ADDENDA

ASHRAE Addendum e to
ASHRAE Guideline 36-2021

High-Performance Sequences of Operation for HVAC Systems

Approved by ASHRAE and the American National Standards Institute on February 29, 2024.

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 (www.ashrae.org/continuous-maintenance).

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(This foreword is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.

FOREWORD

This addendum addresses the following:

1. *Revised sequences make it clear that Zone Group modes are determined at the zone level and generate Requests for modes, so there is no need for system level controllers to poll each zone, which creates unnecessary network traffic.*
2. *The current warmup and cooldown logic tries to warm up or cool down the entire Zone Group right when any zone in the group reaches its optimum start time. It does this by setting all Zone Group setpoints to Occupied setpoints and allowing air to be supplied at the cooling-maximum rate. But this can cause fans and heating/cooling systems to operate near full load. Depending on the utility rate structure, including time-of-day windows, this could set the building's peak demand for the billing period and substantially increase utility bills. The new logic proposed in this addendum only adjusts thermostat setpoints to the occupied setpoints when that zone's optimum start timer indicates it must run to meet the warmup time. This will usually cause zone start times to stagger, reducing peaks.*
3. *Current logic for setback and setup modes have a bug: the logic to terminate the mode is never reached because it waits for zones to exceed setback setpoints but zones are also controlling to those setpoints, so the exceedance is never reached.*
4. *Freeze Protection Mode is eliminated since it is no longer used. This was a mode that at one time was used at the air handler level. But setback logic already serves the purpose of preventing very cold zones.*

Note: In this addendum, changes to the current guideline 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 e to Guideline 36-2021

(IP and SI Units)

Modify Section 5.3.2.3 *as follows:*

5.3.2.3. The active set points shall be determined by the operating mode of the zone group (see Section 5.4.6).

~~a. The set points shall be the occupied set points d~~During occupied mode~~:, warm-up mode, and cooldown mode.~~

1. The cooling set point shall be the occupied cooling set point.

2. The heating set point shall be the occupied heating set point.

b. During warm-up mode:

1. The cooling set point shall be the unoccupied cooling set point.

2. The heating set point shall be the unoccupied heating set point until the time remaining until the zone group’s occupied start time is less than the zone's required warm-up time, tz-warmup, at which point the heating set point shall be the occupied heating set point.

c. During cool-down mode:

1. The cooling set point shall be the unoccupied cooling set point until the time remaining until the zone group’s occupied start time is less than the zone's required cool-down time, tz-cooldown, at which point the cooling set point shall be the occupied cooling set point.

2. The heating set point shall be the unoccupied heating set point.

d. During setback mode:

1. The cooling set point shall be the unoccupied cooling set point.

2. The heating set point shall be 2°C (3°F) above the unoccupied heating set point.

e. During setup mode:

1. The cooling set point shall be 2°C (3°F) below the unoccupied cooling set point.

2. The heating set point shall be the unoccupied heating set point.

f. ~~The set points shall be the unoccupied set points d~~During unoccupied mode~~:, setback mode, and setup mode.~~

1. The cooling set point shall be the unoccupied cooling set point.

2. The heating set point shall be the unoccupied heating set point.

Add Section 5.3.7 *as follows:*

5.3.7. Zone Group Mode Requests

5.3.7.1. Zone Group Mode Requests shall be generated by the conditions in each zone and sent to the Zone Group of which the zone is a member.

5.3.7.2. Warm-up Mode Requests

a. An algorithm provided with the BAS shall calculate the required zone warm-up time, tz-warmup, which shall be less than 3 hours, based on the zone's occupied heating set point, the current zone temperature, the outdoor air temperature, and a heating mass/capacity factor for each zone.

b. The heating mass/capacity factor may be either manually adjusted or automatically self-tuned by the BAS. If automatic, the tuning process shall be turned ON or OFF by a software switch to allow tuning to be stopped after the system has been trained.

c. If the zone group is in any mode other than occupied mode, zone window switch(es) indicate that all windows are closed, and the time remaining until the zone group's occupied start time is less than the zone's required warm-up time, tz-warmup, send 1 Warm-up Mode Request; else, send 0 Warm-up Mode Requests.

5.3.7.3. Cooldown Mode Requests

a. An algorithm provided with the BAS shall calculate the required zone cool-down time, tz-cooldown, which shall be less than 3 hours, based on the zone's occupied heating set point, the current zone temperature, the outdoor air temperature, and a cooling mass/capacity factor for each zone.

b. The cooling mass/capacity factor may be either manually adjusted or automatically self-tuned by the BAS. If automatic, the tuning process shall be turned ON or OFF by a software switch to allow tuning to be stopped after the system has been trained.

c. If the zone group is in any mode other than occupied mode, zone window switch(es) indicate that all windows are closed, and the time remaining until the zone group's occupied start time is less than the zone's required cool-down time, t-cooldown, send 1 Cooldown Mode Request; else, send 0 Cooldown Mode Requests.

