TM23, 2022

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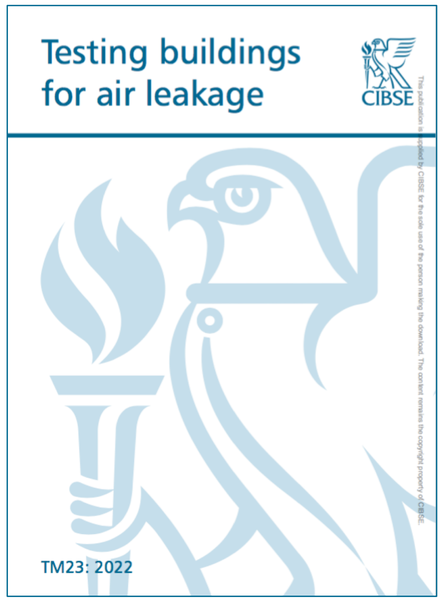

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FREE for members of CIBSE & the CPS

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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

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

TM23 contents

- 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

Table 1 TM23 preparation of building openings for regulatory purposes

Method of air leakage testing BS EN ISO 9972:2015, Method 3 and CIBSE TM23:2022	
Purpose of air leakage testing Regulation 43 of the Building Regulations for England and Wales	
Building completion status Building services systems installed; envelope penetrations and permanent sealing complete No temporary sealing measures, except where allowed to the building openings as described below	
Building openings	**Status**
Windows, doors, trapdoors, in envelope	Closed, not sealed
Ventilation openings for natural ventilation, e.g. trickle vents[1]	Closed, or temporarily sealed where no operable closing mechanism exists[2]
Openings for whole building mechanical ventilation or air conditioning	Closed, or temporarily sealed where no operable closing mechanism exists[2]
Openings for mechanical ventilation or air conditioning (intermittent use only)	Closed, or temporarily sealed where no operable closing mechanism exists[2]
Openings not intended for ventilation, e.g. letter box, cat flap, key holes	Closed, not sealed

[1] For consistency of approach with other sources of air leakage, as trickle vents do have a closing mechanism, when testing for regulatory purposes according to this TM trickle vents should be closed, but not sealed.

[2] Where no closing mechanism exists and temporary sealing is used, it should only seal the opening part of the component, not the junction between the component and the wall, window, or other adjacent elements.

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

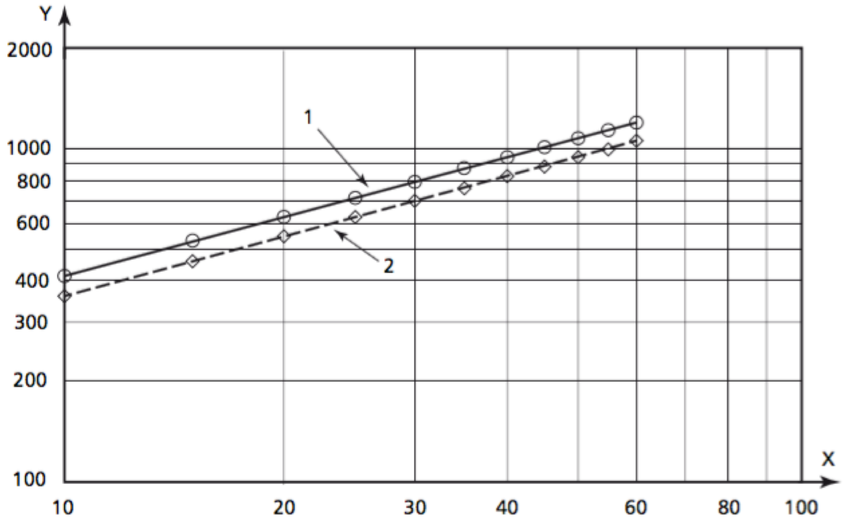
Broadly follows current best practice, including ISO

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.:

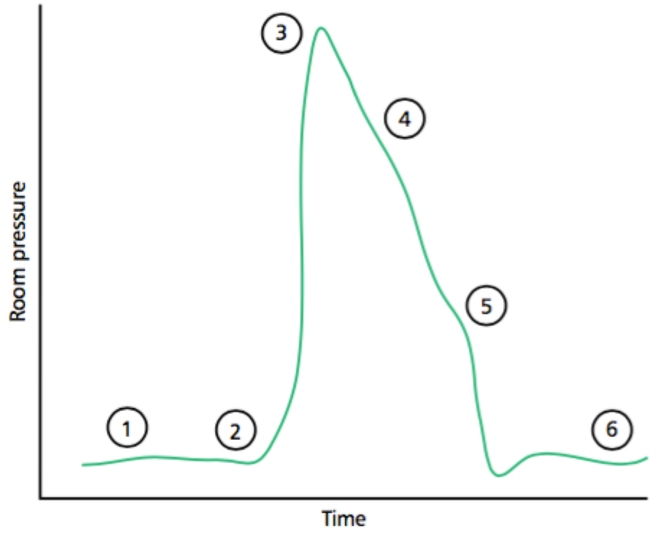
No interpolation of results: **testing range to include 4Pa**

