

# Sealing Heating, Ventilating, and Air-Conditioning Supply and Return Register Boots - Code Compliance Brief

## Overview:

The intent of this brief is to provide code-related information about properly sealing heating, ventilating, and air conditioning (HVAC) register boots to help ensure that the measure will be accepted as being in compliance with the code. Providing consistent information to document compliance with codes and standards to all responsible parties (e.g., code officials, builders, contractors, designers, etc.) is expected to result in increased compliance and more timely, less challenging and more uniform plan review and field inspections.

Heating, ventilating, and air conditioning register boots are products located at the beginning and end of an HVAC duct run to transfer the air moving within the ducts to and from the conditioned space; these products are commonly known as “supply and return register boots.” If HVAC register boots are not properly sealed and insulated, the following problems can arise:

- Air leakage into interstitial cavities and possible failure of a blower door test required by code
- Heat loss from duct leakage and possible failure of the mandatory duct leakage test required by code
- Condensation formation around the HVAC supply and return register boots
- Water damage from condensation occurring where the HVAC supply and/or return register boot is attached to the structure (e.g., subfloor, ceiling, or wall covering).

Applicable code requirements and details helpful for conducting Plan Reviews are discussed in the next section of this Code Compliance Brief. The Field Inspection section provides details for inspecting HVAC supply and return register boots. Finally, resources for technical validation, best practices, and measure guidelines are provided in the Technical Validation/Reference Materials section.

The lists and provisions provided below are intended to target the main code sections and provisions. Words and terms that are italicized, appear in code text and the Chapter 2 definition applies. Other references, code sections, standards, testing methods, etc., that affect the technology or other assemblies or functions of the building (e.g., duct design and duct leakage testing requirements) may exist.

## Plan Review:

Plan review is a process of reviewing building plans, construction documents, and technical validation. This section lists the applicable code requirements and code sections in the 2015/2018 International Residential Code (IRC) and International Energy Conservation (IECC) and details helpful for plan review regarding the provisions to meet the requirements for sealing HVAC supply and return register boots in all climate zones>.

### **2015/2018 IRC, Section R104 Duties and Powers of the Building Official**

**Section R104.1, General.** The building official has authority to render interpretations of this code and to adopt policies, and procedures in order to clarify the application of its provisions. Such interpretations, policies, and procedures shall be in conformance with the intent and purpose of this code.

**2015/2018 IECC, Section 103.1 General.** Construction documents, technical reports or other supporting data shall be submitted in one or more sets with each application for a permit. The documents shall be prepared by a *registered design professional*<sup>2</sup> where required by the statutes of the jurisdiction in which the project is to be constructed. Where special conditions exist, the code official is authorized to require necessary construction documents to be prepared by a *registered design professional*.

**Section R102.1/R104.11, Alternative Materials, Design and Method of Construction and Equipment.** The provisions of this code are not intended to prevent the installation of any material or prohibit any design or method of construction not specifically prescribed in the 2015 IECC/IRC, provided that any such alternative has been approved. The building official is permitted to approve an alternative material, design, or method of construction where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and the material, method, or work offered is for the purpose intended, not less than the equivalent of that prescribed in the code. Compliance with the specific performance-based provisions of the International Codes is an alternative to the specific requirements of this code.

**2015/2018 IECC/IRC, Section R103.3/R106.3, Examination of Documents.** The code official/building official must examine or cause to be examined construction documents for code compliance.

**Construction Documentation.** Review the construction documents for details describing the location, insulation, and sealing material specifications for the HVAC supply and return register boots.

- **2015/2018 IECC/IRC, Section R103.2/N1101.5, Information on Construction Documents.** Construction documents should include:

- Location of each HVAC supply and return register boot
- Specified R-value of insulation and sealant materials.

### Air Sealing/Air Leakage Control

- **2015/2018 IECC/IRC, R402.4./N1102.4, Air Leakage Section R402, Building Thermal Envelope**[\[1\]](#).
- **Section R402.4.1/N1102.4.1, Building Thermal Envelope.** The sealing methods between dissimilar materials should allow for differential expansion and contraction.
- **Section R402.4.1.1/N1102.4.1.1, Installation.** Components listed in the Air Barrier and Insulation Installation Table should be installed in accordance with the manufacturer's instructions and the criteria listed as the applicable method of construction. Below are the General Requirements and components from the table that are applicable to sealing HVAC supply and return register boots.
- Excerpts from Table R402.4.1.1/N1102.4.1.1, Air Barrier and Insulation Installation
  - **HVAC register boots.** HVAC supply and return register boots that penetrate the *building thermal envelope* shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot. (The 2018 IECC/IRC fixed this provision to include sealing the "supply and return" register boots.)

