



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 X 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.

Revise IECC Section C403.5 – Strikeout/underline changes below

Revise DGC Section 701.4.3.4 to be consistent with proposed IECC requirements. Modify exception to reduce allowance of systems without economizers for Denver Green Code.

Proposal:

Instructions: Show the proposal using ~~strikeout~~, underline format.

Place an "X" next to the choice that best defines your proposal: X Revision ___ New Text ___ Delete/Substitute ___ Deletion Amend

C403.5 Economizers. Economizers shall comply with Sections C403.5.1 through C403.5.5.

An air or water economizer shall be provided for the following cooling systems:

1. Chilled water systems with a total cooling capacity, less cooling capacity of cooling units provided with air economizers, as specified in Table C403.5(1).
2. Individual fan systems with a rated cooling capacity greater than or equal to ~~54,000~~ 33,000 Btu/h (~~15.8~~ 9.7 kW) in buildings having other than a *Group R* occupancy. The total supply capacity of all fan cooling units not provided with economizers shall not exceed 20 percent of the total supply capacity of all fan cooling units in the building or 300,000 Btu/h (88 kW), whichever is greater.
3. Individual fan systems with cooling capacity greater than or equal to 270,000 Btu/h (79.1 kW) in buildings having a *Group R* occupancy. The total supply capacity of all fan cooling units not provided with economizers shall not exceed 20 percent of the total supply capacity of all fan cooling units in the building or 1,500,000 Btu/h (440 kW), whichever is greater.

Exceptions: Economizers are not required for the following systems.

- ~~1. Individual fan systems not served by chilled water for buildings located in Climate Zones 0A, 0B, 1A and 1B.~~
1. 2. Where more than 25 percent of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35°F (1.7°C) dew-point temperature to satisfy process needs.
3. Systems scheduled to operate less than 20 hours per week, per construction documents.
4. Systems serving supermarket areas with open refrigerated casework.
5. Where the cooling efficiency is greater than or equal to the efficiency requirements in Table C403.5(2).
6. Systems that include a heat recovery system in accordance with Section C403.10.5.
7. VRF systems with heat recovery installed with a dedicated outdoor air system.

8. Split systems with cooling capacity less than 54,000 Btu/h that do not provide a supply of outside air ventilation.

**TABLE C403.5(1)
MINIMUM CHILLED-WATER SYSTEM COOLING CAPACITY FOR
DETERMINING ECONOMIZER COOLING REQUIREMENTS**

| TOTAL CHILLED-WATER SYSTEM CAPACITY LESS CAPACITY OF COOLING UNITS WITH AIR ECONOMIZERS | |
|--|---|
| Local water-cooled chilled-water systems | Air-cooled chilled water systems or district chilled-water systems |
| 1,320,000 Btu/h (387,000 W) | 1,720,000 Btu/h (504,000 W) |

C403.5.1 Integrated economizer control. Economizer systems shall be integrated with the mechanical cooling system and be configured to provide partial cooling even where additional mechanical cooling is required to provide the remainder of the cooling load. Controls shall not be capable of creating a false load in the mechanical cooling systems by limiting or disabling the economizer or any other means, such as hot gas bypass, except at the lowest stage of mechanical cooling.

Units that include an air economizer shall comply with the following:

1. Unit controls shall have the mechanical cooling capacity control interlocked with the air economizer controls such that the outdoor air damper is at the 100-percent open position when mechanical cooling is on and the outdoor air damper does not begin to close to prevent coil freezing due to minimum compressor run time until the leaving air temperature is less than 45°F (7°C).
2. Direct expansion (DX) units that control 75,000 Btu/h (22 kW) or greater of rated capacity of the capacity of the mechanical cooling directly based on occupied space temperature shall have no fewer than two stages of mechanical cooling capacity.

2.1. Rooftop units with a rated capacity of at least 33,000 Btu/h (9.7 kW) but less than 75,000 Btu/h (16 kW) shall have an airside economizer with two stages of capacity control, with the first stage controlling the economizer and the second stage controlling mechanical cooling.

Table C403.5(2). Reproduced from ASHRAE 90.1-2019

Table 6.5.1.3 DX Cooling Stage Requirements for Modulating Airflow Units

| Rating Capacity, Btu/h | Minimum Number of Mechanical Cooling Stages | Minimum Compressor Displacement ^a |
|------------------------|---|--|
| ≥85,000 and <240,000 | 3 | ≤35% of full load |
| ≥240,000 | 4 | ≤25% full load |

a. For mechanical cooling stage control that does not use variable compressor displacement the percent displacement shall be equivalent to the mechanical cooling capacity reduction evaluated at the full load rating conditions for the compressor.

