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Building Enclosure Air Tightness Testing Reference Sheet

Air tightness testing using a Blower Door is a powerful tool for assisting in making new & old buildings more energy efficient. Air leakage through building enclosures accounts for 30-60% of winter heating energy, 10-30% of summer cooling, creates drafts, transmits noise, allows introduction of pollutants &, importantly, transfers significant amounts of moisture into wall & attic cavities. Here are some common metrics used to report air tightness test results.

Air Tightness Metrics	Description
CFM@50Pa - cubic feet per minute required to create a 50 Pascal pressure difference across the building envelope.	The use of CFM at 50 Pa is an easy way to track air sealing efforts in any individual building. It is the most common metric used in residential U.S. weatherization programs because it is a simple, definable number for a specific home or building that doesn't require calculation of volumes or surface areas. Often weatherization programs will simply set a simple reduction target of 20 to 30% in the CFM50 number.
ACH@50Pa - air changes per hour at a pressure difference of 50 Pa. $\text{ACH@50} = \frac{\text{CFM@50} \times 60\ \text{min/hr}}{\text{Volume of building}}$	Factoring in the volume of a building allows comparisons of the air tightness between buildings of different sizes. This is the metric is commonly used in new housing programs such as the ENERGY STAR Qualified Homes program, Passive House or in Canada the R2000 Home program. Very tight buildings would have an ACH50 of under 1 and very loose buildings would be over 7 ACH50. A good goal for most buildings / builders would be 3 ACH50.
ELA@10Pa - equivalent leakage area is defined as the size hole that would leak the same amount of air that the building is at a pressure of 10 Pa. That is, all the holes in the building are acting like a round hole of this size.	This number is extrapolated from the leakage characteristics of a building air tightness test. It is used in many algorithms for calculating the daily infiltration rates of buildings to determine energy losses due to air leakage. Contractors can relate to this metric as indication of the size of holes in square inches that they should be looking to seal up.
NLR@50Pa – normalized flow rate at 50 Pascal pressure. Expressed as CFM/sq.ft. of surface area of the entire building – floor, walls, ceiling $\text{NLR@50} = \frac{\text{CFM@50}}{\text{Surface area of building}}$	This number is a straightforward forward calculation of the surface area of the building being tested divided into the blower door air flow rate in CFM that was required to create a 50 Pascal pressure difference across the building. This is a metric that is used to compare buildings of different sizes and geometries. It is a common metric in the ENERGY STAR for New Homes program in Canada.

NLR@75Pa – normalized flow rate at 75 Pascal pressure. Expressed as CFM/sq.ft. of surface area of the entire building – floor, walls, ceiling NLR@75 = $\frac{\text{CFM@75}}{\text{Surface area of building}}$	This number is a straightforward forward calculation of the surface of the building being tested divided into the blower door air flow rate in CFM that was required to create a 75 Pascal pressure difference across the building. This metric more closely matches the air permeance measurements for building materials. This is the most common metric used in commercial building air tightness testing.

There are specific test protocols or standards for testing air tightness of buildings, the most common being the ANSI/ASTM-779-99, *Standard Test Method for Determining Air Leakage Rate by Fan Pressurization* and the CAN/CGSB 149.1 "*Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method*". Work is being currently by the Air Barrier Association of America to create a new updated test protocol for testing buildings. In all cases a large fan is used to create a significant pressure across the building enclosure (50 Pascal in most residential applications, 75 Pa in commercial testing, the equivalent of a 25-35 MPH wind on all sides of the building at one time). These exaggerated pressures enable simple detection of leaks and help negate wind effects that could skew results during testing. The fan is calibrated and results are reported in a variety of ways to meet the needs of various programs.

The table below shows some of the most common air tightness requirements expressed in the different test metrics to allow comparisons between different metrics. It is important to note that some metrics use the volume of a building and some use the surface area of the building There really is no direct correlation or calculation between the various metrics as it would be dependent on the geometry of a specific building.

Relative Air Tightness Metrics of Buildings

Standard		CFM@50	ACH@50	EqLA@10Pa	NLR@75 Pa
Passive House (Germany)		500	*** 0.6 ***	52	0.05
R-2000 (Canada)		1250	*** 1.5***	130	0.125
ENERGY STAR V3	CZ 8	2500	*** 3.0***	260	0.25
	CZ 5-7	3333	*** 4.0***	350	0.30
	CZ 3,4	4167	*** 5.0***	430	0.42
	CZ 1,2	5000	*** 6.0***	520	0.50
ENERGY STAR (Canada 2012)		1250	*** 2.5***	130	0.125
Army Corp of Engineers		2498	3.0	260	*** 0.25***
2009 IECC Target **		5833	*** 7.0***	600	0.59
2015 !ECC**	CZ 3-7	2500	*** 3.0***	260	0.25
	CZ 1-2	4167	*** 5.0***	430	0.42
Very leaky old building		7500 10000	9 12	780 1040	0.75 1.0

NOTES:

- ***0*** indicates the actual performance requirement for the listed program
- This table is for reference purposes only and represents data from a one-story, rectangular 5,000 sq. ft. building with a 10' ceiling, thus a volume of 50,000cu.ft. and a surface area of 13,000 sq. ft.
- ** - The 2009 IECC does not require testing, 2012 IECC mandates air tightness testing of buildings.

Other Air Barrier Test Metrics

- *Building Materials* are tested for air permeance under ASTM E2178. Results are presented as CFM/ft^2 @75 Pa. Commercial air barriers must be no more than 0.004 CFM/ft^2@75Pa
- *Building Assemblies* are tested in wall mock-up sections under ASTM E 2357 or E 1677 and again results are presented as CFM/ft^2 @75 Pa. The assembly goal is 0.04 CFM/ft^2@75Pa.