

ALTERNATIVE 1 FOR 1312.9:

1312.9 Air leakage. The following areas of the building envelope shall be sealed, caulked, gasketed, or weather-stripped to minimize air leakage:

- (1) joints around fenestration and door frames
- (2) junctions between walls and foundations, between walls at building corners, between walls and structural floors or roofs, and between walls and roof or wall panels
- (3) openings at penetrations of utility services through roofs, walls, and floors
- (4) site-built fenestration and doors
- (5) building assemblies used as ducts or plenums
- (6) joints, seams and penetrations of vapor retarders and vapor barriers
- (7) all other openings in the building envelope

1312.9.1 Fenestration and doors. Air leakage for fenestration and doors shall be determined in accordance with NFRC 400. Air leakage shall be determined by a laboratory accredited by a nationally recognized accreditation organization, such as the National Fenestration Rating Council, and shall be labeled and certified by the manufacturer.

Air leakage shall not exceed 1.0 cfm/ft² for glazed swinging entrance and revolving doors and 0.4 cfm/ft² for all other products

Exceptions:

1. Site-built fenestration and doors.
2. For garage doors, air leakage determined by test at standard test conditions in accordance with ANSI/DASMA 105 shall be an acceptable alternate for compliance with air leakage requirements.

The following sections: Loading dock weatherseals, Vestibules, and Recessed lighting fixtures (blue text), are identical in both Alternatives 1 and 2.

1312.9.2 Loading dock weatherseals. Cargo doors and loading dock doors shall be equipped with weatherseals to restrict infiltration when vehicles are parked in the doorway.

1312.9.3 Vestibules. Building entrances that separate conditioned space from the exterior shall be protected with an enclosed vestibule, with all doors opening into and out of the vestibule with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to be open at the same time. Interior and exterior door shall have a minimum distance between them of not less than 7 feet or a distance that will comply with accessibility requirements of Chapter 11 when in the closed position. Automatic door opening devices shall be required to operate independently; one control shall not operate both the interior and exterior doors simultaneously. The exterior envelope of conditioned vestibules shall comply with the requirements for a conditioned space.

Exceptions:

1. Doors not intended to be used as a building entrance.
2. Doors opening directly from a dwelling unit or guest room.
3. Building entrances in buildings located in Climate Zone 1 that are less than four stories above grade and less than 10,000 square feet in area.

4. Building entrances located in Climate Zone 2 that are less than 1,000 square feet in area.
5. Doors that open directly from a space that is less than 3,000 square feet in area and is separate from the building entrance.
6. Revolving doors are exempt. The hinged entrance doors adjacent to a revolving door are not exempt.

1312.9.4 Recessed lighting fixtures. Recessed lighting fixtures installed within an insulated component of the building envelope shall meet one of the following requirements:

- (1) Type IC rated, manufactured with no penetrations between the inside of the recessed fixture and the ceiling cavity, and the annular space between the ceiling cutout and lighting fixture shall be sealed.
- (2) Type IC rated in accordance with ASTM E283 with no more than 2.0 cubic feet per minute (cfm) (0.944 L/s) air movement from the conditioned space to the ceiling cavity, at 1.57 psi pressure (75 Pa) difference and shall be labeled and the annular space between the ceiling cutout and the lighting fixture shall be sealed.
- (3) Type IC rated installed inside a sealed box constructed from a minimum 0.5-inch-thick (12.7 mm) gypsum wallboard or constructed from a preformed polymeric vapor barrier, or other air-tight assembly manufactured for this purpose.

ALTERNATIVE 2 FOR 1312.9:

1312.9 Building envelope sealing: The building envelope shall be designed and constructed with a *continuous air barrier* to control air leakage into, or out of the conditioned space. All air barrier components of each envelope assembly shall be clearly identified on construction documents, and the joints, interconnections, and penetrations of the air barrier components shall be detailed.

Exception: Building envelopes of buildings more than seven stories above grade or semi-conditioned spaces, provided the following areas of those building envelope are sealed, caulked gasketed or weather-stripped to minimize air leakage:

1312.9.1 Characteristics. The continuous air barrier shall have the following characteristics and shall also comply with Section 1312.9.2:

- (1) The continuous air barrier shall be continuous throughout the envelope (at the lowest floor, exterior walls, and ceiling or roof), with all joints and seams sealed and with sealed connections between all transitions in planes and changes in materials and at all penetrations.
- (2) The air barrier component of each assembly shall be joined and sealed in a flexible manner to the air barrier component of adjacent assemblies, allowing for the relative movement of these assemblies and components.
- (3) The continuous air barrier shall be capable of withstanding positive and negative combined design wind, fan, and stack pressures without damage or displacement and shall transfer the load to the structure. It shall not displace adjacent materials under full load.

- (4) The continuous air barrier shall be installed in accordance with manufacturer's instructions and in such a manner as to achieve the performance requirements.
- (5) Where lighting fixtures with ventilation or other similar objects are to be installed in such a way as to penetrate the continuous air barrier, provisions shall be made to maintain the integrity of the continuous air barrier.

