Air Barriers & Building Tightness

Montana Commercial Energy Code Tech Sheet

2012 IECC

Air leakage can increase energy costs from 30% to 40% in heating climates according to an analysis by the National Institute of Standards. Buildings which have a properly installed air barrier system can operate comfortably with a smaller HVAC system. In some cases, the reduction in mechanical equipment size and cost can offset the cost of the air barrier. Air barrier systems also provide a barrier to pollutants such as suspended particulates, dust, insects, and smells from entering the building.

Montana's energy code, the *2012 International Energy Conservation Code* (IECC), includes significant new provisions dealing with air barriers and building envelope tightness testing. According to the Montana energy code an air barrier is defined as:

Material(s) assembled and joined together to provide a barrier to air leakage through or into the building envelope. An air barrier may be a single material or a combination of materials.

What Are the Benefits of a Properly Installed Air Barrier?

- Reduces uncontrolled (and additional) outside air and heating or cooling of that air.
- Prevents unheated infiltration which can cause drafts (people then turn up thermostats) and potentially freeze equipment (plumbing and sprinkler pipes) in unoccupied spaces.
- Sets goal of leakage 50% - 75% less than current field measurements of existing buildings.
- Reduces required capacity of HVAC system through lower heating and cooling load.
- Reduces the transfer of odor into a building.
- Improves acoustical isolation.
- Reduces condensation in some climates.

Air Barrier Construction

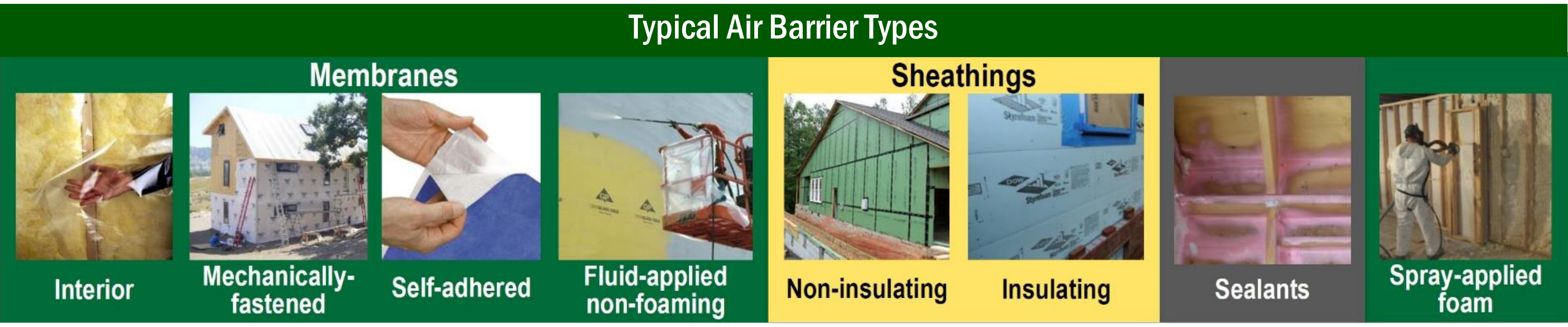
According to the IECC the air barrier must comply with the following provisions:

1. The air barrier must be continuous across all thermal envelope assemblies and joints.
2. All joints, seams, and penetrations must be sealed.
3. Fenestration assemblies must comply with the specified air infiltration rate, be tested in accordance with the reference standard, and be labeled by the manufacturer.

4. Doors and openings to shafts, chutes, stairways, and elevator lobbies must meet infiltration rates for fenestration or be gasketed, weatherstripped, or sealed.
5. Stairway and shaft vents must use Class 1 motorized dampers.
6. Outdoor air Intakes and exhausts must use Class 1A motorized dampers with some exceptions.
7. Cargo doors and loading docks shall have weatherseals.
8. Building entrances must be provided with vestibules unless one of several exceptions is applicable.
9. Recessed light fixtures in the thermal envelope must be IC-rated and meet the air leakage rate specified in the code.
10. Must comply with one of three compliance options.

