

Comparison of Air Leakage Testing Requirements

Compiled by the Engineering Staff of the Metal Building Manufacturers Association

To increase energy conservation, energy codes and standards have been stepping up the effort to reduce air leakage, moving toward a requirement for whole-building tests to ensure an adequate air barrier in addition to, or in place of, the prescriptive requirements for materials and assemblies. This recognizes that prescriptive requirements alone are only effective if good installation is practiced. The table below summarizes the key air leakage test requirements for multiple editions of various codes and standards of interest, including the International Energy Conservation Code (IECC), ASHRAE 90.1, state of Washington (WSEC), state of California (Title 24), and U.S. Army Corps of Engineers (COE). Several editions are included because the adoption of a particular edition varies with jurisdiction. Until mandated, whole-building air leakage testing is optional that can eliminate the need to document and install materials and assemblies that meet the prescriptive air leakage requirements and avoid inspections that evaluate whether such products were correctly installed.

	IECC			ASHRAE 90.1			WA (WSEC)		CA Title 24		COE
	2015	2018	2021	2013	2016	2019	2015	2018 ¹	2016	2019 ²	2012
Whole-Building Test Required?	Optional	Optional	Yes ³	No ⁴	Optional	Yes ³	Yes	Yes	Optional	Optional	Yes
ASTM Test(s)	E779	E779	E779 E1827 ⁵	NA	E779 E1827	E779 ⁶	E779 ⁶	E779 ⁶	E779 ⁶	E779 ⁶	COE ⁷
Pass Limit (cfm/ft²)⁸	0.40	0.40	0.40	0.40 ⁴	0.40	0.40	0.40	0.25	0.40	0.40	0.25
Grace Range (cfm/ft²)⁹	None	None	0.60	NA	0.60	0.60	Seal/no test ¹⁰	0.40 ¹¹	None	None	None
Fenestration	Yes ¹²	Yes ¹²	Yes ¹³	Yes ⁴	Yes ¹²	Yes ¹²	No	No	Yes ¹⁴	Yes ¹⁴	No
Loading Dock Vehicle Seals	Yes	Yes	Yes	Yes ¹⁵	Yes ¹⁵	Yes	Yes	Yes	No	No	No
Vestibules	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes ¹⁶

1. Effective Feb.1, 2021 (Note, original effective date was July 1, but this was delayed due to COVID-19).
2. Effective Jan. 1, 2020.
3. See the discussion of exceptions for each code below.
4. Even though this edition does not mention whole-building testing as an option for compliance, under fenestration, an exception indicates that if an ASTM E779 test is performed and the air leakage for the building is less than 0.40 cfm/ft², the prescriptive requirements for fenestration are waived.

5. ASTM E3158 for large or multi-zone buildings.
6. Or equivalent approved by building official, or in California by the energy commission.
7. The COE test is based on ASTM E779, but has differences.
8. All tests are conducted at the same differential pressure of 0.3 in. of water gauge (75 Pa).
9. Provides some leeway if the air leakage exceeds the pass limit, but is less than the grace range. This is discussed further for each applicable code below.
10. If the air leakage is greater than 0.40 cfm/ft², leaks must be sealed and reported, but no additional test is required.
11. If the air leakage is between 0.25 and 0.40 cfm/ft², leaks must be sealed and reported, but no additional test is required. However, if the air leakage is greater than 0.40 cfm/ft² then corrective action must be taken, and the building retested until 0.40 cfm/ft² or better is met.
12. If the prescriptive path is used, fenestration components must meet the maximum air leakage in the itemized table in the code/standard. However, if the whole-building test is used, prescriptive requirements for fenestration are exempted.
13. The 2021 IECC is a little unclear, with several accepted revisions that need to be fit together, but we think the prescriptive requirements, including fenestration, also must be met, even if a whole-building test is completed.
14. There are mandatory prescriptive requirements except for field-fabricated fenestration. These do not seem to be waived even with the optional whole-building test.
15. Only required for Climate Zones 4 through 8.
16. General requirement to provide airtight vestibules at building entrances with high traffic.

IECC

The 2021 IECC is the first edition to require a whole building air leakage test, but there are exceptions based on building size and/or climate zone. As shown in the following figure, climate zones range from Climate Zone 1 (hot) through Climate Zone 8 (very cold). These climate zones also have a letter designation —A, B and C—where A is moist (humidity levels may be higher), B is dry, and C is marine (moderate temperatures with a summer dry season). Keep in mind that the 2021 IECC also gives the alternate compliance path of using the 2019 ASHRAE 90.1.

