



# 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

1) **Name:** Kristen Salinas **Date:** October 14, 2021  
**Email:** ksalinas@noresco.com **Representing (organization or self):** City of 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  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	<b>DGC</b>	<b>Denver Green Code</b>

## AMENDMENT PROPOSAL

Please provide all the following items in your amendment proposal.

**Code Sections/Tables/Figures Proposed for Revision:**  
**New Section 402 System Commissioning and Functional Testing**

**Proposal:**

Revision  New Text \_\_\_ Delete/Substitute \_\_\_ Deletion

**401.2 (4.2) Compliance.** The energy systems shall comply with Mandatory Sections 401.3 through 401.4, and one of the following Project Electives:

1. Section 401.4, "Passive House Approach"
2. Section 401.5, "Net Zero Approach"
3. Section 401.6, "Energy Rating Approach."

**401.3 (4.3)Electric-vehicle charging (Mandatory).** UNCHANGED

**401.4 (4.4) System commissioning and functional testing (Mandatory).** The building’s mechanical and lighting systems shall be commissioned and functionally tested in accordance with Section 402.

*(Remaining 401 sections unchanged except to be renumbered)*

**Add new section:**

### **SECTION 402** **SYSTEM COMMISSIONING AND FUNCTIONAL TESTING**

#### **402.1 General.**

This section covers the provision of maintenance information and the commissioning of, and the functional testing requirements for, residential mechanical and lighting systems.

#### **402.1.1 Building operations and maintenance information.**

The building operations and maintenance documents shall be provided to the owner and shall consist of manufacturers' information, specifications and recommendations; programming procedures and data points; narratives; and other means of illustrating to the owner how the equipment and systems are intended to be installed, maintained and operated. Required regular maintenance actions for equipment and systems shall be clearly stated on a readily visible label. The label shall include the title or publication number for the operation and maintenance manual for that particular model and type of product.

#### **402.2 Mechanical systems commissioning and completion requirements.**

Prior to the final mechanical and plumbing inspections, the *registered design professional or approved agency* shall provide evidence of mechanical systems *commissioning* and completion in accordance with the provisions of this section.

*Construction document* notes shall clearly indicate provisions for *commissioning* and completion requirements in accordance with this section and are permitted to refer to specifications for further requirements. Copies of all documentation shall be given to the owner or owner's authorized agent and made available to the *code official* upon request in accordance with Sections 402.2.4.2 and 402.5.2.2.2.

#### **402.2.1 Commissioning plan.**

A *commissioning plan* shall be developed by a *registered design professional or approved agency* and shall include the following items:

- 1.1.A narrative description of the activities that will be accomplished during each phase of *commissioning*, including the personnel intended to accomplish each of the activities.
- 2.2.A listing of the specific equipment, appliances, or systems to be tested and a description of the tests to be performed.
- 3.3.Functions to be tested.
- 4.4.Conditions under which the test will be performed. Testing shall affirm winter and summer design conditions and full outside air conditions.
- 5.5.Measurable criteria for performance.

#### **402.2.2 Systems adjusting and balancing.**

HVAC systems shall be balanced in accordance with generally accepted engineering standards. Air and water flow rates shall be measured and adjusted to deliver final flow rates within the tolerances provided in the product specifications. Test and balance activities shall include air system and hydronic system balancing.

#### **402.2.2.1 Air systems balancing.**

Each supply air outlet and *zone* terminal device shall be equipped with means for air balancing in accordance with ACCA Manual D.

#### **402.2.2.2 Hydronic systems balancing.**

Individual hydronic heating and cooling coils shall be equipped with means for balancing and measuring flow. Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses, then the pump impeller shall be trimmed, or pump speed shall be adjusted to meet design flow conditions.

**402.2.3 Functional performance testing.**

Functional performance testing specified in Sections 402.2.3.1 through C408.2.3.2 shall be conducted.

**402.2.3.1 Equipment.**

Equipment functional performance testing shall demonstrate the installation and operation of components, systems and system-to-system interfacing relationships in accordance with approved plans and specifications such that operation, function, and maintenance serviceability for each of the commissioned systems are confirmed.

**402.2.3.2 Controls.**

HVAC control systems shall be tested to document that control devices, components, equipment and systems are calibrated and adjusted and operate in accordance with approved plans and specifications.

**402.2.4 Final commissioning report.**

A report of test procedures and results identified as “Final Commissioning Report” shall be delivered to the building owner or owner’s authorized agent and to the AHJ. The report shall be organized with mechanical system and service hot water system findings in separate sections to allow independent review. The report shall include the following:

1. Results of functional performance tests.
2. Disposition of deficiencies found during testing, including details of corrective measures used or proposed.
3. Functional performance test procedures used during the commissioning process including measurable criteria for test acceptance, provided herein for repeatability.

**Exception:** Deferred tests that cannot be performed at the time of report preparation due to climatic conditions.

**402.2.4.1 Acceptance of report.**

Buildings, or portions thereof, shall not be considered as acceptable for a final inspection until the *code official* has received the Final Commissioning Report from the building owner or owner’s authorized agent.

