



DENVER AMENDMENT PROPOSAL FORM FOR PROPOSALS TO THE 2019 DENVER BUILDING CODE AMENDMENTS AND THE 2021 INTERNATIONAL CODES

DENVER
THE MILE HIGH CITY

2021 CODE DEVELOPMENT CYCLE

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2) One proposal per this document is to be provided with clear and concise information.

Is a separate graphic file provided ("X" to answer): ___ Yes or ___ No

3) Highlight the code and acronym that applies to the proposal

| <u>Acronym</u> | <u>Code Name</u> | <u>Acronym</u> | <u>Code Name</u> |
|----------------|--|----------------|--------------------------------|
| DBC-AP | Denver Building Code–Administrative Provisions | IPC | International Plumbing Code |
| IBC | International Building Code | IRC | International Residential Code |
| IECC | International Energy Conservation Code | IFGC | International Fuel Gas Code |
| IEBC | International Existing Building Code | IMC | International Mechanical Code |
| IFC | International Fire Code | DGC | Denver Green Code |

Please provide all the following items in your amendment proposal.

Code Sections/Tables/Figures Proposed for Revision:
Instructions: If the proposal is for a new section, indicate (new), otherwise enter applicable code section.

C403.2.3

Proposal:
Instructions: Show the proposal using ~~strikeout~~, underline format.
Place an "X" next to the choice that best defines your proposal: ___ Revision ___ New Text **x**___ Delete/Substitute ___
 Deletion

IECC 2021:

C403.2.3 Fault detection and diagnostics. New buildings with an HVAC system serving a gross conditioned floor area of ~~100,000 square feet (9290 m²)~~ 20,000 square feet (1858 m²) or larger shall include a fault detection and diagnostics (FDD) system to monitor the HVAC system's performance and automatically identify faults. The FDD system shall:

1. Include permanently installed sensors and devices to monitor the HVAC system's performance.
2. Sample ~~the~~ each HVAC system's ~~performance~~ at least once every 15 minutes.
3. Automatically identify and report HVAC system faults.
4. Automatically notify authorized personnel of identified HVAC system faults.
5. Automatically provide prioritized recommendations for repair of identified faults based on analysis of data collected from the sampling of HVAC system performance.
6. Be capable of transmitting the prioritized fault repair recommendations to remotely located authorized personnel.

Exceptions: the following building types and system types are exempt from the requirements of C403.2.3:

1. R-1 and R-2 occupancies.
2. Warehouse buildings with heating-only systems.

C403.5.5 Economizer fault detection and diagnostics. Air-cooled unitary direct-expansion units, ~~listed in Tables C403.3.2(1) through C403.3.2(3) and Table-C403.3.2(9)–the tables in Section C403.3.2~~ and variable refrigerant flow (VRF) units, and air handling units that have a nominal cooling capacity of 33,000 Btu/h or greater and are equipped with an economizer in accordance with Sections C403.5 through C403.5.4 shall include a fault detection and diagnostics system complying with the following:

1. The following temperature sensors shall be permanently installed to monitor system operation:
 - 1.1. Outside air.
 - 1.2. Supply air.
 - 1.3. Return air.
2. Temperature sensors shall have an accuracy of $\pm 2^{\circ}\text{F}$ (1.1°C) over the range of 40°F to 80°F (4°C to 26.7°C).
3. Refrigerant pressure sensors, where used, shall have an accuracy of ± 3 percent of full scale.
4. The unit controller shall be configured to provide system status by indicating the following:
 - 4.1. Free cooling available.
 - 4.2. Economizer enabled.
 - 4.3. Compressor enabled.
 - 4.4. Heating enabled.
 - 4.5. Mixed air low limit cycle active.
 - 4.6. The current value of each sensor.
5. The unit controller shall be capable of manually initiating each operating mode so that the operation of compressors, economizers, fans and the heating system can be independently tested and verified.
6. The unit shall be configured to report faults to a fault management application available for *access* by day-to-day operating or service personnel, or annunciated locally on zone thermostats.

Supporting Information :

All proposals must include a written explanation and justification as to how they address physical, environmental, and/or customary characteristics that are specific to the City and County of Denver. The following questions must be answered for a proposal to be considered.

- Purpose: What does your proposal achieve?
- Reason: Why is your proposal necessary?
- Substantiation: Why is your proposal valid? (i.e. technical justification)

Purpose: this proposal seeks to align fault detection and diagnostics (FDD) requirements with current equipment capabilities. The IECC code sets a minimum building area threshold of 100,000 square feet for the FDD requirement. The feasibility of the proposed requirement does not depend on building floor area but on HVAC system size. The proposed language sets a minimum HVAC nominal capacity of 54,000 Btu/h (4.5 tons) based on previous studies for the California Building Energy Efficiency Standards.

A second objective under this measure is to include built-up air handling units (AHU) that meet minimum capacity thresholds in the scope of the FDD requirements. Control systems are capable of diagnosing key system faults with AHU in a similar manner as packaged HVAC units.

Reason: The proposal is needed to provide facilities and maintenance staff tools to diagnose and troubleshoot issues and identify and prioritize repairs. Light commercial buildings of this size (20,000 ft² to 100,000 ft²) often do not have dedicated maintenance staff, and staff often have limited training and limited access to perform maintenance beyond changing filters and restarting units. Linking the requirement to system capacity will align capabilities with available features from manufacturers. Very low-capacity units (2 to 3 tons) may not have capability for FDD. Small split systems serving computer rooms or small private offices will not have FDD capability.

Substantiation: Major HVAC rooftop equipment manufacturers provide fault detection and diagnostics capabilities as product options. The software and sensors can be used to detect common faults, including improper economizer operation, low discharge air temperature. Often, rooftop units receive little to no maintenance, particularly on smaller buildings that do not have dedicated maintenance personnel. It is crucial that the faults can be reported asynchronously to building maintenance staff. Air handling units used with hydronic heating and cooling can also use FDD packages to detect and report faults.

A recent study by Lawrence Berkeley National Laboratory (2020) found that building owners saw an annual energy savings of \$0.19/ft², with an initial system cost of \$0.03/ft² and an annual recurring cost of \$0.02/ft² for software services.

Bibliography and Access to Materials (as needed when substantiating material is associated with the amendment proposal):

Kramer, Hannah et. al. 2020. Building Analytics and Monitoring-based Commissioning: Industry Practice, Costs, and Savings, Lawrence Berkeley National Laboratory, March 2020.

2019 Title 24 Building Efficiency Standards, California Energy Commission.

2017 Pacific Gas & Electric Company. Economizer Fault Detection and Diagnostics (FDD) for Built-Up Air Handlers – Final Report, August 2017. <https://title24stakeholders.com/wp-content/uploads/2016/11/203A5B1.pdf>

Other Regulations Proposed to be Affected

***For proposals to delete content from the 2019 Denver Green Code in conjunction with adding it to other mandatory Denver codes and/or regulations, only.**

Please identify which other mandatory codes or regulations are suggested to be updated (if any) to accept relocated content.

Referenced Standards:

List any new referenced standards that are proposed to be referenced in the code.

Impact:

How will this proposal impact cost and restrictiveness of code? ("X" answer for each item below)

Cost of construction: Increase ___ Decrease ___ No Impact

Cost of design: ___ Increase ___ Decrease No Impact

Restrictiveness: ___ Increase ___ Decrease No Impact