



DENVER
THE MILE HIGH CITY

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

2021 CODE DEVELOPMENT CYCLE

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Date: 5/31/22
Representing (organization or self): Denver
City Staff Proposal (check box):

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

AMENDMENT PROPOSAL

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.

C402.5 Air Leakage Testing

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 X Deletion

Revise:

C402.5 Air leakage—thermal envelope. *The building thermal envelope shall comply with Sections C402.5.1 through Section C402.5.11.1, ~~or the building thermal envelope shall be tested in accordance with Section C402.5.2 or C402.5.3. Where compliance is based on such testing, the building shall also comply with Sections C402.5.7, C402.5.8 and C402.5.9.~~*

Revise:

C402.5.1.2 A continuous air barrier for the opaque building envelope shall comply with the following:

1. Buildings or portions of buildings, including that include Group R and I occupancies, shall meet the provisions of Section C402.5.2.

Exception: ~~Buildings in Climate Zones 2B, 3C, and 5C.~~

2. Buildings or portions of buildings other than Group R and I occupancies shall meet the provisions of Section C402.5.3.

3. If the air leakage requirements of C402.5.1.2 are not met, a Visual Inspection and Diagnostic Evaluation shall be performed, and all observed leaks shall be sealed where such sealing can be made without destruction of existing building components. Nonresidential buildings where the tested leakage rate exceeded 0.6 cfm/ft² of building shell area at 75 Pa shall be retested to confirm leakage is below 0.6 cfm/ft². Residential occupancies, including Group R and I buildings that do not pass leakage requirements shall have a visual inspection performed, with sealing of available leaks that do not require modification of the existing building envelope. The building shall be retested if the air leakage rate exceeded 0.45 cfm/ft² on the initial test.

Exceptions:

1. Buildings in Climate Zones 2B, 3B, 3C, and 5C.
2. Buildings larger than 5,000 square feet (464.5 m²) floor area in Climate Zones 0B, 1, 2A, 4B, and 4C.
3. Buildings between 5,000 square feet (464.5 m²) and 50,000 square feet (4645 m²) floor area in Climate Zones 0A, 3A and 5B.
3. Buildings or portions of buildings that do not complete air barrier testing shall meet the provisions of Section C402.5.1.3 or C402.5.1.4 in addition to Section C402.5.1.5.

Remove from Code:

~~**C402.5.1.3 Materials.** Materials with an air permeability not greater than 0.004 cfm/ft² (0.02 L/s × m²) under a pressure differential of 0.3 inch water gauge (75 Pa) when tested in accordance with ASTM E2178 shall comply with this section. Materials in Items 1 through 16 shall be deemed to comply with this section, provided that joints are sealed and materials are installed as air barriers in accordance with the manufacturer's instructions.~~

- ~~1. Plywood with a thickness of not less than 3/8 inch (10 mm).~~
- ~~2. Oriented strand board having a thickness of not less than 3/8 inch (10 mm).~~
- ~~3. Extruded polystyrene insulation board having a thickness of not less than 1/2 inch (12.7 mm).~~
- ~~4. Foil back polyisocyanurate insulation board having a thickness of not less than 1/2 inch (12.7 mm).~~
- ~~5. Closed-cell spray foam having a minimum density of 1.5 pcf (2.4 kg/m³) and having a thickness of not less than 1 1/2 inches (38 mm).~~
- ~~6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m³) and having a thickness of not less than 4.5 inches (113 mm).~~
- ~~7. Exterior or interior gypsum board having a thickness of not less than 1/2 inch (12.7 mm).~~
- ~~8. Cement board having a thickness of not less than 1/2 inch (12.7 mm).~~
- ~~9. Built-up roofing membrane.~~
- ~~10. Modified bituminous roof membrane.~~
- ~~11. Single-ply roof membrane.~~
- ~~12. A Portland cement/sand parge, or gypsum plaster having a thickness of not less than 5/8 inch (15.9 mm).~~
- ~~13. Cast-in-place and precast concrete.~~
- ~~14. Fully grouted concrete block masonry.~~
- ~~15. Sheet steel or aluminum.~~
- ~~16. Solid or hollow masonry constructed of clay or shale masonry units.~~

~~**C402.5.1.4 Assemblies.** Assemblies of materials and components with an average air leakage not greater than 0.04 cfm/ft² (0.2 L/s × m²) under a~~

~~pressure differential of 0.3 inch of water gauge (w.g.)(75 Pa) when tested in accordance with ASTM E2357, ASTM E1677, ASTM D8052 or ASTM E283 shall comply with this section. Assemblies listed in Items 1 through 3 shall be deemed to comply, provided that joints are sealed and the requirements of Section C402.5.1.1 are met.~~

- ~~1. Concrete masonry walls coated with either one application of block filler or two applications of a paint or sealer coating.~~
- ~~2. Masonry walls constructed of clay or shale masonry units with a nominal width of 4 inches (102 mm) or more.~~
- ~~3. A Portland cement/sand parge, stucco or plaster not less than 1/2 inch (12.7 mm) in thickness.~~

C402.5.1.53 Building envelope performance verification. The installation of the continuous air barrier shall be verified by the *code official*, a *registered design professional* or *approved agency* in accordance with the following:

1. A review of the construction documents and other supporting data shall be conducted to assess compliance with the requirements in Section C402.5.1.
2. Inspection of continuous air barrier components and assemblies shall be conducted during construction while the air barrier is still accessible for inspection and repair to verify compliance with the requirements of **Sections C402.5.1.3 and C402.5.1.4.**
3. A final commissioning report shall be provided for inspections completed by the *registered design professional* or *approved agency*. The commissioning report shall be provided to the building owner or owner's authorized agent and the *code official*. The report shall identify deficiencies found during the review of the construction documents and inspection and details of corrective measures taken.

