate the fully *reset* supply air temperature.

Exceptions to 6.5.3.5:

1. Systems in Climate Zones 0A, 1A, and 3A with less than 3000 cfm of design *outdoor air*.

2. *Systems* in Climate Zone 2A with less than 10,000 cfm of design *outdoor air*.

3. *Systems* in Climate Zones 0A, 1A, 2A, and 3A with at least 80% *outdoor air* and employing exhaust

air *energy* recovery complying with Section 6.5.6.1.

4. *Systems* that prevent *reheating*, *recooling*, or mixing of heated and cooled supply air.
5. *Systems* in which at least 75% of the *energy* for *reheating* (on an annual basis) is from *site recovered energy* or *on-site renewable energy*.

Informative Notes:

1. *HVAC zones* that are expected to experience relatively constant loads typically include electronic *equipment* rooms and interior zones.
2. ASHRAE Guideline 36 includes detailed sequences of control for resetting supply air temperature *set point* on multiple zone air handling units based on both zone air *terminal* unit cooling and dehumidification *demand* and *outdoor air* temperature.

6.5.3.5.1 Dehumidification Control Interaction. In Climate Zones 0A, 1A, 2A, and 3A, the *system* design shall allow supply air temperature *reset* while dehumidification is provided. When dehumidification control is active, *air economizers* shall be locked out.

Informative Note: Examples of *HVAC systems* that can allow supply air temperature *reset* while dehumidifying include cooling of *outdoor air* with a separate cooling coil, bypassing return air around the cooling coil, a dedicated *outdoor air system*, and *series energy recovery*.