### Duct System Provisions

**2015/2018 IECC/IRC, Section R403.3/N1103.3 Ducts.** Ducts and air handlers shall be in accordance with Sections R403.3.1/N1103.3.1 through R403.3.5/N1103.3.5. (Sections R403.3.6/N1103.3.6 through R403.3.8/N1103.3.8 are new provisions in the 2018 IECC/IRC regarding ducts buried within ceiling insulation[\[2\]](#).)

**Section R403.3.1/N1103.3.1 Insulation (prescriptive).** Supply and return ducts in attics should be insulated to a minimum of R-8 where 3 inches (76 millimeters) in diameter and greater and R-6 where less than 3 inches (76 millimeters) in diameter. Supply and return ducts in other portions of the building shall be insulated to a minimum of R-6 where 3 inches (76 millimeters) in diameter or greater and R-4.2 where less than 3 inches (76 millimeters) in diameter. (Per Building America research, a minimum of R-8 duct insulation would be required on all buried ducts.)

Exception:

Ducts or portions thereof located completely inside the *building thermal envelope*. (Buried ducts will be installed outside the *building thermal envelope* so this exception would not apply.)

- **Section R403.3.2/N1103.3.2 Sealing (mandatory).** Ducts, air handlers, and filter boxes shall be sealed. Joints and seams shall comply with either the International Mechanical Code or IRC, as applicable.

Exceptions:

1. Air-impermeable spray foam products shall be permitted to be applied without additional joint seals.
2. For ducts having a static pressure classification of less than 2 inches of water column (500 Pa), additional closure systems shall not be required for continuously welded joints and seams, and locking-type joints and seams of other than the snap-lock and button-lock types.

### Existing Buildings

**2015/2018 IECC/IRC, Section R501.1.1/N1107.1.1 Additions, alterations, or Repairs: - General.** Additions, alterations, or repairs to an existing building, building system or portion thereof should comply with Section R502/N1108, R503/N1109 or R504/N1110. Unaltered portions of the existing building or building supply system are not required to comply with these sections.

- **Section R503.1/N1109.1, General.** Alterations to any building or structure should comply with the requirements of the code for new construction. Alterations should be such that the existing building or structure is no less conforming to the provisions of this code than the existing building or structure was prior to the alteration. Alterations should not create an unsafe or hazardous condition or overload existing building systems. Alterations should be such that the existing building or structure uses no more energy than the existing building or structure prior to the alteration.

- **Section R503.2/N1109.2 Change in space conditioning.** Any non-conditioned or low-energy space that is altered to become conditioned space should be required to be in full compliance with this code. (This means not only the altered assembly is brought into compliance but the entire space or building would need to be brought into compliance.)

#### Exception

Where the simulated performance option in Section R405/N1105 is used to comply with this section, the annual energy cost of the proposed design is permitted to be 110% of the annual energy cost otherwise allowed by Section R405.3/N1105.3.

- **Section R503.1.2/N1109.1.2, Heating and Cooling Systems.** New heating, cooling, and duct systems that are part of the alteration shall comply with Sections R403/N1103.

#### Section R502/N1108, Additions

- **Section R502.1.1.2/N1108.1.1.2, Heating and Cooling Systems.** New heating, cooling, and duct systems that are part of the addition shall comply with Sections R403/N1103

[1]The *building thermal envelope*” is defined as the basement walls, exterior walls, floor, roof, and any other building elements that enclose conditioned space or provide a boundary between conditioned space and exempt or unconditioned space.

[2]See Code Compliance Brief on *Buried Ducts within Ceiling Insulation of Vented Attics in All Climate Zones* in the Building America Solution Center at <https://basc.pnnl.gov/code-compliance/buried-ducts-within-ceiling-insula...> [1].

