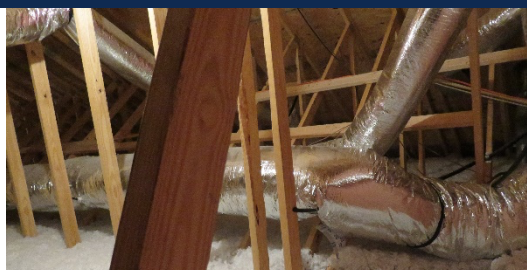
Ducts Buried Within Insulation

2021 VRC/VECC Update Guide





Ducts Buried Within Insulation:

Summary: The 2018 Virginia Residential Code was the first edition to include prescriptive requirements to be complied with when ducts are buried within ceiling insulation. This provides better thermal insulation for the ducts and minimizes heat losses and gains while also ensuring that sufficient attic insulation is provided. This guide will cover the key installation details that must be followed in order to properly utilize this installation method.

Why: HVAC ductwork installed outside of the building thermal envelope in a vented attic is only required to have R-8 insulation protecting it from extreme summer and winter temperatures in that space. While best practice dictates installing ductwork entirely in conditioned space, many designers prefer to locate this equipment in vented attics. To better protect ductwork from attic temperatures, the Virginia Residential Code allows ducts to be buried within the attic insulation.

Items of Note:

* *The code is silent as to whether batts are allowed to be used for this installation method. However, only sprayed or blown insulation could be installed to avoid air gaps or compression without unusual effort by installers – particularly with round ducts. The batts would have to be carefully cut to fit against the sides of the duct to avoid an air gap. Any compression of the batts (e.g., from the duct resting on a batt) would have to be compensated for with additional insulation in order to achieve a fully code-compliant installation.*
* *Best practices for buried ducts include placing the ducts very close to or in contact with the ceiling drywall and encapsulating these ducts in closed cell foam. As always, duct systems should be well sealed and installed in as compact a layout as possible.*
* *The potential for condensation during the summer exists when burying ducts. Duct leakage and a lack of continuity of the vapor barrier on the duct insulation (e.g., rips in the duct jacket) are the two largest contributing factors to this risk. This is because it becomes more likely that the attic air will come in contact with a condensing plane that is at or below the attic air's dew point. It is recommended to encapsulate ducts in closed cell spray foam to minimize the potential for condensation. In the absence of encapsulating the duct in closed cell foam, extra attention should be paid to ensure the continuity of the vapor barrier on the duct insulation jacket.*[1]
* *Well-sealed ducts properly buried in attic insulation have been shown to deliver 7 degrees cooler air in the summer – as compared to exposed ducts. This provides increased comfort for the occupants as well as energy savings.*[1]

[1] https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/compact-buried-ducts-hot-humid.pdf

Visual Reference:

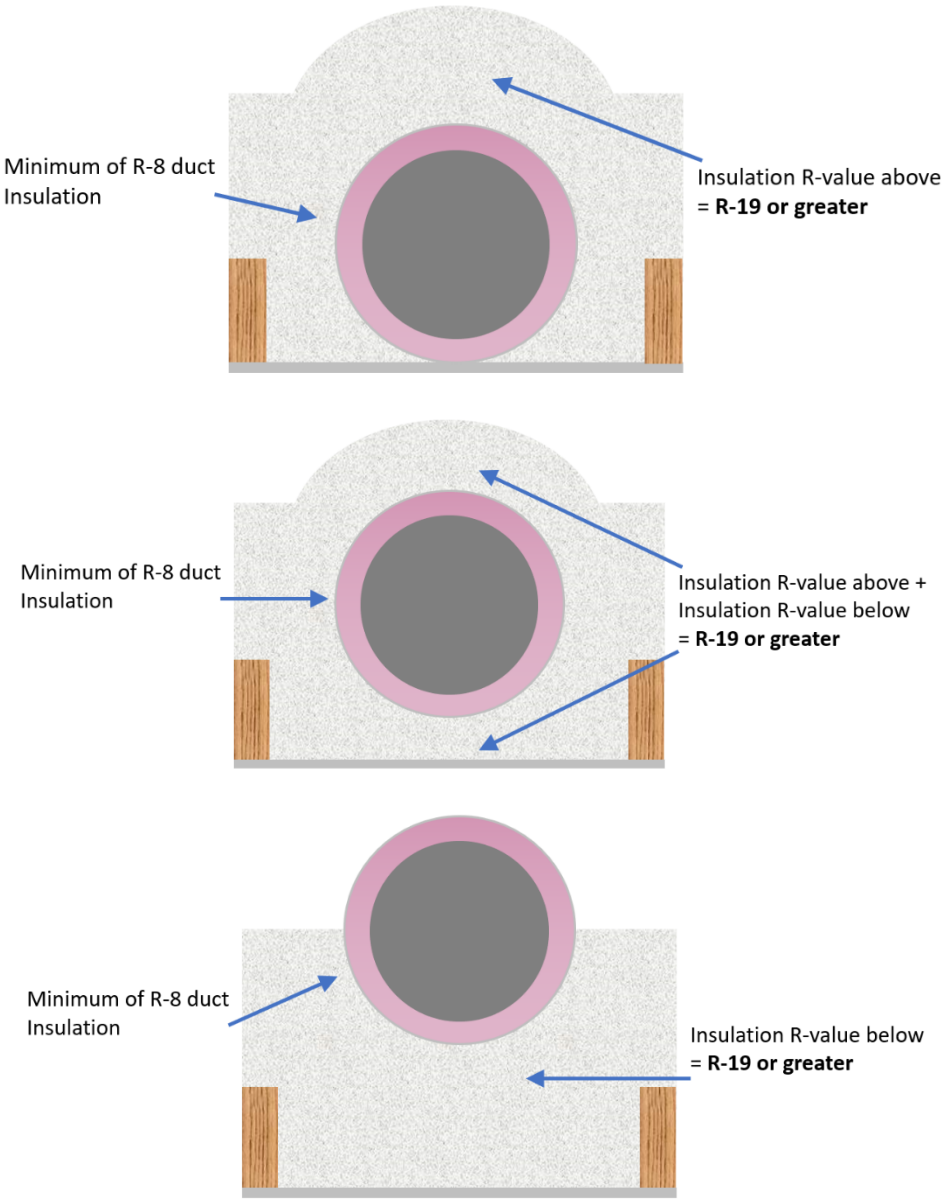


Figure 1: Different configuration options for burying ducts

2021 VRC/VECC Code References:

N1103.3.1 (R403.3.1) Ducts located outside conditioned space. Supply and return ducts located outside conditioned space shall be insulated to an R-value of not less than R-8 for ducts 3 inches (76 mm) in diameter and larger and not less than R-6 for ducts smaller than 3 inches (76 mm) in diameter. Ducts buried beneath a building shall be insulated as required by this section or have an equivalent thermal distribution efficiency. Underground ducts utilizing the thermal distribution efficiency method shall be listed and labeled to indicate the R-value equivalency.

N1103.3.2 (R403.3.2) Ducts located in conditioned space. For ductwork to be considered inside a conditioned space, it shall comply with one of the following:

1. The duct system is located completely within the continuous air barrier and within the building thermal envelope.
2. Ductwork in ventilated attic spaces is buried within ceiling insulation in accordance with Section N1103.3.3 and all of the following conditions exist:
    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, is less than or equal to 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m2) 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 have the following:
    3.1. A continuous air barrier installed between unconditioned space and the duct.
    3.2. Insulation installed in accordance with Section N1102.2.7.
    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 have 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 fully insulated to the drywall side.

N1103.3.3 (R403.3.3) Ducts buried within ceiling insulation. Where supply and return air ducts are partially or completely buried in ceiling insulation, such ducts shall comply with all of the following:

1. The supply and return duct shall have an insulation R-value not less than R-8.
2. At all points along each duct, the sum of the ceiling insulation R-values against and above the top of the duct, and against and below the bottom of the duct shall be 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-13 and in compliance with the vapor retarder requirements of Section M1601.4.6.

    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.

N1103.3.3.1 (R403.3.3.1) Effective R-value of deeply buried ducts. Where using the Total Building Performance Compliance Option in accordance with Section N1101.13.2, sections of ducts that are installed in accordance with Section N1103.3.3, 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 R-25.

N1102.4.1.1 (R402.4.1.1) Installation. The components of the building thermal envelope as indicated in Table N1102.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria indicated in Table N1102.4.1.1, as applicable to the method of construction. Where required by the code official, an approved third party shall inspect all components and verify compliance.

Definitions:

AIR BARRIER. One or more materials joined together in a continuous manner to restrict or prevent the passage of air through the building thermal envelope and its assemblies.

ATTIC. The unfinished space between the ceiling assembly and the roof assembly.

ATTIC, HABITABLE. A finished or unfinished habitable space within an attic.

BUILDING THERMAL ENVELOPE. The basement walls, exterior walls, floors, ceiling, roofs and any other building element assemblies that enclose conditioned space or provide a boundary between conditioned space and exempt or unconditioned space.

CAVITY INSULATION. Insulating material located between framing members.

CONDITIONED SPACE. An area, room or space that is enclosed within the building thermal envelope and that is directly or indirectly heated or cooled. Spaces are indirectly heated or cooled where they communicate through openings with conditioned spaces, where they are separated from conditioned spaces by uninsulated walls, floors or ceilings, or where they contain uninsulated ducts, piping or other sources of heating or cooling.

CONTINUOUS AIR BARRIER. A combination of materials and assemblies that restrict or prevent the passage of air through the building thermal envelope.

CONTINUOUS INSULATION (ci). Insulating material that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior, or is integral to any opaque surface, of the building envelope.

DUCT. A tube or conduit utilized for conveying air. The air passages of self-contained systems are not to be construed as air ducts.

DUCT SYSTEM. A continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, plenums, fans and accessory air-handling equipment and appliances.

R-VALUE (THERMAL RESISTANCE). The inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area (h × ft2 × °F/Btu) [(m2 × K)/W].

VAPOR PERMEABLE. The property of having a moisture vapor permeance rating of 5 perms (2.9 × 10-10 kg/Pa × s × m2) or greater, where tested in accordance with Procedure A or Procedure B of ASTM E96. A vapor permeable material permits the passage of moisture vapor.

VAPOR RETARDER CLASS. A measure of the ability of a material or assembly to limit the amount of moisture that passes through that material or assembly. Vapor retarder class shall be defined using the desiccant method with Procedure A of ASTM E96 as follows:

Class I: ≤ 0.1 perm rating
Class II: > 0.1 to ≤ 1.0 perm rating
Class III: > 1.0 to ≤ 10 perm rating