Air Barrier Compliance Options

The IECC identifies three air barrier compliance options: 1) Materials, or 2) Assemblies, or 3) Building test. Practically speaking many air barrier system solutions will be a combination of materials and assemblies that together provide a barrier throughout the entire building enclosure. Keys to a successful air barrier include not only air tightness but also continuity, structural integrity, and durability. The IECC does not specify the location of the air barrier but the Montana air barrier definition includes the words *or into* the building envelope. This amendment was added to specify placement of an air barrier on the warm side of the wall.



Source: Oak Ridge National Laboratory, U.S. Department of Energy

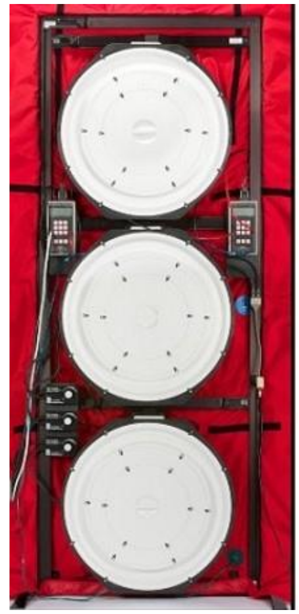
Compliance Option 1 - Materials

To be used in an air barrier system materials must be tested according to ASTM E2178 to have an air permeability no greater than 0.004 cfm/ft^2 tested at 0.3 inches of water (75 Pascals) or be listed as acceptable in the IECC. Some examples of air barrier systems include certain liquid applied membranes, spray foams, building wraps, and rigid insulation. Materials and sealants must be compatible and installed according to manufacturer's instructions.

Compliance Option 2 - Assemblies

To be used in an air barrier system assemblies must be tested in accordance with one of the three listed ASTM standards to have an air permeability no greater than 0.04 cfm/ft^2 tested at 0.3 inches of water (75 Pascals). This compliance option allows manufacturers to develop products that are composed of multiple materials and sealants to be tested as to compliance with the code.

Compliance Option 3 - Building Testing



Building envelope tightness testing is the third air barrier compliance option. The test must demonstrate that the air leakage rate of the envelope is no greater than 0.4 cfm/ft^2 of envelope area at a pressure of 0.3 inches of water (75 Pascals). The testing must comply with ASTM E779. This test procedure measures air leakage rates through a building envelope under controlled pressurization and depressurization at a standard test pressure. Building testing procedures were originally developed for testing single family homes but those procedures have been expanded and modified for commercial buildings. Multiple residential size fans, shown in the adjacent photo, may be adequate for smaller commercial buildings but larger cargo door fans are being used in some areas of the country for larger commercial buildings. Since the IECC does not specify the qualifications or certifications required for those performing the testing, that code official is responsible for making that determination.

When the building testing air barrier compliance option is selected it is not necessary to document and inspect for compliant materials or assemblies. In addition, fenestration assemblies do not need to meet requirements for fenestration air leakage per C402.4.3. Practically speaking, achieving a successful test is dependent upon utilizing appropriate materials, assemblies, and fenestrations that meet the intent of the code. One study found that the workmanship quality and joint detailing at interfaces can have a much greater impact on air barrier effectiveness than the type of air barrier system installed. Below is a basic summary of the steps involved with building tightness testing.

Step 1. Seal operable dampers (do not adjust balancing dampers).

Step 2. Ensure uniform interior pressure distribution by opening interior doors.

Step 3. Close and latch exterior windows and doors.

Step 4. Ensure that the test complies with ambient requirements for testing conditions (i.e., temperature differential, wind speed).

Step 5. Install pressure sensing devices across the building envelope.

