Envelope Airtightness Test Results Theatre, Royal & Derngate Theatre, 9-20 Guildhall Road, Northampton

Carried out for Historic England

Report CAT-HIS01-NA001-ROY01-021025-673171

Tested by J Askem

2 October 2025

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Envelope Airtightness Test Results
Theatre, Royal & Derngate Theatre,
9-20 Guildhall Road, Northampton

Carried out for:	Historic England Accounts Payable Rm 2/60 The Engine House Fire Fly Avenue Wiltshire SN2 2EH
Contract:	106886
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Quality Assurance

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1 INTRODUCTION

This report presents the results of the air permeability test, undertaken 02 October 2025, on the Theatre at Royal & Derngate Theatre, to determine the air permeability of the existing building.

2 METHODOLOGY

Air leakage testing measures the air leakage through a test area at a given induced pressure normalised against the test envelope. The test area may comprise a whole building or part there of.
The reported test(s) utilised the fan pressurisation or 'blower door' method. This method is undertaken by mounting a fan (or series of fans) in a suitable aperture (typically a door) in the structure to pressurise the test area. An internal/external pressure difference is created across the test area, in line with the requirements of the test standard. The fan speed is varied to induce different pressures across the structure. At each fan speed the air volume flow rate through the fan and the pressure across the structure envelope is recorded, and the air leakage coefficient calculated from the equation:

$$Q=C_L (\Delta p)^n$$

Where:

Q	is the air flow rate supplied to the building $m^3.s^{-1}$
Δp	is the pressure differential across the building Pa
C_L	is the air leakage coefficient $m^3.s^{-1}.Pa^{-n}$
n	is an exponent normally between 0.5 and 1.0

From the above equation the air flow rate, Q50 required to pressurise the building to 50Pa can be calculated.

The test procedure and calculation were carried out in accordance with the requirements of the appropriate ATTMA Standard (TSL1, TSL2, TSL3 or TSL4), CIBSE TM23:2022, ISO 9972:2015 Method B, and is UKAS accredited. The relevant equations and correction factors applied to the data can be found within the same test standard.

The results presented within this report are only applicable to the specified test area and the measurements recorded at the time of the test.

Opinions and interpretations expressed within this report are outside the scope of our UKAS accreditation. Smoke tests are not covered by our UKAS accreditation for airtightness testing of buildings.
Unless otherwise stated, the envelope areas and/or volumes used in producing the presented results were calculated by BSRIA Ltd.

3 TEST SUMMARY

3.1 TEST DETAILS

Site Address:	Royal & Derngate Theatre 19-21 Guildhall Road Northampton, Northamptonshire NN1 1DP
Building:	Royal & Derngate Theatre
Test Area:	Theatre
Test Regulation/Specification:	Part L2A of The Building Regulations

Design Air Leakage Criteria	Air Permeability @ 50Pa	25.00 $m^3.h^{-1}.m^{-2}$ @ 50Pa
Measured Air Leakage	Air Permeability @ 50Pa	19.04 $m^3.h^{-1}.m^{-2}$ @ 50Pa

The Theatre achieved an air leakage rate of 19.04 $m^3.h^{-1}.m^{-2}$ @ 50Pa.

3.2 DEVIATIONS & OBSERVATIONS

Deviations from Test Measurement Requirements:
- None

Deviations from Required Building Conditions:
- None

Identified air leakage paths:
- None significant identified.
- Slight leakage around some roof tongue and groove planks but unconfirmed whether localised or widespread. Membrane visible above but unknown if its breather membrane or air line/thermal line.
- Some leakage around old flue tower above centre of seating area.
- High level fly tower & vents not checked due to limited access / height / risk of items in pockets dropping to ground.
- Externally there were some bricks missing at the partition wall to MailCoach underpass with air egress from cavity.

4 TEST CONDITIONS

4.1 BUILDING INFORMATION

Type of building	Theatre
Estimated year of construction	Approximately 1880
Primary heating	Unknown
Primary ventilation	Unknown
Primary air conditioning	Unknown

4.2 BUILDING PREPARATION

All external doors closed
All internal doors open
All drainage traps filled with water
Ventilation shut off and dampers closed.
The fan assembly was installed in the goods delivery doorway to stage.

5 TEST EQUIPMENT

Equipment Used	Identifier	Calibration Expiry Date
Flow Meter(s)		
Retrotec Blower Door	BF16-01	06/12/2025
Retrotec Blower Door	BF16-02	05/12/2025
Retrotec Blower Door	BF16-03	11/12/2025
Retrotec Blower Door	BF06-02	21/11/2025
Retrotec Blower Door	BF06-03	22/11/2025
Micromanometer(s)		
TEC DG700	DBS41-2	13/12/2025
TEC DG700	MO34	20/11/2025
TEC DG700	MO30	25/11/2025
TEC DG700	DBS45-2	08/01/2026
Thermometer(s)		
Testo 110 Temperature Probe	TP15	11/11/2025
Barometer(s)		
Druck DPI705 Pressure Meter	BO17	03/03/2026
Anemometer(s)		
WindTron	INS44-3	Indication only

6 SUMMARY OF RESULTS

6.1 Calculated Results

Variable	Notation	Units	Value
Footprint	-	m^2	485.84
Volume	V	m^3	n/a
Envelope area	S_p	m^2	2653.73
Leakage coefficient	C_L	$m^3.h^{-1}.Pa^{-n}$	4473.631
Air flow coefficient	C_{env}	$m^3.h^{-1}.Pa^{-n}$	4457.76
Flow index	n	-	0.620
Correlation coefficient	r^2	-	0.986
Air flow rate at 50Pa	Q_{50}	$m^3.h^{-1}$	**50528**
Equivalent leakage area (approximate)	$Q_{50}/5.57$	m^2	2.52
Air changes per hour at 50Pa	N_{50} (Q_{50}/V)	$m^3.h^{-1}.m^{-3}$	n/a
Leakage per m² of envelope at 50Pa	AP_{50} (Q_{50}/S_p)	$m^3.h^{-1}.m^{-2}$	**19.04**

