WHOLE BUILDING AIR TIGHTNESS TESTING

A 6-Year History of Test Results in the Pacific Northwest

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Are Buildings Improving with Energy Codes?

Industry Trends

It's no secret that green building practices and energy efficiency are on top of many contractors, owners, and industry professionals' minds right now, and for good reason. We all want quality buildings, low energy and maintenance costs, and reduction in liability to name a few benefits. But are designs, products and energy codes yielding the results the industry is seeking?

QED has tested over 31 million square feet of building enclosures since 2012, but this article focuses on whole calendar years between 2016 and 2021 in the Pacific Northwest. Why? Many airtightness energy codes in the Pacific Northwest took effect in 2012, but it takes years between code implementation and building completion before a these projects can yield solid data.

A 15-fan test performed by QED LAB on a high school near Spokane, Washington. August 2021

Current Maximum Leakage Rates

2018 Washington State Energy Code & City of Seattle Energy Code

- .25 CFM/SF75 Commercial
- .17 CFM/SF75 Commercial reduced option
- 5 ACH50 Residential
- 3 ACH50 Residential reduced option

ASHRAE 90.1-2019 (Oregon, Idaho, Montana)

- .40 CFM/SF75 Commercial

2019 California Energy Code

- .40 CFM/SF75 Commercial

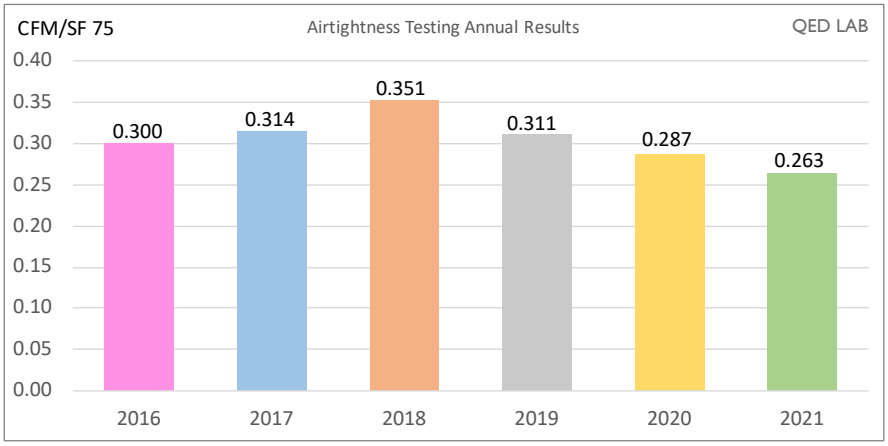
The matrix below details QED's 6-year history of test results encompassing 439 individual commercial buildings tested for air leakage and sorted by calendar year, including total area of all enclosures per year. This is the basis of the study.

Year	Buildings Tested	Enclosure Tested (SF)
2016	48	2,876,355
2017	53	2,158,793
2018	59	4,734,846
2019	76	5,204,776
2020	83	6,300,201
2021	120	8,288,253

The industry standard starting point for maximum air leakage for commercial buildings is .40 CFM/SF75 as identified by many state energy codes, ASHRAE 90.1, and ABAA. Some states or cities have taken it a step or two further by requiring maximum air leakage to drop to .30 CFM/SF75, .25 CFM/SF75, or even down to .17 CFM/SF75 for the City of Seattle, Washington, with the reduced air infiltration option. Passive House requirements are even more stringent!

Test Results

Lets focus on standard buildings expected to comply with the energy codes, not the specialty programs. The chart below graphs average test results per calendar year from 2016 to 2021. Data shows a measurable improvement in building airtightness averages by over 10%, but it's very slow moving, getting worse in 2017 and 2018 before getting better.



Failure Rates

2016 = **25%**

2017 = **20.7%**

2018 = **20.3%**

2019 = **15.7%**

2020 = **10.8%**

2021 = **9.1%**

Based on data from QED LAB 2016-2021

Data Collection from Testing in:

Washington

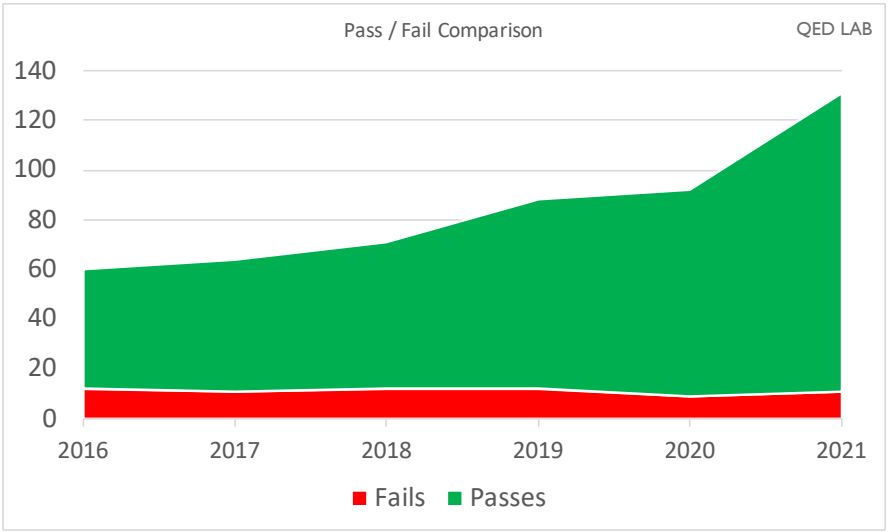
Oregon

Idaho

California

With hundreds of buildings to reference, the chart shows a trend of improving building airtightness performance in the Pacific Northwest. This trend is related to Washington State being at the forefront of energy code implementation. But what about the buildings that aren't meeting the standard criteria?

Failures occur when the air leakage is beyond the maximum leakage criteria. Failures only occur around 10-15% of the time, and this is trending downward as related to number of buildings being tested. The chart below depicts the relationship between failed test results, and passing test results.



As testing becomes more common whether by code requirement, specification requirement, or other programs, buildings should improve their airtightness and lower their energy usage.

I've found that education and understanding of airtightness benefits are a key contributor for improved results. It's not always a code requirement or specification requirement that leads to better buildings; it's the desire for quality. Desire of quality starts in plan review, product selection, and oversight during construction to ensure compliance of craftsmanship.

Testing Agency Qualifications

An accurate test is everything in our industry. The testing company must be competent and qualified to perform the test comprehend building performance and design, and to appropriately prepare the building for testing. Some codes don't require any qualifications of the tester, nor do they require the tester to even be an independent third party. The last thing we need for quality building testing is a tester who has an interest in a passing result to perform the test, that's a conflict of interest.

Multiple training programs are available by Retrotec, ABAA, ATTMA, RESNET, and others to ensure education and certification are making their way to the people in the field.

Building Sizes

2016 = **7,560 SF - 224,705 SF**

2017 = **683 SF - 161,639 SF**

2018 = **2,780 SF - 417,358 SF**

2019 = **1,890 SF - 400,870 SF**

2020 = **3,054 SF - 532,920 SF**

2021 = **558 SF - 495,260 SF**

Based on data from QED LAB 2016-2021

Best and Worst Results (CFM/SF75)

2016 = **.037 - .478**

2017 = - **.073 - .518**

2018 = **.065 - 1.05**

2019 = **.039 - .553**

2020 = **.043 - .961**

2021 = **.074 - .569**

Based on data from QED LAB 2016-2021

Still, there seems to be too many under-qualified and inexperienced companies performing "tests". False passes, false failures, cheating, over-prepared buildings are just some of the things that occur with omission of education and certification. These problems do not help the building's performance, the long-term energy costs for the building owner, or the improvement of the construction industry; and are not fair to the building owner/developer, contractor, installers, and are not energy code compliant. Accuracy and qualifications are key.

Compartmentalization Testing

Some codes, specifications, or strategies allow for compartmentalization testing, which means you're testing a sampling of the building for air leakage and not the entire building. In some cases this is appropriate, but it is not the intent of energy codes, nor is it to the test's benefit. You should never be talked into compartmentalization testing because the test agency doesn't own enough equipment to test the building in its entirety. This can create unnecessary liability for the building owner, general contractor, and enclosure trades.

Compartmentalization testing is appropriate for phased projects, unusually large projects (at least 250,000 square feet of enclosure or even better, over 500,000 square feet of enclosure), and buildings where some areas are inaccessible. The interior boundary should always be at a fire rated wall/floor/ceiling assembly, not just any interior partition not sealed for airtightness or smoke.

Summary

We're on a good path here in the Pacific Northwest for energy efficient buildings, air tightness, and lowering energy costs for new construction. Many states and cities across the US are implementing airtightness testing requirements because of the long term value and quality it provides. Commonly, enclosure consultants heavily participate in the design and installation oversight of the air barrier systems, and this certainly has a high value and aids in passing the whole building test. Albeit, the only way to confirm the airtightness is via formal and accurate test by a qualified technician.

I'll see you on site on your next test!

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