#### Field Inspection:

Per the **2015/2018 IECC, Section R104, Inspections**, construction or work for which a permit is required is subject to inspection. Construction or work is to remain accessible and exposed for inspection purposes until approved. Required inspections include footings and the foundation, framing and rough-in work, plumbing rough-in, mechanical rough-in, and final inspection.

- **Section R104.2.4, Mechanical Rough-In Inspection.** Inspections at mechanical rough-in shall verify compliance as required by the code and approved plans and specifications as to installed HVAC equipment type and size, required controls, system insulation and corresponding R-value, system air leakage control, programmable thermostats, dampers, whole-house ventilation, and minimum fan efficiency.

Per the **2015/2018 IRC, Section R109, Inspections**, the wording is somewhat different in that for onsite construction, from time to time the building official, upon notification from the permit holder or his agent, can make or cause to be made any necessary inspections. Further details are provided for inspections regarding foundation, plumbing, mechanical, gas and electrical, floodplain, frame and masonry, and final inspection. Any additional inspections are at the discretion of the building official.

This section provides details for inspecting to the specific provisions for HVAC supply and return register boots where one or more specific type of inspection per the IECC or IRC may be necessary to confirm compliance. Verifying code compliance for HVAC register boots would typically be at the mechanical rough-in and final inspection. Inspections should provide verification in the following areas:

- Verify that HVAC supply and return register boots are sealed and insulated properly.
- Verify that joints and seams in ductwork are properly sealed, and the duct tightness report is complete and has been submitted per jurisdictional requirements. If ducts are employed, verify that duct insulation is installed in accordance with manufacturer's installation instructions and that the manufacturer's R-value mark is readily available and meets the approved R-value specified in construction documents.
- Verify that joints, seams, holes, and penetrations are caulked, gasketed, weather-stripped, or otherwise sealed.

#### Technical Validation(s):

This section provides additional related information and references to materials that are applicable to the provision.

- [2015/2018 IECC—International Energy Conservation Code](#) [2]

Author(s): ICC

Organization(s): ICC

Publication Date: May 2014/October 2017

This code establishes a baseline for energy efficiency by setting performance standards for the building envelope (defined as the boundary that separates heated/cooled air from unconditioned, outside air), mechanical systems, lighting systems, and service water heating systems in homes and commercial businesses.

- [2015/2018 IRC—International Residential Code for One- and Two-Family Dwellings](#) [3]

Author(s): ICC

Organization(s): ICC

Publication Date: May 2014/October 2017/

This code for residential buildings creates minimum regulations for one- and two-family dwellings of three stories or less. It brings together all building, plumbing, mechanical, fuel gas, energy, and electrical provisions for one- and two-family residences.

- ACCA Manual J – Residential Load Calculation, Air Conditioning Contractors of America, 2011. <http://www.acca.org/technical-manual/manual-j/> [4]
- ACCA Manual S – Residential Equipment Selection, Air Conditioning Contractors of America, 2013. <http://www.acca.org/technical-manual/manual-s/> [5]
- ACCA Standard 5: HVAC Quality Installation Specification, Air Conditioning Contractors of America, 2010. [http://www.energystar.gov/ia/home\\_improvement/home\\_contractors/qispec.pdf](http://www.energystar.gov/ia/home_improvement/home_contractors/qispec.pdf) [6]
- ACCA Standard 9: HVAC Quality Installation Verification Protocols, Air Conditioning Contractors of America, 2009. [http://www.energystar.gov/ia/home\\_improvement/home\\_contractors/QI\\_Verification\\_Protocols.pdf](http://www.energystar.gov/ia/home_improvement/home_contractors/QI_Verification_Protocols.pdf) [7]

#### **Related BASC Guides and Code Briefs:**

- Whole Building Delivered Ventilation, <https://basc.pnnl.gov/resource-guides/whole-building-delivered-ventilation#quicktabs-guides=0> [8]
- Duct Leakage to the Outdoors, <https://basc.pnnl.gov/resource-guides/duct-leakage-outdoors> [9]
- Ducted Returns, <https://basc.pnnl.gov/resource-guides/ducted-returns> [10]
- Buried Ducts within Ceiling Insulation in Vented Attics in all Climate Zones, <https://basc.pnnl.gov/code-compliance/buried-ducts-within-ceiling-insula...> [1]