Whole-building tests would be required for all nonresidential buildings unless they are exempted based on climate zone and/or square footage as follows.

- Climate Zone 2B is exempt from all air barrier requirements (no change from previous editions).
- Buildings in Climate Zones 3C, 5C and 3B.
- Buildings with floor space greater than 5,000 ft² in Climate Zones 1, 2A, 4B and 4C.
- Buildings with floor space between 5,000 and 50,000 ft² in Climate Zones 3A and 5B.

Note that testing will be required when the 2021 IECC begins to be adopted starting in 2022.

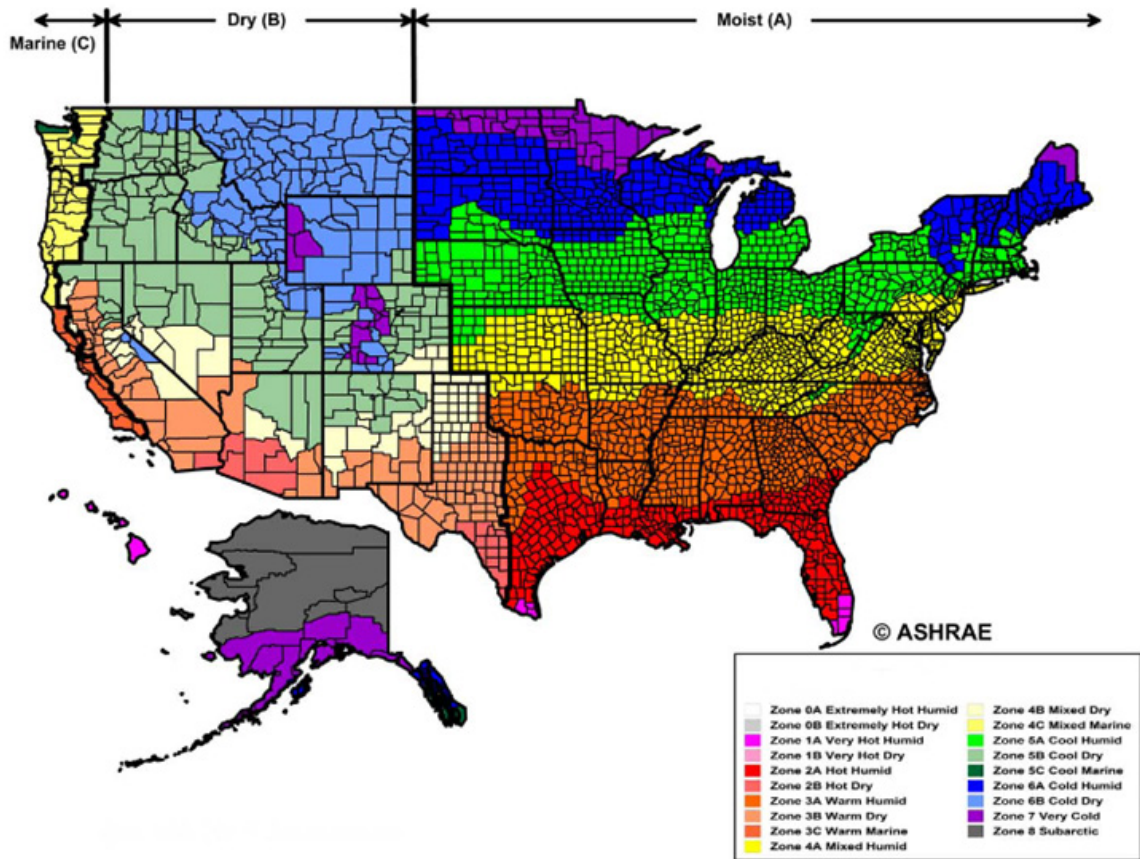


Figure Annex 1-1 ASHRAE Standard 169-2013, Figure B-1: Climate Zones for United States Counties

As mentioned in the summary table above, some of the codes provide a “grace” range. For the IECC, if the test yields between 0.40 and 0.60 cfm/ft², the building is still deemed to pass if smoke tracer or infrared imaging is used to detect leaks and these are sealed, where possible, and a report of these corrective actions is submitted.

Where testing is not required because of an exception, the same prescriptive requirements as currently provided in all editions of IECC are used for materials or assemblies. However, what is new in 2021 is a requirement for a building envelope verification by either the building code official, a registered design professional or an approved agency. This verification involves a review of the construction documents, inspections (and possibly repairs) during construction and a final commissioning report. Note that even if a test is not required, it could still be done to show compliance and might be a better option than the building envelope verification in some cases.