Exception: Buildings that comply with Section 1312.9.2 (3) are not required to comply with either Sections 1312.9.1 (1) or 1312.9.1 (5).

1312.9.2 Compliance options. Compliance of the continuous air barrier for the opaque building envelope shall comply with Section 1312.9.1 and shall be demonstrated by one of the following:

- (1.) using individual materials that have an air permeance not exceeding 0.004 cfm/ft^2 under a pressure differential of 0.3 in. w.g. (1.57 psf) (0.02 L/s.m^2 at 75 Pa) when tested in accordance with ASTM E 2178; or
- (2.) using assemblies of materials and components that have an average air leakage rate not to exceed 0.4 cfm/ft^2 under a pressure differential of 0.3 in. w.g. (1.57 psf) (0.02 L/s.m^2 at 75 Pa) when tested in accordance with ASTM E 1677; or
- (3.) testing the completed building and demonstrating that the air leakage rate of the building envelope does not exceed 0.4 cfm/ft^2 at a pressure differential of 0.3 in. w.g. (1.57 psf) (0.02 L/s.m^2 at 75 Pa) in accordance with ASTM E 779 or an equivalent approved method.

The following Sections address generic building materials and assemblies that comply with the air barrier requirements of Sections 1312.9.2 (1) and 1312.9.2 (2) and discusses in detail the three compliance methods in Section 1312.9.2 by providing guidance to those performing compliance testing.

1312.9.2.1 Building materials and assemblies. The following materials shall comply with Section 1312.9.2 (1):

- (1) plywood – minimum 3/8 in. (10 mm)
- (2) oriented strand board – minimum 3/8 in. (10 mm)
- (3) extruded polystyrene insulation board – minimum 3/4 in. (19 mm)
- (4) foil-back urethane insulation board – minimum 3/4 in. (19 mm)
- (5) exterior or interior gypsum board – minimum 1/2 in. (12 mm)
- (6) cement board – minimum 1/2 in. (12 mm)
- (7) built up roofing membrane
- (8) modified bituminous roof membrane
- (9) fully adhered single-ply roof membrane
- (10) a Portland cement/sand parge or gypsum plaster – minimum 5/8 in. (16 mm)
- (11) cast-in-place or precast concrete
- (12) fully grouted concrete block masonry
- (13) sheet steel

The following materials shall comply with Section 1312.9s.2 (2):

- (1) assemblies that include a continuous air barrier material and comply with either ASTM E 2357 or ASTM E 1677 and 1312.9.2 (2).

(2) concrete masonry walls with:

- a. one application of block filler and two applications of a paint or sealer coating, or
- b. a Portland cement/sand parge stucco or plaster minimum 1/2 in. (12 mm) thick.

All joints shall be sealed and the other requirements of Sections 1312.9.1 shall be complied with for the material or assembly to comply as part of a continuous air barrier.

1312.9.2.2 Air barrier compliance testing.

1312.9.2.2.1 Material air permeance testing to comply with Section 1312.9.2(1). Individual materials proposed as part of the continuous air barrier shall be tested by the manufacturer in accordance with ASTM E 2178. Following are comments referring to ASTM E 2178.

The effectiveness of fluid-applied materials in sealing a rough surface is dependent on application thickness. Fluid-applied materials shall be tested as a 1 x 1 M film applied to a concrete block substrate with cells open at the top, using ASTM E 2178. This will verify the dry film thickness of material needed for an effective application and shall be reported by the manufacturer.

1312.9.2.2.2 Assembly air permeance testing to comply with Section 1312.9.2(2). Assemblies of materials proposed as part of the continuous air barrier shall be tested by the manufacturer in accordance with ASTM E 2357 or ASTM E 1677. Metal building assemblies are allowed to be tested in accordance with ASTM E 1680. Following are comments referring to ASTM E 1677:

- (1) **Paragraph 1.1:** Although the original intent of this test was to test frame walls for low-rise residential buildings, this test specification is allowed to be used to verify the air permeance of opaque wall assemblies of materials and to report permeance of an opaque wall system design for any building type and height, (See also ASTM E 1677, Annex Paragraph A.1.2.1) Any combination of materials is allowed to be tested so long as the specimen is representative of the complete opaque building wall proposed for a building and primary air barrier material is sealed to the perimeter test chamber.
- (2) **Paragraph 5.1.1:** Maximum acceptable air permeance of an assembly shall be in accordance with ASHRAE Standard 90.1, Section 5.4.3.1.2 (b).
- (3) **Paragraph 5.1.2:** Test pressure selected for the test shall comply with the design wind and gust requirements for the intended application. Test pressures shall be recorded and reported by the manufacturer.
- (4) **Paragraph 5.1.3 and 5.1.4:** The water resistance and water vapor permeance testing and reporting requirements in ASTM E 1677 are not mandatory to comply with requirements of ASHRAE Standard 90.1.