**402.2.5 Functional testing of lighting controls.**

Automatic lighting controls shall comply with this section.

**402.2.5.1 Functional testing.**

Prior to passing final inspection, the *registered design professional* or *approved agency* shall provide evidence that the lighting control systems have been tested to ensure that control hardware and software are calibrated, adjusted, programmed and in proper working condition in accordance with the *construction documents* and manufacturer’s instructions. Functional testing shall be in accordance with Sections 402.5.1.1 through 402.5.2.2.

**402.2.5.1.1 Occupant sensor controls.**

Where *occupant sensor controls* are provided, the following procedures shall be performed:

1. Certify that the *occupant sensor* has been located and aimed in accordance with manufacturer recommendations.
2. For projects with seven or fewer *occupant sensors*, each sensor shall be tested.
3. For projects with more than seven *occupant sensors*, testing shall be done for each unique combination of sensor type and space geometry. Where multiples of each unique combination of sensor type and space geometry are provided, not less than 10 percent and in no case fewer than one of each combination shall be tested unless the *code official* or design professional requires a higher percentage to be tested. Where 20 percent or more of the tested controls fail, all remaining identical combinations shall be tested.

For *occupant sensor controls* to be tested, verify the following:

- 3.1. Where *occupant sensor controls* include status indicators, verify correct operation.
- 3.2. The controlled lights turn off or down to the permitted level within the required time.
- 3.3. For auto-on *occupant sensor controls*, the lights turn on to the permitted level when an occupant enters the space.
- 3.4. For manual-on *occupant sensor controls*, the lights turn on only when manually activated.
- 3.5. The lights are not incorrectly turned on by movement in adjacent areas or by HVAC operation.

**402.2.5.2 Drawings.**

Construction documents shall include the location and type of each lighting control.

**402.2.5.2.1 Manuals.**

An operating and maintenance manual shall be provided and include the following:

1. Submittal data indicating all selected options for each piece of lighting equipment and lighting controls.
2. Operation and maintenance manuals for each piece of lighting equipment. Required routine maintenance actions, cleaning and recommended re-lamping shall be clearly identified.

**402.2.5.2.2 Report.**

A report of test results shall be provided and include the following:

1. Results of functional performance tests.
2. Disposition of deficiencies found during testing, including details of corrective measures used or proposed.

**402.2.5.2.2.1 Acceptance of report.**

Buildings, or portions thereof, shall not be considered as acceptable for a final inspection until the *code official* has received the Final Commissioning Report from the building owner or owner's authorized agent.

**Supporting Information (Required):**

Currently, residential HVAC equipment does not perform optimally or even as many codes and forecasts predict, largely because there is no consistent process to identify problems or to correct them. Residential commissioning is a solution to this problem.

The commissioning requirements found here were copied from IECC Section C408 for commercial buildings. Where a reference was made to a commercial test or standard, the applicable residential test or standard was referenced.

Commercial commissioning has been in the IECC since the 2012 edition and has been working well to ensure that building owners are getting what they paid for. No longer is it enough to just see that something was installed correctly, we need to ensure that it actually works the way it was designed so that the equipment lasts its useful life and runs as efficiently as possible in order to conserve energy.

Lawrence Berkely National Laboratories put out a report in 2003, "Guidelines for Residential Commissioning", in which they explain:

**Air Distribution Systems:** Ducts that are part of the thermal distribution system may be the single worst performer in the energy performance of a house. Duct leakage, duct insulation compression, and other poor installation practices can reduce duct efficiency by 30% from even a moderate level of design performance. Houses use whole-house ventilation as well, sometimes directly linked to the space conditioning system. The delivery effectiveness and room by room distribution efficiency of both the thermal and ventilation distribution systems thus depend on the proper flow of air through the air moving equipment. Poor operation of the air distribution systems wastes energy and can cause comfort problems, structural moisture problems, and poor indoor environmental quality.

**Cooling Equipment:** Even in new houses, cooling systems rarely perform as intended. Refrigerant charge levels and airflow across coils often do not meet manufacturers specifications used in the system design. As a result, the capacity and efficiency of the equipment can be substantially degraded.

**Combustion Appliances:** Fueled appliances must vent as intended. Poor installation of either the combustion equipment or air moving equipment can reduce efficiency and lead to backdrafting and combustion gas spillage or other hazards. Such events, along with insufficient ventilation for unvented combustion appliances, can directly affect the indoor environment and cause health or comfort problems.

Although there are few controls in a house compared to those in commercial buildings, controls and occupant interactions with them can play an important role in house performance, especially when the systems become complex (e.g., multistage systems, integrated heat-pump/ventilation systems). Even common heating-setback / cooling-setup thermostats need to be properly commissioned and occupants need to be educated in their proper use. Making sure that these controls are doing what was intended or is appropriate is often crucial to achieving good energy performance. In this guide, we do not provide a separate section to discuss controls, because their effects are integrated with component and whole-house performance. Instead, our discussions of components describe control issues when appropriate.

**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.

**N/A**

**Referenced Standards:**

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

*ACCA MANUAL D (as currently referenced in IRC)*

**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.