ASHRAE 90.1

The 2019 ASHRAE 90.1 is the first edition to require a whole-building air leakage test, but there are some exceptions.

- An air barrier is not required for semi-heated buildings in zones 1 through 6, unless required to complete the air barrier of an adjacent conditioned space. There are specific requirements for testing a building with both conditioned and semi-heated spaces.
- For buildings over 50,000 ft² of gross conditioned floor space, the whole-building test can be conducted on less than the entire building, and this is spelled out in the provisions; but for one-story buildings, it seems likely that an entire building test would need to be done.
- In lieu of doing a whole building test, an installation verification program can be utilized. This includes a design review of the air barrier and periodic inspections during construction by an independent third party. Repairs need to be performed as needed and a final report submitted.

There is one major difference between IECC and ASHRAE 90.1 in that IECC requires a whole-building test unless an exemption applies due to climate zone and/or building size. However, ASHRAE 90.1 permits the installation verification program to be utilized in lieu of a whole-building test for any building.

As mentioned in the summary table above, some of the codes provide a “grace” range. ASHRAE 90.1 is similar to IECC whereby a test result between 0.40 and 0.60 cfm/ft², is still deemed to pass if smoke tracer or infrared imaging is used to detect leaks and these are sealed, where possible, and a report of these corrective actions is submitted.

WA (WSEC)

Washington was the first state to introduce a requirement for whole building air leakage testing in its 2015 WSEC that went into effect on July 1, 2016. However, even though the pass limit was set at 0.40 cfm/ft², it was very lenient if this limit was not met. It states: “If the tested rate exceeds that defined here (0.40 cfm/ft²), a visual inspection of the air barrier shall be conducted, and any leaks noted shall be sealed to the extent practicable. An additional report identifying the corrective actions taken to seal air leaks shall be submitted to the building owner and the Code Official and any further requirement to meet the leakage air rate will be waived.”

However, the 2018 edition that will now go into effect on Feb. 1, 2021 sets the pass limit at 0.25 cfm/ft², but if the test is between 0.25 and 0.40 cfm/ft², leaks must be sealed where practicable, and a report submitted with no further testing required. If the air leakage is greater than 0.40 cfm/ft², leaks must be sealed and retests conducted until the air leakage is 0.40 cfm/ft² or less.

Note that the 2018 ASTM E779 requires reporting of pressurization, depressurization and combined (average) air leakage, but is silent on what to use to compare to a code limit. The WSEC is very specific with respect to pressurization and depressurization readings, saying that the test must be conducted with either (1) both pressurization and depressurization (average), or (2) pressurization only. But depressurization only is not allowed. The WSEC also is more specific than others in that the pressure differential of 75 Pa is permitted to vary within a given range.



CA Title 24

California has not been out in front of other energy codes with respect to air leakage testing. Current editions of Title 24 only have whole-building testing as an optional compliance path. However, the 2022 Edition that will go into effect on Jan. 1, 2023 will likely require whole-building testing, and first drafts are currently looking at something similar to WSEC, but a little less stringent (substitute 0.30 and 0.60 cfm/ft² for WSEC's 0.25 and 0.40 cfm/ft², respectively).

COE

The COE started publishing a standard for building airtightness and building air leakage testing for new and renovation construction projects in 2009. The current edition (3rd revision) was published in 2012. The COE used ASTM E779 as the basis for its standard, but there are differences, and the COE is clear in stating that "ASTM E779 is not the governing document in this standard except where specific provisions of it are mentioned."

The pass limit is 0.25 cfm/ft². But the COE test states that, "Even if the building achieves the required airtightness requirement, a thorough diagnostic evaluation should be conducted to help the construction team identify additional areas of leakage that could be sealed on the current building or similar future buildings. At a minimum, a visual inspection, a feel test, a fog test, and a thermography test shall be performed to identify leakage areas." It also states that any building that does not meet the 0.25 cfm/ft² leakage rate shall be repaired and retested until it conforms to the leakage rates specified.

Some other items of interest are that the test shall be done under pressurization and depressurization conditions unless an airflow in excess of 200,000 cfm at 75 Pa is required to perform the test and the airflow testing method can only pressurize or depressurize, but not both. The mean value (of pressurization and depressurization if both are performed) of the air leakage flow must not exceed 0.25 cfm/ft².