Supporting Information (Required):

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?

1. Revise C402.5 to end sentence after C402.5.11.1 and delete remainder of sentence.
The current language of Section C402.5 leads the reader to believe that the building air barrier may comply with the code based on the air barrier construction and materials sections, without providing air barrier testing. This is misleading, as both options listed in section C402.5 require air barrier testing. Removal of the secondary compliance option will make the section clearer.
2. Revise Item 1 of C402.5.1.2:
This is a clarification that this item applies only to group R and I. As currently written, R and I are a subset of buildings or portions of buildings but does not say that buildings with other occupancies don't have to comply with this item.
3. Revise C402.5.1.2 to delete all exceptions in Items 1 and 2, and to delete Item 3.
Exception 3 to Item 2 is the only exception that applies to CZ 5B and the others are moot so they can be deleted. With no exceptions, testing is always required, and item 3 becomes moot since it only applies to projects without testing. With Denver's climate goals we don't think it's appropriate to include Exception 3 to Item 2.
4. Delete C402.5.1.3, C402.5.1.4, and C402.5.1.5.
Compliance with these sections is intended to only be required when testing is not completed, so these sections are not needed with the changes above to Items 1, 2 and 3 of C402.5.1.2. In IECC proposals CE96-19 and CE97-19,

these sections were intended to be subsections to C402.5.1.2 with compliance required only as scoped in C402.5.1.2; however, these ended up being the same level in the code (.3, .4 and .5 instead of .2.1, .2.2 and .2.3). With this error, the charging language in C402.5 would require compliance with these sections, even if testing is done, which is not the intent. By deleting, we avoid this error in the code.

- Reason: Why is your proposal necessary?

Air leakage can be a significant source of energy waste in buildings, contributing to higher heating and cooling costs for building owners and occupants, and increasing risk related to comfort and durability. Air tightness testing can result in more attention to envelope assembly air barrier sealing and significantly reduced building leakage. Adequate control over air leakage can provide many benefits including reduced HVAC equipment sizing, better building pressurization, and energy savings due to reduced heating and cooling of infiltrated outside air.

- Substantiation: Why is your proposal valid? (i.e. technical justification)

Materials and assemblies do not guarantee a low leakage building. Recent research (Wiss 2014) shows that 40% of buildings constructed without an envelope consultant have air leakage exceeding the currently optional test standard requirements, while buildings with envelope consultants all had leakage below 0.25 cf m/ft². Testing is the most reliable means of ensuring that the intent of this code section-limiting unintended energy waste in buildings due to air infiltration -will be achieved.

The measure retains the current IECC compliance path test limit of 0.40 cf m/ft² at 75 Pa. Durston and Heron's review (2012) of the more stringent requirements by the U.S. Department of Defense (DOD) shows that without testing, the range of building leakage can exceed the requirement by more than double (0.9 cf m/ft²). However, with testing included as part of the construction process, the average leakage of buildings was determined to be well below the 0.4 cf m/ft² limit. Therefore, based on the DOD findings, the test limit of 0.40 cf m/ft² is considered a realistic and achievable goal. In addition, the target is well established in the IECC, and aligns with similar optional requirements contained in Standard 90.1.

Cost Impact: The code change proposal will increase the cost of construction

This measure will increase the cost of construction of new commercial buildings as whole building air leakage testing will be required except for primarily residential buildings (Group R and I building occupancies). Based on a survey of professional commercial building air barrier testing companies, it was determined that the cost of air leakage testing fell into three ranges:

- \$350 or \$0.12 to \$0.07 per square foot for buildings up to 5000 square feet
 - \$0.50 to \$0.15 per square foot for buildings between 5000 and 50,000 square feet
 - \$0.15 to \$0.09 per square foot for buildings between 50,000 and 100,000 square feet, with decreasing costs for larger buildings.
- As demand for air leakage testing in commercial buildings increases, more companies will enter the market to provide these services. Therefore, a gradual decrease in cost is expected as more companies are available to do the testing.*

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

Wiss J. 2014. ASHRAE 1478-RP Measuring Airtightness of Mid- and High-Rise Non-Residential Buildings. Elstner Associates, Inc. for ASHRAE. <https://www.ashrae.org/resources--publications/periodicals/enewsletters/esociety/2014-12-10-articles/completed-research-december-2014>.

Durston JL and M Heron. 2012. Summary and Analysis of Large Building Air Leakage Testing for the U.S. Department of Defense. Atlanta, GA. http://c.ymcdn.com/sites/www.nibs.org/resource/resmgr/BEST/best3_durston.2.9.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

Departmental Impact (City use only):

This amendment proposal increases/decreases/is neutral to the cost of plans review.
This amendment increases/decreases/is neutral to the cost of inspections.