Warm-up and cooldown modes are used to bring the zone groups up to temperature based on their scheduled occupancy period. The algorithms used in these modes (often referred to as "optimal start") predict the shortest time to achieve occupied set point to reduce the central system energy use based on past performance.

It is recommended to use a global outdoor air temperature not associated with any AHU to determine warm-up start time. This is because unit-mounted OA sensors, which are usually placed in the outdoor air intake stream, are often inaccurate (reading high) when the unit is OFF due to air leakage from the space through the OA damper.

5.3.7.4. Setback Mode Requests

a. If the zone group is in unoccupied or setback mode, zone window switch(es) indicate that all zone windows are closed, and zone temperature is less than the unoccupied heating setpoint for 5 minutes, send 1 Setback Mode Request; else, send 0 Setback Mode Requests.

5.3.7.5. Setup Mode Requests

a. If the zone group is in unoccupied or setup mode, zone window switch(es) indicate that all zone windows are closed, and zone temperature is greater than the unoccupied cooling setpoint for 5 minutes, send 1 Setup Mode Requests; else, send 0 Setup Mode Requests.

5.4.6.1

Modify Section 5.4.6 Zone-Group Operating Modes *as follows:*

5.4.6.2. Warm-Up Mode. ~~For each zone, the BAS shall calculate the required warm-up time based on the zone's occupied heating set point, the current zone temperature, the outdoor air temperature, and a mass/capacity factor for each zone. Zones where the window switch indicates that a window is open shall be ignored. The mass factor shall be manually adjusted or self-tuned by the BAS. If automatic, the tuning process shall be turned ON or OFF by a software switch to allow tuning to be stopped after the system has been trained.~~ Warm-up mode shall start when the number of Warm-Up Mode Requests > I (I = ignores, default = 5)~~based on the zone with the longest calculated warm-up time requirement, but no earlier than 3 hours before the start of the scheduled occupied period~~ and shall end at the zone group's scheduled occupied start ~~hour~~time or Warm-Up Mode Requests <MT (MT=minimum threshold, default = 1) after a minimum of 10 minutes in this mode.

5.4.6.3. Cool-down Mode. ~~For each zone, the BAS shall calculate the required cooldown time based on the zone's occupied cooling set point, the current zone temperature, the outdoor air temperature, and a mass/capacity factor for each zone. Zones where the window switch indicates that a window is open shall be ignored. The mass factor shall be manually adjusted or self-tuned by the BAS. If automatic, the tuning process shall be turned ON or OFF by a software switch to allow tuning to be stopped after the system has been trained.~~ Cool-down mode shall start when the number of Cool-down Mode Requests > I (I = ignores, default to 5)~~based on the zone with the longest calculated cooldown time requirement, but no earlier than 3 hours before the start of the scheduled occupied period~~ and shall end at the zone group's scheduled occupied start ~~hour~~time or Cool-down Mode Requests <MT (MT=minimum threshold, default = 1) after a minimum of 10 minutes in this mode.

5.4.6.4. Setback Mode. ~~During unoccupied mode, if any 5 zones (or all zones if fewer than 5) in the zone group fall below their unoccupied heating set points, or if the average zone temperature of the zone group falls below the average unoccupied heating set point, the zone group shall enter setback mode until all spaces in the zone group are 1°C (2°F) above their unoccupied set points~~ Setback mode shall start when the number of Setback Mode Requests > I (I = ignores, default to 4) and shall end when Setback Mode Requests <MT (MT=minimum threshold, default = 1) after a minimum of 10 minutes in this mode.

~~5.4.6.5. Freeze Protection Setback Mode. During unoccupied mode, if any single zone falls below 4°C (40°F), the zone group shall enter setback mode until all zones are above 7°C (45°F), and a Level 3 alarm shall be set.~~

5.4.6.6. Setup Mode. ~~During unoccupied mode, if any 5 zones (or all zones if fewer than 5) in the zone group rise above their unoccupied cooling set points, or if the average zone temperature of the zone group rises above the average unoccupied cooling set point, the zone group shall enter setup mode until all spaces in the zone group are 1°C (2°F) below their unoccupied set points. Zones where the window switch indicates that a window is open shall be ignored~~ Setup mode shall start when the number of Setup Mode Requests > I (I = ignores, default to 4) and shall end when Setup Mode Requests <MT (MT=minimum threshold, default = 1) after a minimum of 10 minutes in this mode.

Setback and setup modes are used to keep zone temperatures (and mass) from straying excessively far from occupied set points so that the cooldown and warm-up modes can achieve set point when initiated. The ~~minimum~~ number of ignored zones (set at ~~5~~ 4 here) are to ensure that the central systems (fans, pumps, heating sources, or cooling sources) can operate stably. Obviously, the size of the zones and the characteristics of the central systems are a factor in choosing the correct number of zones in each group.

5.4.6.7. When zones in one Zone Group are generating requests for different modes, the hierarchy in Section 5.15.1 shall be used to determine Zone Group Operating Mode.

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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.

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