



- 2.1. The air handler is located completely within the *continuous air barrier* and within the *building thermal envelope*.
- 2.2. The duct leakage, as measured either by a rough-in test of the ducts or a postconstruction total system leakage test to outside the *building thermal envelope* in accordance with Section N1103.3.6 / R403.3.6, is less than or equal to 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m<sup>2</sup>) of *conditioned floor area* served by the duct system.
- 2.3. The ceiling insulation *R*-value installed against and above the insulated duct is greater than or equal to the proposed ceiling insulation *R*-value, less the *R*-value of the insulation on the duct.
3. Ductwork in floor cavities located over unconditioned space shall comply with all of the following:
  - 3.1. A *continuous air barrier* installed between unconditioned space and the duct.
  - 3.2. Insulation installed in accordance with Section R402.2.7.
  - 3.3. A minimum R-19 insulation installed in the cavity width separating the duct from unconditioned space.
4. Ductwork located within *exterior walls* of the *building thermal envelope* shall comply with the following:
  - 4.1. A *continuous air barrier* installed between unconditioned space and the duct.
  - 4.2. Minimum R-10 insulation installed in the cavity width separating the duct from the outside sheathing.
  - 4.3. The remainder of the cavity insulation shall be fully insulated to the drywall side.

**N1103.3.3 / R403.3.3 Ducts buried within ceiling insulation.** ~~Where Supply and return air ducts located in unconditioned attic or ceiling spaces are partially or completely buried in ceiling insulation, such ducts shall comply with all of the following:~~

1. The supply and return ducts shall have an insulation *R*-value not less than R-8.
2. The duct shall be installed on the truss bottom cord or ceiling joist closest to the ceiling finish material separating conditioned space from unconditioned space and ~~At all points along each duct, the sum of the ceiling insulation *R*-value against and above the top of the duct, and against and below the bottom of the sides of the duct, shall be equal that required in table N1103.1.3 / R402.1.3. not less than R-19, excluding the *R* value of the duct insulation.~~
3. ~~In Climate Zones 0A, 1A, 2A and 3A, the supply ducts shall be completely buried within ceiling insulation, insulated to an *R* value of not less than R-19.3 and in compliance with the vapor retarder requirements of Section 604.11 of the *International Mechanical Code* or Section M1601.4.6 of the *International Residential Code*, as applicable.~~

**Exception:** ~~Sections of the supply duct that are less than 3 feet (914 mm) from the supply outlet shall not be required to comply with these requirements.~~

**R403.3.3.1 Effective *R*-value of deeply buried ducts.** ~~Where using the Total Building Performance or Energy Rating Index Compliance Option in accordance with Section R401.2.2 or R401.2.3, sections of ducts that are installed in accordance with Section N1103.3.3 / R403.3.3, located directly on or within 5.5 inches (140 mm) of the ceiling, surrounded with blown-in attic insulation having an *R*-value of R-30 or greater and located such that the top of the duct is not less than 3.5 inches (89 mm) below the top of the insulation, shall be considered as having an effective duct insulation *R*-value of not more than R-25.~~

**Supporting Information (Required):**

- The purpose of this proposal is to take an incremental step to bring all duct work into the building envelope by requiring that the air handler be installed within the envelope and any ductwork located in a ventilated attic be installed in such a way that it can be insulated properly to perform.
- Reason: Ducts located outside the envelope are subject to extreme temperatures and do not deliver heated and cooled air as well as if they were installed within the envelope. There are ways to change that dynamic without creating a conditioned attic or by bring the duct physically within the envelope. This proposal is a stepped approach to a requirement that all ducts be located inside the envelope at the 2024 adoption to meet the City of Denver goals.
- Substantiation: Why is your proposal valid? (i.e., technical justification)
  - o There has been substantial research conducted that documents that ductwork located in unconditioned attics loses 25-50 percent of the heating or cooling energy put out by the HVAC system. Bringing ductwork into the envelope is a tested strategy to reduce this lose. This proposal is a beginning step to change construction practices in preparation to requiring all duct be brought into the envelope. This is a necessary step in order to improve the efficiency of mechanical systems in preparation to meet the City of Denver’s zero energy goals

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

- <https://www.nrel.gov/docs/fy10osti/48163.pdf>
- [https://www1.eere.energy.gov/buildings/publications/pdfs/building\\_america/27630.pdf](https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/27630.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:	<input checked="" type="checkbox"/> Increase	<input type="checkbox"/> Decrease	<input type="checkbox"/> No Impact
Cost of design:	<input checked="" type="checkbox"/> Increase	<input type="checkbox"/> Decrease	<input type="checkbox"/> No Impact
Restrictiveness:	<input checked="" type="checkbox"/> Increase	<input type="checkbox"/> Decrease	<input type="checkbox"/> 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.

## Denver Green Code Ducts and air handler location Proposal

### Code Sections/Tables/Figures Proposed for Revision:

**Instructions:** If the proposal is for a new section, indicate (new), otherwise enter applicable code section

### Ducts and air handler location

#### Proposal:

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

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

**401.7 Duct and air handler location.** Ducts and air handlers Shall not be installed in unconditioned space outside the *building thermal envelope*.

**407.1 Ducts and air handlers located in conditioned space.** For ductwork and air handlers to be considered inside *conditioned space*, they shall comply with the following:

1. The duct and air handler system shall be located completely within the *continuous air barrier* and within the building thermal envelope.
2. Ductwork in floor cavities located over unconditioned space shall comply with all of the following:
  - 3.1. A *continuous air barrier* installed between unconditioned space and the duct.
  - 3.2. Insulation installed in accordance with IECC Section R402.2.7.
  - 3.3. A minimum R-19 insulation installed in the cavity width separating the duct from unconditioned space.
  - 3.4 R5 rigid insulation board installed against the bottom of the floor joist between the joist and the drywall or soffit material.
3. Ductwork located within *exterior walls* of the *building thermal envelope* shall comply with the following:
  - 4.1. A *continuous air barrier* installed between unconditioned space and the duct.
  - 4.2. Minimum R-10 insulation installed in the cavity width separating the duct from the outside sheathing.
  - 4.3. The remainder of the cavity insulation shall be fully insulated to the drywall side.

#### Exception

**Ducts in ventilated attics.** Supply and return air ducts located in unconditioned attic or ceiling spaces shall comply with the following to be considered inside conditioned space:

1. The duct shall not be flex duct and shall be installed on the bottom cord of the truss or rafter closest to the drywall separating conditioned space from unconditioned space.
2. Five inches of Closed cell foam shall cover the duct or plenum run from the drywall or other boundary to conditioned space on one side of the duct or plenum, up and over the duct or plenum, to the drywall or other boundary to conditioned space on the other side of the duct or plenum. Thus, completely enclosing the duct within an air barrier, a minimum R30, and bringing it into conditioned space.

**Supporting Information (Required):**

Purpose: DGC is requiring ducts to be inside the conditioned space or to be installed so they perform as if they are within the conditioned space.

Reason: Duct located outside the envelope are subject to extreme temperatures and do not deliver heated and cooled air as well as if they were installed within the envelope. There are ways to change that dynamic without creating a conditioned attic or by bring the duct physically within the envelope.

Substantial research has been conducted that demonstrates the performance advantages to bringing the ductwork into conditioned space. It is being proposed for the DGC in order to gain comfort and experience with the requirement before this becomes an IECC requirement.

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

**Other Regulations Proposed to be Affected**

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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.