Measuring Air Leakage in Commercial & Multi-Family Buildings

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Stack Pressure + Holes = Leaks

Stack Effect
Warm air rising
Cold air falling
Separation of floors reduces stack

a) No Separation  b) Separated Floors  c) Some Flow through Floors

Primary Boundaries for cold climates

Elevator shaft  Stairwell  Stairwell
14 windows open at -25 C
inset shows open window

Stack Pressure + Wind Pressure + Holes = Bigger Leak
Adding all driving forces

Real problems
Smoke safety is affected by floor to floor leakage

Hallway mechanicals cannot keep up with flow requirements
Most important leakage at top and bottom

Smoke and IR identify air leakage paths
Т = -22°C  Т = +19°C  ΔТ = 41°C

ΔP = +8 Pa
ΔP = - 8 Pa

Without and With depressurization
What components of buildings can be measured?

USACE pass/fail for new construction

“shall pass ...0.25 CFM/sq ft ...at 75 Pa ...”

=1.0 L/s-m² at 50Pa
Whole building envelopes can be measured

Individual apartments can be measured
Hallways can be measured

Stairwells can be measured
Floor to floor leakage can be measured

Total Unit Leakage - All 6 Sides, 1 Door Fan
Measure Entire Envelope

Measure Entire Envelope
Slab leakage – total floor leakage

Pressurizing the Floor Above
Floor to floor leakage can be measured

[Diagram showing air leakage tests]

Standard Test Method - large building

- **Canada**: CGSB 149.10
- **UK**: TS-L1/TS-L2
- **Europe**: EN13829
- **USA**: USACE Air Leakage Protocol
### Results expressed in many ways

<table>
<thead>
<tr>
<th>Standard</th>
<th>ASTM</th>
<th>CGSB</th>
<th>EN13829 ATTMA</th>
<th>USACE WA State</th>
<th>North America</th>
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<tbody>
<tr>
<td>Origin</td>
<td>USA</td>
<td>Canada</td>
<td>Europe</td>
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<td>Results</td>
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<td>EqLA_{10}</td>
<td>ACH_{50} \text{,} m^3/h/m^2 \text{,} CFM_{50}/\text{ft}^2</td>
<td>ERLA \text{,} ACH_{50} CFM_{50}/100 \text{ft}^2</td>
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Suggest using only:
ACH50
EqLA 50/Floor area x 1,000,000
- Unitless
- Always whole number
- Calibrate against holes of known sizes
- Always reference results to 50 Pa

### Case Study - Germany

![Image of a workshop or industrial setting with workers and machinery]
15,000,000 cubic feet
Automatic vs. manual data collection
Lots of cable & tubing

Connections that work best:

* USB Hub only necessary if computer does not have enough USB ports.
* Equipment dimensions are not shown to scale.
Easier connections
Conclusions

- Virtually any component of a building can be tested
- Running tubing and speed control cables long distances is cumbersome
- New technology eases setup & allows testers to take advantage of existing networks
- Software is needed for large tests with many fans

Questions? Comments? Angry rants?

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