Step 6. Measure natural pressure difference between interior and exterior of building with HVAC and exhaust systems deactivated and adjust further readings accordingly. Natural pressure differences are caused primarily by wind and the stack effect.

Step 7. Adjust test fan(s) to modulate airflow to achieve test pressure between interior and exterior of building.

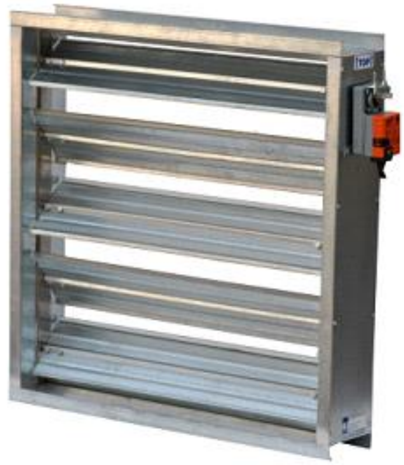
Step 8. Measure airflow at test pressure.

Step 9. Conduct pressurization test (test fans blow air into the building). Use calculations and data analysis methods in ASTM E779 to determine compliance.

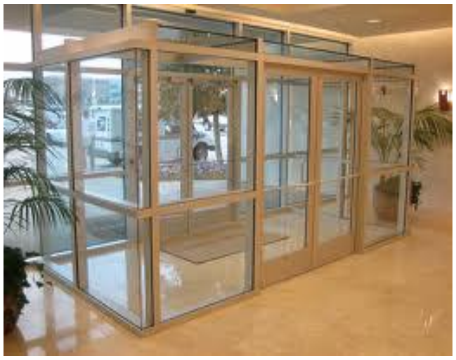
Step 10. Conduct depressurization test (test fans exhaust air from the building). Use calculations and data analysis methods in ASTM E779 to determine compliance.

Other Building Tightness Provisions

Other building components also affect building tightness. *Shafts* and *chutes* are often vented to the outside so the code requires associated doors and access openings comply with the air leakage provisions of fenestration assemblies or be gasketed, weatherstripped, or sealed. The Stack effect (warm air rising) makes this especially important in taller buildings since these vertical spaces throughout the building are air paths for air movement.

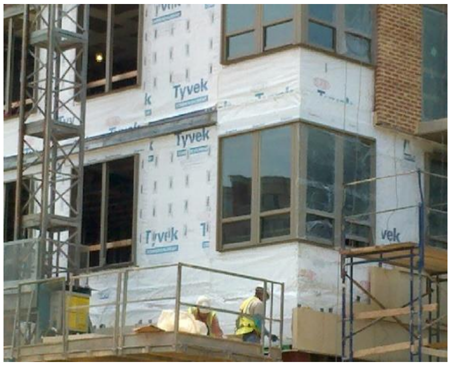


According to the IECC *stairway and shaft vents* must be provided with Class I motorized dampers to prevent air infiltration through the closed damper. The dampers must be tested for a maximum leakage rate of 4 cfm/ft^2. The IECC also requires automatic opening controls for specified operating conditions.



According to the IECC *outdoor air supply and exhaust openings* must be provided with Class IA motorized dampers to prevent air infiltration through the closed damper. The IECC includes some exceptions for gravity dampers and dampers smaller than 24 inches in either dimension.

Both the IECC and ASHRAE 90.1-2010 require vestibules or revolving doors for most building entrances. There are a number of exceptions. The exception for doors that open directly from a space less than 3,000 ft^2 may require an interpretation by the code official regarding the term *space*.



Integrated Air Barrier Systems

Specifications should integrate the installation of the air barrier system with the project specifications to maintain the continuity of the complete building air barrier system. Cladding and insulation manufacturers and subcontractors need to know about air barrier manufacturer requirements for treatment of penetrations and adhesive compatibilities. The final performance of the air barrier can be affected by a lack of coordination resulting in such problems as inadequate substrate installation, incompatibilities in product selection, or inadequacies in the installation.

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