6.2 Environmental Conditions

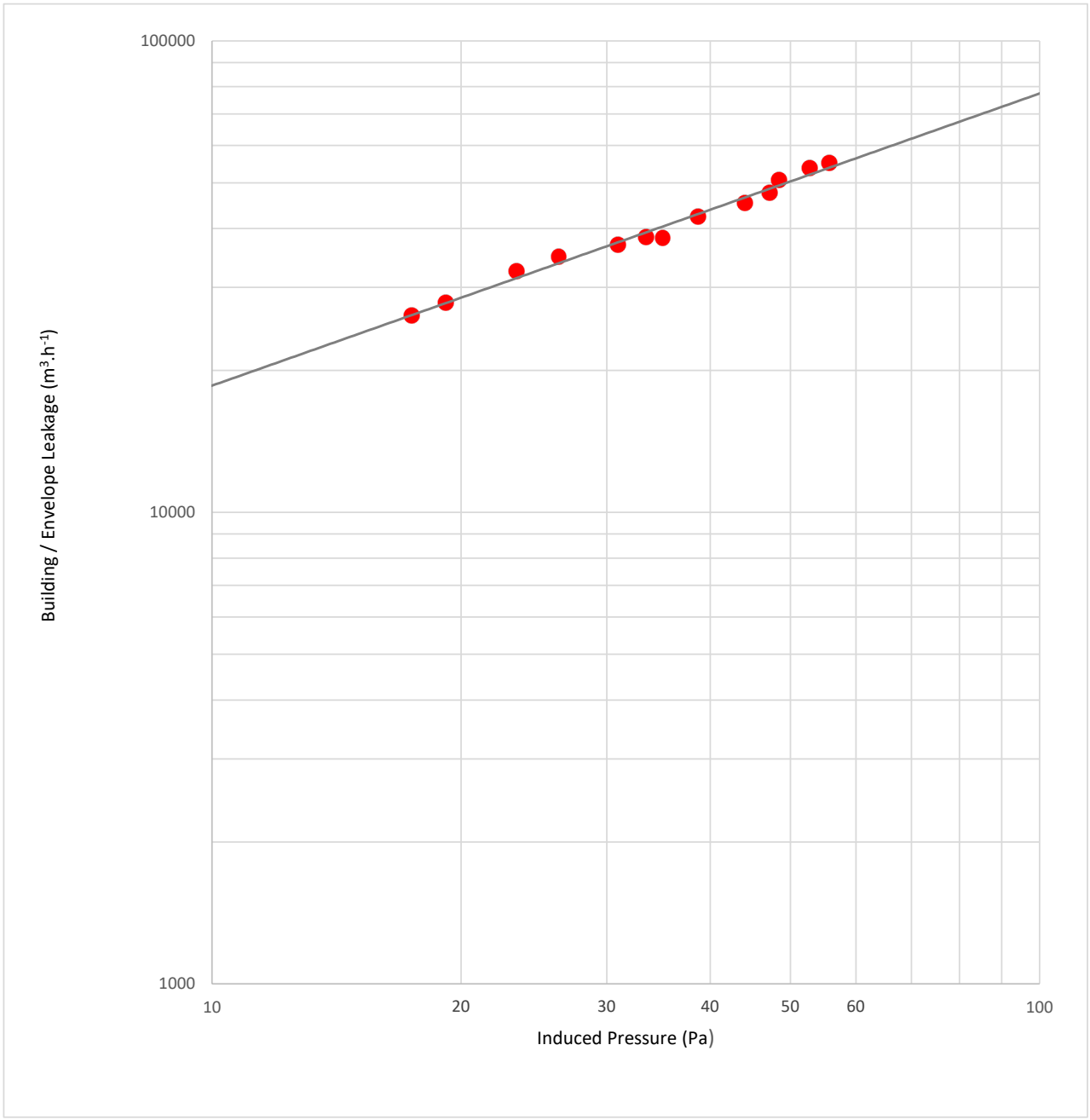
	Pre-Test		Post Test		Average
Windspeed (Beaufort Scale)	Beaufort Scale		Beaufort Scale		n/a
Barometric Pressure (mbar)	1016		1016		1016
Average Internal Temperature (°C)	18.5		17.9		18.2
Average External Temperature (°C)	15.0		15.0		15.0
Zero Flow Building Pressure Differential (Pa)	$\Delta P_{0,1+}$	0.00	$\Delta P_{0,2+}$	0.00	n/a
	$\Delta P_{0,1-}$	-1.22	$\Delta P_{0,2-}$	-1.67	n/a
	$\Delta P_{0,1}$	-1.22	$\Delta P_{0,2}$	-1.67	-1.45

6.3 Test Measurements

Corrected Differential Building Pressure (Pa)	Air Flow Rate ($m^3.h^{-1}$)
17.45	26140
19.15	27848
26.25	34847
30.95	37001
33.45	38300
38.65	42398
44.05	45360
47.15	47640
48.45	50850
52.75	53743
55.75	55020
35.05	38202
23.35	32484

6.4 FIGURES

Figure 6.1: 10:20, 2 October 2025. Theatre, Royal & Derngate Theatre



End of report