1312.9.2.2.3 Whole-building air leakage rate testing to comply with Section 1312.9.2(3). Whole-building testing as the compliance method shall be accomplished in accordance with ASTM E 779 or an approved similar test. Tests shall be accomplished using either pressurization or depressurization or both. The building shall not be tested unless it is verified that the continuous air barrier is in place and installed without failures in accordance with the installation instructions so that repairs to the continuous

air barrier, if needed to comply with the required air leakage rate, can be completed in a timely manner. Following are comments referring to ASTM E 779:

- (1) Under ASTM E 779 it is permissible to test using the building's HVAC system. In buildings with multistory HVAC systems and shafts, it is permissible to test using the building's mechanical system using *CAN/CGSB-149.15-96, Determination of the Overall Envelope Airtightness of Buildings by the Fan Pressurization Method Using the Building's Air Handling Systems* (Canadian General Standards Board, Ottawa).
- (2) In lieu of the fan pressurization method described in ASTM E 779, a tracer gas test of the building air change rate in accordance with ASTM E 741 is also allowed. The tracer gas test shall be run with building HVAC fans turned off.
- (3) **Section 8.1:** For purposes of this test, a multi-zone building shall be configured as a single zone by opening all interior doors and otherwise connecting the interior spaces as much as possible. It is also allowed to test a smaller section of the building, provided the test area can be isolated from neighboring conditioned zones by balancing the pressure in adjacent conditioned zones to that in the zone being tested. This can be very difficult to do in buildings with multistory shafts and HVAC systems. If a smaller section of the building is tested, provide a drawing showing the zone(s) tested, the pressure boundaries, and a diagram of the testing equipment configuration.
- (4) **Section 8.2:** Seal all intentional functional openings that are not used in the test to introduce air, such as exhaust and relief louvers, grilles, and dryer vents, using plastic sheeting and duct tape or similar materials. All plumbing traps shall be filled with water.
- (5) **Section 8.10:** The test pressure range shall be from 10 to 80 Pa. If approved by the Building Official, lower test pressures are acceptable, but the upper limit shall not be less than 50 Pa.
- (6) **Section 9.4:** If both pressurization and depressurization are not tested, plot the air leakage against the corrected DP for either pressurization or depressurization.
- (7) **Section 9.6.41:** If the pressure exponent n is less than 0.5 or greater than 1, corrective work shall be performed to the continuous air barrier and the test shall be re-run.
- (8) **Section 10.4:** Report the air leakage rate normalized over the area of enclosure (see Section 3.2 definition of *air leakage rate of the building enclosure*) in cfm/ft^2 at 0.3 in. w.g. (1.57 psf) ($\text{L}/\text{s}\cdot\text{m}^2$ at 50 Pa).

1312.9.3 Fenestration and Doors: Air leakage for fenestration and doors shall be determined in accordance with NFRC 400. Air leakage shall be determined by an independent laboratory accredited by a nationally recognized accreditation organization, such as the National Fenestration Rating Council and shall be labeled and certified by the manufacturer.

Air leakage shall not exceed $1.0 \text{ cfm}/\text{ft}^2$ for glazed swinging entrance doors and for revolving doors, and $0.4 \text{ cfm}/\text{ft}^2$ for all other products.

Exceptions:

1. Field fabricated fenestration and doors that are weather-stripped.

2. For garage doors, air leakage determined by test at standard test conditions in accordance with ANSI/DASMA 105 shall be an acceptable alternate for compliance with air leakage requirements.

1312.9.4 Loading dock weatherseals. Cargo doors and loading dock doors shall be equipped with weatherseals to restrict infiltration when vehicles are parked in the doorway.

1312.9.5 Vestibules. Building entrances that separate conditioned space from the exterior shall be protected with an enclosed vestibule, with all doors opening into and out of the vestibule with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to be open at the same time. Interior and exterior door shall have a minimum distance between them of not less than 7 feet or a distance that will comply with accessibility requirements of Chapter 11 when in the closed position. Automatic door opening devices shall be required to operate independently; one control shall not operate both the interior and exterior doors simultaneously. The exterior envelope of conditioned vestibules shall comply with the requirements for a conditioned space.

Exceptions:

1. Doors not intended to be used as a building entrance.
2. Doors opening directly from a dwelling unit or guest room.
3. Building entrances in buildings located in Climate Zone 1 that are less than four stories above grade and less than 10,000 square feet in area.
4. Building entrances located in Climate Zone 2 that are less than 1,000 square feet in area.
5. Revolving doors are exempt. The hinged entrance doors adjacent to a revolving door are not exempt.

1312.9.6 Recessed lighting fixtures. Recessed lighting fixtures installed within an insulated component of the building envelope shall meet one of the following requirements:

- (1) Type IC rated, manufactured with no penetrations between the inside of the recessed fixture and the ceiling cavity, and the annular space between the ceiling cutout and lighting fixture shall be sealed.
- (2) Type IC rated in accordance with ASTM E283 with no more than 2.0 cubic feet per minute (cfm) (0.944 L/s) air movement from the conditioned space to the ceiling cavity, at 1.57 psi pressure (75 Pa) difference and shall be labeled and the annular space between the ceiling cutout and the lighting fixture shall be sealed.
- (3) Type IC rated installed inside a sealed box constructed from a minimum 0.5-inch-thick (12.7 mm) gypsum wallboard or constructed from a preformed polymeric vapor barrier, or other air-tight assembly manufactured for this purpose.