3. Other DX units, including those that control space temperature by modulating the airflow to the space, shall be in accordance with Table C403.5.1.

C403.5.2 through C403.5.5 unchanged

Denver Green Code changes:

701.4.3.4 (7.4.3.4) Economizers. Where economizers are required by Section 701.4.3.4 (7.4.3.4), economizers shall meet the requirements in the IECC, Section C403.5, except as modified by the following:

- a. ~~Rooftop units with a capacity of less than 54,000 Btu/h (16 kW) shall have two stages of capacity control, with the first stage controlling the economizer and the second stage controlling mechanical cooling. Units with a capacity equal to or greater than 54,000 Btu/h (16 kW) shall comply with the staging requirements defined in the IECC, Section C403.8.~~
- b. ~~For systems that control to a fixed leaving air temperature (i.e., variable air volume [VAV] systems), the system shall be capable of resetting the supply air temperature up at least 5°F (3°C) during economizer operation.~~

All of the exceptions in the IECC, Section C403.5, shall apply except as modified by the following.

- a. ~~Where the reduced renewable approach defined in Section 701.4.1.1.2 (7.4.1.1.2) is used, the IECC, Section C403.5, Exception 5, shall be permitted to eliminate the economizer requirement, provided the requirements in the IECC, Table C403.5(2), are applied to the efficiency requirements required by Section 701.4.1.1.2 (7.4.1.1.2). If the standard renewable approach is chosen, as defined in Section 701.4.1.1.2 (7.4.1.1.2), then the requirements in the IECC, Table C403.5(2), shall be applied to the efficiency requirements in the IECC, Tables C403.3.2(1) through C403.3.2(10).~~
- b. For water-cooled units with a capacity less than 54,000 Btu/h (16 kW) that are used in systems where heating and cooling loads are transferred within the building (i.e., water-source heat pump systems), the requirement for an air or

water economizer can be eliminated if the con- denser-water temperature controls are capable of being set to maintain full-load heat rejection capacity down to a 55°F (12°C) condenser-water supply temperature, and the HVAC equipment is capable of operating with a 55°F (12°C) condenser-water supply temperature.

TABLE 701.4.3.4 (TABLE 7.4.3.4) MINIMUM SYSTEM SIZE FOR WHICH AN ECONOMIZER IS REQUIRED

| CLIMATE ZONES | COOLING CAPACITY FOR WHICH AN ECONOMIZER IS REQUIRED ^a |
|---------------|---|
| 5B | ³ 33,000 Btu/h (9.7 kW) ^a |

a. Where economizers are required, the total capacity of all systems without economizers shall not exceed ~~480,000~~ 240,000 Btu/h (40 70 kW) per building or 10% ~~20%~~ of the building's air economizer capacity, whichever is greater.

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? This proposal increases cooling system efficiency by requiring economizers on smaller capacity systems and requiring those economizers to minimize compressor operation when free cooling is available.
- Reason: Why is your proposal necessary? This proposal increases the efficiency of cooling systems when outdoor air temperatures are mild, enabling more systems to use free cooling with cool outdoor air rather than through operation of the compressor-based cooling equipment. Efficiency increases like this are necessary for Denver to reach its goals for low energy buildings. The change to DGC aligns the DGC with the revised IECC economizer requirement, and removes unnecessary exceptions.
- Substantiation: Why is your proposal valid? (i.e. technical justification) This proposal moves a requirement from the DGC to the IECC. This requirement is very similar to a requirement in the IgCC, and equipment that complies with the requirements is widely available.

This proposal achieves cooling energy savings for small packaged equipment. Many larger packaged equipment (6 tons and above) already employs staging or some means of capacity control. Airside economizers are a tested and readily available system feature that allow the use of outside air for cooling when conditions dictate (outside air temperatures of 55F to 75F). These systems serve one zone and the controls are simple to setup.

Limited exceptions are given for systems that have a dedicated supply of ventilation through a DOAS system, and whose space conditioning systems can cycle with load.

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

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.

This proposal moves the economizer requirements in Section 701.4.3.4 of the DGC into the IECC in section C403.5. Section 701.4.3.4 would be deleted as the requirements would be present in the IECC.

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 x No Impact