AIVC & TightVent Webinar
Building and ductwork airtightness trends and regulations in Estonia, Germany and the U.S.A
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Building and ductwork airtightness in the U.S.: national trends and requirements

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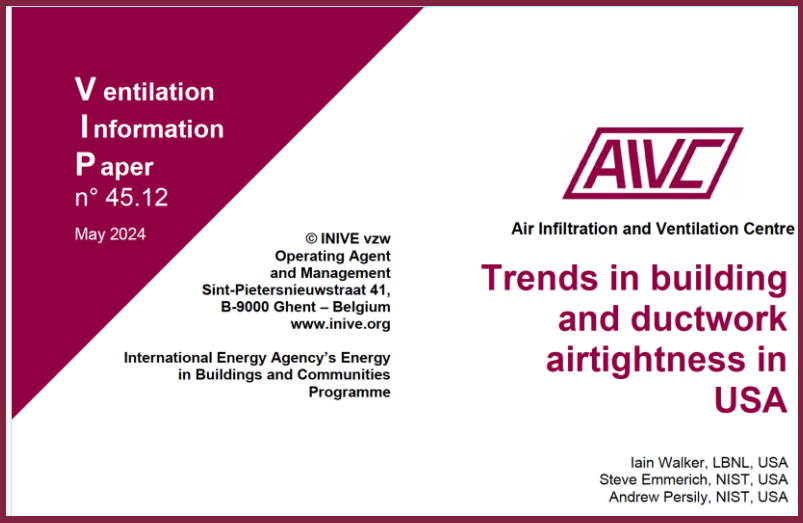
BASED ON VIP 45.12

Published in May 2024; USA can and does change



AIRTIGHTNESS MOTIVATIONS

Historically, many in USA didn't care much about airtightness
Or assumed it was not an issue
Or thought it was a bad thing

But the situation has gotten better

We keep telling them it's important because....
Energy consumption for heating & cooling
Indoor air quality
Moisture management
Noise

And it might even be required

Build Tight, Ventilate Right

Arne Elmroth
Air Infiltration Review, 1980

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USA AIRTIGHTNESS REQUIREMENTS

Standards (e.g., ASHRAE)
- Voluntary, consensus

Model codes (e.g., International Energy Conservation Code)
- Local adoption makes them law, adoption often partial

State and local codes
- Force of law
- Focus on new buildings and renovations
- Enforcement varies

Other: Federal agencies, states, various programs, etc.

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AIRTIGHTNESS METRICS (2.2) from Fan Pressurization Tests

ACH50

(Personally, I don't like goofy, made-up symbols)

Air changes per hour (h^{-1}) at 50 Pa or Q_{50} is better

Effective or specific leakage area at 4 Pa, ELA or SLA

Normalized leakage area, ELA/floor area

Airflow divided by surface area

$L/s \cdot m^2$ at 50 Pa (often 75 Pa in non-residential)

Envelope area for normalization, include below grade?

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TEST PROCEDURES (2.5)

Residential

ASTM E779-19 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization

- U.S. standard for multipoint measurements; First approved in 1981

ASTM E1827-11 (2017) Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door

- Standard for single point measurements - almost always at 50 Pa.

Most testing uses ANSI/RESNET 380 or blower door manufacturer's instructions.

Non-residential

ASTM E779

ASTM E3158-18 Standard Test Method for Measuring the Air Leakage Rate of a Large or Multizone Building

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USA RESIDENTIAL AIR TIGHTNESS LIMITS (2.3.1)

IECC energy airtightness requirement is 3 ACH50 (set in 1998)
Except in mild climates where the requirement is 5 ACH50

U.S. EPA Energy Star requirement for reference design home is 3 ACH50
Also includes checklists for air sealing individual building components.
Checklists used in U.S. Department of Energy Weatherization program
DOE Zero Energy Ready Home program requirements vary with climate

2009 IECC Climate Zone	1-2	3-4	5-7	8
Air Leakage Limit (ACH50)	≤3.0	≤2.5	≤2.0	≤1.5

Interzone airtightness requirements in multifamily residential buildings,
e.g., Standard 62.2 and LEED; most around 1 to 1.5 L/s•m^2 at 50 Pa

VIP TABLE 2. NON-RESIDENTIAL AIR TIGHTNESS LIMITS

	Air Leakage at 75 Pa (L/s·m^2)		
Standard or code	**Material**	**Assembly**	**Whole building**
ASHRAE 90.1-2022	0.02	0.2	2.0
ASHRAE/ICC/USGBC/IES 189.1-2023	References ASHRAE 90.1	References ASHRAE 90.1	1.0
IECC	0.02	0.2	2.0
IgCC-2021	Same as 189.1	Same as 189.1	1.25
USACE ECB 2009-29	0.02	-	1.25
GSA P100-2021*	0.02	0.2	1.25

Whole building limits based on 6-sided enclosure including slab and below-grade walls.
GSA P100-2021 recently replaced but still available
https://www.gsa.gov/system/files/P100%202022%20Addendum%20Final_.pdf

DATABASES

LBNL Residential Diagnostics Database (ResDB): nearly 150,000 homes through about 2010 (resdb.lbl.gov).

NIST, Commercial Building Airtightness Database (CBAD): over 1000 buildings (> 400 military, > 600 commercial/institutional) online soon

GUIDELINES TO BUILD AIRTIGHT

Checklists under many programs, for example:

ENERGY STAR Qualified Homes, Version 3 (Rev. 04), Inspection Checklists for National Program Requirements

IECC Air Barrier and Insulation Inspection Checklist

BPI Technical Standards for Certified Shell Specialists.

National Institute of Building Sciences Whole Building Design Guide

Air Barrier Association of America Air Barrier System Specification

DUCT LEAKAGE

Residential

Little change in recent years in requirements.

Testing has led to better sealing and redesign to bring ducts inside conditioned space.

Construction practice adapts to leakage requirements.

State requirements have national impacts since most equipment targets national markets.

Non-residential

Increased awareness of energy impacts has led to changes in regulations and reduced leakage for ducts and HVAC components.

CONCLUSIONS

USA has long lagged Europe and elsewhere on airtightness and testing requirements.

But the situation has been improving for both residential and non-residential.

Requirements in standards, codes and other programs have stimulated change.

US Army Corps of Engineers has played key role in improving non-residential airtightness.

Standardized test methods are crucial to improving airtightness.