Context: why a revision?

Air leakage matters for energy efficiency, air quality, comfort, as indicator of general build quality etc …

« Infiltration » : under normal conditions
« Air permeability » and « air change rate » : tested at a reference pressure

Developments to standards, practice and regulatory framework

TM23, 2000: no standard
- Development of practice and standards, incl. BS EN ISO 9972:2015 and ATTMA guidance
  2021 revision to Building Regulations: TM23 to provide the methodology
### Context: Two methods approved for Building Regs

<table>
<thead>
<tr>
<th>Fan pressurisation « Blower door »</th>
<th>Low pressure pulse « Pulse », LPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan installed, usually in door</td>
<td>Equipment indoors, no envelope intervention</td>
</tr>
<tr>
<td>Pressurisation and/or pressurisation</td>
<td>1-3 “pulses” of air, short time (a few seconds)</td>
</tr>
<tr>
<td>Testing at 50Pa, intended as standardised “stress test”</td>
<td>Testing at 4Pa, intended to be closer to conditions usually experienced in buildings</td>
</tr>
<tr>
<td>BS EN ISO 9972:2015, ATTMA guidance</td>
<td>New – no standard available</td>
</tr>
<tr>
<td>Several equipment manufacturers</td>
<td>Single equipment manufacturer</td>
</tr>
</tbody>
</table>
TM23 contents

Introduction
Definitions
  Terminology
  Building dimensions
Overview of air leakage testing methods
  Fan pressurisation
  Low pressure pulse (LPP)
  Tracer gas
Applying the test methods
  Test conditions
  Preparation
  Fan pressurisation
  Low pressure pulse

Test results
  Air change rate and air permeability
  Relating air leakage at 4Pa and 50Pa
  Relating air leakage test results to infiltration

Reporting
  Test report: option 1
  Test report: option 2 (CPS members)

Further air leakage and diagnostics

References and bibliography

➢ Sets framework methodology
➢ Common procedures for preparation, testing and reporting
Not detailed to level of existing resources for practitioners e.g. from the CPS
Test conditions

Common to both methods

BS ISO "ideal" wind conditions: <3 m/s ground or 6m/s meteorological
Acknowledgement that these may be impractical

- Avoid if possible
- Corrections in analysis
- Record & report T, wind speed, barometric pressure
Preparation – Building measurement

Common to both methods

Known to be a source of discrepancies in test results

Tester’s responsibility to validate measurements, even if provided by project team

ATTMA resources for detailed application of the building measurement definitions
Preparation – Building set-up

Common to both methods

Regulatory compliance set-up

BS ISO “method 3”

Broadly as per current practice

Trickle vents closed, but not sealed

Other possible preparations

For uses outside of Building Regulations
  e.g. interim checks during construction
Calibration

AD, 2021: “The building control body should be provided with evidence that test equipment has been calibrated using a UKAS-accredited facility or by the original manufacturer within either of the following periods: The previous 12 months, OR A period in accordance with manufacturer’s guidance.

Calibration should be carried out in accordance with CIBSE’s TM23. It is recommended that test equipment is recalibrated at least every 24 months.

« Blower door »
Calibration to UKAS standards, by UKAS or equivalent accredited body
Annual
“Traceable” calibration against calibrated equipment is not acceptable

« Pulse »
No UKAS standard available as a whole
➢ ”Master device” whose components are calibrated to UKAS standards
➢ Calibration in test chamber against “master device”- NOT by tester / testing organisation
➢ UKAS calibration of components if issues are found

Expected area of development
Fan (de)pressurisation method

Broadly follows current best practice, including ISO

Measurement of zero flow pressure pre- & post- test

Recommended, but not required for building regs: both pressurisation and depressurisation

Validity criteria incl.:
- No interpolation of results: testing range to include 50Pa (ISO accepts 25Pa)
- Number of points, zero flow pressures, min 30Pa range etc…
- Coefficient of determination r² at least 0.9800
- Air flow exponent 0.5-1.00

Courtesy of BSI
Pulse method

New: no standard

- Literature and field trials mostly based on earlier versions of the procedure and/or equipment
- TM23 methodology proposed on the basis of evidence available

Relatively automated method
2-3 tests in series, to collect sufficient and valid points

Validity criteria incl.:
- No interpolation of results: testing range to include 4Pa
- Number of points etc...
- Coefficient of determination r^2 at least 0.9600
- Air flow exponent 0.5-1.00

Caution for tests carried out at very low air permeability, until body of evidence grows
Results analysis

Based on similar principles for both methods

Main differences are time frame and pressure ranges

Software-based in both methods
Reporting

Common contents for both methods

Option 1: recommended contents
Option 2: CPS

Report failed and invalid tests

Photographic evidence e.g. preparation

Differences where relevant
  e.g. blower door: Pressurisation and depressurisation: include both, and use average as result, or justify why one mode only

Air permeability at 50Pa obtained from test result at 4Pa NOT to be reported as “test result”

Proposed convention

\[ \text{AP}_4 \]: tested air permeability obtained from analysis of test results that met the LPP pressure range validity criteria, i.e. including testing around 4 Pa.

\[ \text{AP}_{50} \]: tested air permeability obtained from analysis of test results that met the fan pressurisation pressure range test validity criteria, i.e. including testing around 50 Pa.

\[ \text{AP}_{4e(50)} \]: estimated air permeability at 4 Pa, obtained by extrapolation of tested air permeability at 50 Pa (\( \text{AP}_{50} \)) not directly obtained from test results.

\[ \text{AP}_{50e(4)} \]: estimated air permeability at 50 Pa, obtained by extrapolation of tested air permeability at 4 Pa (\( \text{AP}_4 \)) not directly obtained from test results.

Use of results for Building Regulations

2021 revision, in force from June 2022

Limits to air permeability

- New non-domestic buildings: @ 50Pa
- New build homes: $8.0m^3/(h\cdot m^2)$ @ 50Pa OR $1.57m^3/(h\cdot m^2)$ @ 4Pa
Use of results for Building Regulations

Use in SAP

Developed by BRE and BTS:

\[ AP_{50e(4t)} = 5.2540 \times AP_4^{0.9241} \]

To be kept under review

Common reporting and sharing of data would benefit whole industry

Tested and estimated \( AP \) @50Pa:

Standard deviation 12%
Relative difference -35% to 27%
Next steps

Industry resources

- MTC review by DLUHC, incl. incorporation of Pulse method
- CIBSE intend to work with the Competent Person Schemes on supporting resources
e.g. measuring building dimensions, specific building types (e.g. high-rise)

Continuing development and research opportunities

TM23 sets common framework for procedure and reporting
Intended to contribute to data gathering and evolution of best practice for both methods

- Please share:
  - Feedback on the TM
  - Project results, incl. test results under both methods

Associated research questions e.g. ”divide by 20” rule used in SAP
Thank you

Any questions to the panel?

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