Number of points etc…

Coefficient of determination r2 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



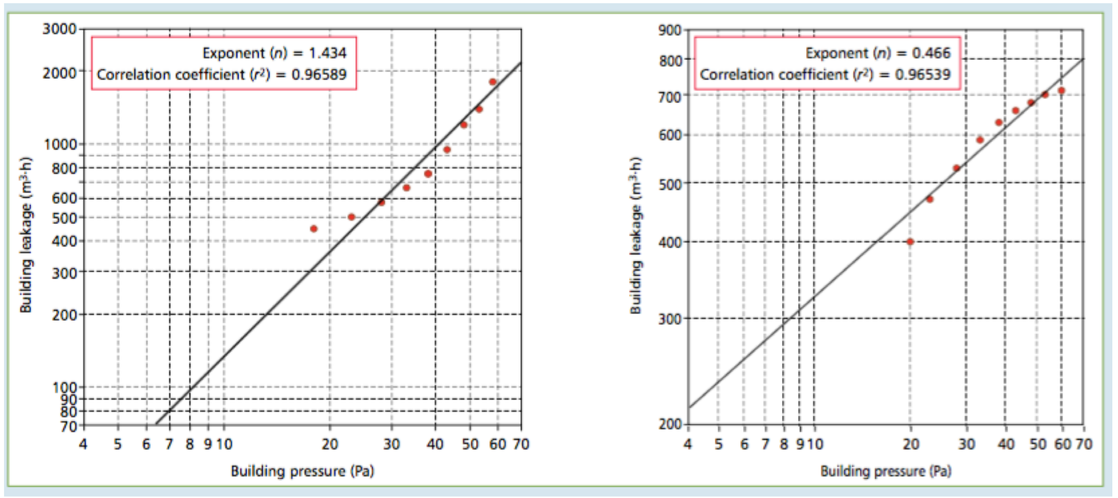
Courtesy of BTS

Results analysis

Based on similar principles for both methods

Main differences are time frame and pressure ranges

Software-based in both methods



Courtesy of BSRIA

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

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.

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.

$AP_{4e(50t)}$: estimated air permeability at 4 Pa, obtained by extrapolation of tested air permeability at 50 Pa (AP_{50}) not directly obtained from test results.

$AP_{50e(4t)}$: estimated air permeability at 50 Pa, obtained by extrapolation of tested air permeability at 4 Pa (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: 8.0$m^3/(h \cdot m^2)$ @ 50Pa **OR**
  1.57$m^3/(h \cdot m^2)$ @ 4Pa

Use of results for Building Regulations

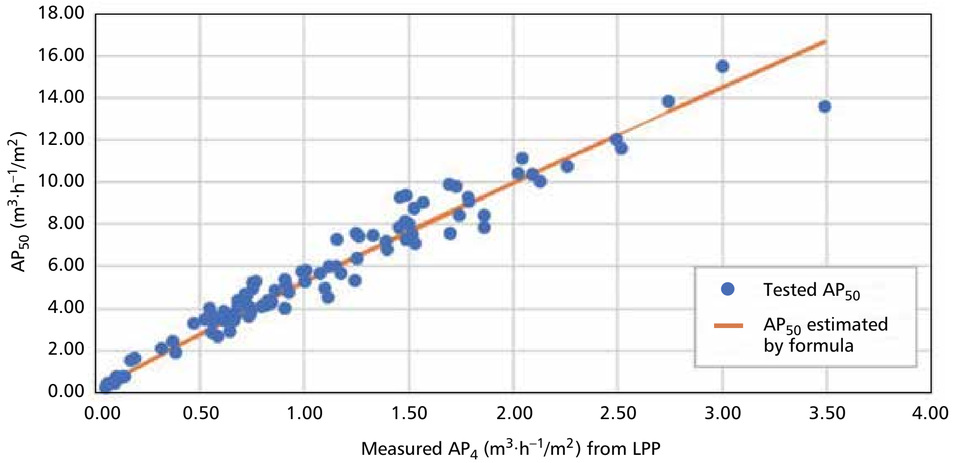
Use in SAP

Developed by BRE and BTS:

$AP_{50e(4t)} = 5.2540 * AP_4^{0.9241}$

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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