Ductwork Airtightness in the UK: Requirements and Assessment of Installed Performance

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1 INTRODUCTION

A ductwork system that has limited air leakage, within defined limits, will ensure that the design characteristics of the VAC system are sustained. It will also ensure that energy and operational costs are maintained at optimal levels.

Does the UK have any requirements regarding ventilation ductwork airtightness and how does the UK assess the installed performance of ducted mechanical ventilation systems?

The UK's Building Regulations set the minimum standard for the energy performance of domestic and non-domestic buildings as part of its commitment to reduce greenhouse gas emissions.

Essentially, reasonable provision shall be made for the conservation of fuel and power by doing the following:

- Limiting heat losses and gains;
- Providing fixed building services, which are:
    - energy-efficient;
    - have effective controls, which are commissioned and tested;
    - provide the owner with sufficient information about the building and the fixed building services so that the building can be operated to use no more fuel and power than is reasonable.

2 BUILDING REGULATIONS

2.1 Domestic

The UK's Building Regulations' 'Approved Documents' and associated compliance guides make little reference to ductwork airtightness in domestic mechanical ventilation systems. However, SAP 2012 (the software used to calculate the energy performance of new domestic buildings) features a range of 'in-use factors' to estimate the installed performance of mechanical ventilation systems more accurately (see Table 4h). They have been developed to reflect the impact of typical installation and operation practices of flexible, semi-rigid and rigid ductwork systems.

Table 4h: In-use factors for mechanical ventilation systems

In-use factors are applied to the data for mechanical ventilation systems in all cases

Type of mechanical ventilation	Approved install-ation scheme	In-use factor for Specific fan power			In-use factor for Efficiency	
		Flexible duct	Rigid duct	No duct	Uninsulated ducts	Insulated ducts [c]
Mechanical extract ventilation, centralised [a]	No	1.70	1.40	-	-	-
	Yes	*	*	-	-	-
Mechanical extract ventilation or positive input ventilation from outside, decentralised [a]	No	1.45	1.30	1.15	-	-
	Yes	*	*	*	-	-
Balanced whole house mechanical ventilation, without heat recovery [a]	No	1.70	1.40	-	-	-
	Yes	*	*	-	-	-
Balanced whole house mechanical ventilation, with heat recovery [a]	No	1.70	1.40	-	0.70	0.85
	Yes	*	*	-	*	*
Default data from Table 4g (all types) [b]		2.5			0.70	

An assessment and test method for semi-rigid ductwork used to distribute air for domestic mechanical ventilation systems was also published in 2011. Individual semi-rigid ductwork manufacturers or suppliers must demonstrate that the aerodynamic performance of their system is equal to or better than the aerodynamic performance of the (airtight) rigid ductwork used to test the SFP and thermal efficiency of MVHR units for the defined dwelling types. The 'in-use factors' applied to rigid ductwork are also applied to semi-rigid ductwork, i.e. those semi-rigid ductwork systems, which are listed in the Product Characteristics Database (PCDB).

2.2 Non-domestic

The ductwork system designer/specifier dictates how airtight the ductwork of non-domestic mechanical ventilation systems should be. The limits of air leakage for various pressure classes of ductwork systems in 'buildings other than dwellings' are specified in Table 1 of BESA DW/144 (see below).

Table 1 Ductwork Classification and Air Leakage Limits

Duct pressure class	Static pressure limit		Maximum air velocity	Air leakage limits litres per second per square metre of duct surface area
	Positive	Negative		
1	*2*	*3*	*4*	*5*
	Pa	Pa	m/s	
Low pressure – Class A	500	500	10	$0.027 \times p^{0.65}$
Medium pressure – Class B	1000	750	20	$0.009 \times p^{0.65}$
High pressure - Class C	2000	750	40	$0.003 \times p^{0.65}$
High pressure - Class D	2000	750	40	$0.001 \times p^{0.65}$

Where *p* is the differential, pressure in pascals.

3 FIELD MEASUREMENT

Air leakage testing is not regulatory for domestic mechanical ventilation systems, but it is mandatory and in accordance with BESA DW/143 for high-pressure ductwork systems of non-domestic ventilation systems. The ductwork system designer/specifier may also demand random air leakage tests of medium and low pressure ductwork systems in his/her specification and choose which ductwork systems to test.

4 WHAT IS NEEDED?

4.1 Domestic

In my opinion a regulatory requirement because …

- Air leakage/tightness affects the installed performance of ducted mechanical ventilation systems, but it is highly variable and a direct function of the type of ductwork used and the quality of the installation.
- The 'in-use factors' try to estimate the installed performance of ducted mechanical ventilation systems more accurately, which is a start, but they still may not reflect the actual installed performance, don't set minimum standards for ductwork airtightness or recognise truly airtight ductwork systems.
- Laboratory testing can identify systems, which are inherently airtight, e.g. rigid and semi-rigid ductwork systems with purposed-designed/manufactured (airtight) mechanical connections, but testing installed systems is the only way to assess if the installation meets the required level of performance.

4.2 Non-domestic

Building Regulations already specify the various pressure classes of ductwork systems and air leakage testing of high-pressure ductwork systems is mandatory.

5 CHALLENGES

5.1 Domestic

Any regulatory assessment of more efficient and effective central mechanical ventilation systems will be resisted by developers and drive them to cheaper and easier to install systems, e.g. background ventilation + intermittent extract fans. These systems are cheap, but the IAQ implications in airtight dwellings are not widely understood/appreciated yet.

5.2 Non-domestic

Ideally, the ductwork system designer/specifier will witness the air leakage test, but this may not always be the case.

KEYWORDS

Ductwork airtightness leakage installed performance

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7 REFERENCES

Ministry of Housing, Communities and Local Government
https://www.gov.uk/government/collections/approved-documents

- Part L1A: Conservation of fuel and power in new dwellings
  Part L1B: Conservation of fuel and power in existing dwellings
  Part L2A: Conservation of fuel and power in new buildings other than dwellings
- Part L2B: Conservation of fuel and power in existing buildings other than dwellings
- Part F: Ventilation (2010 and 2013 amendments)
- Domestic ventilation compliance guide

- Domestic building services compliance guide
- Non-domestic building services compliance guide

Product Characteristics Database
https://www.ncm-pcdb.org.uk/sap/page.jsp?id=24

- Test method for centralised Mechanical Ventilation and Heat Recovery (MVHR) system packages
- Specification requirements applicable to the utilisation of semi-rigid ducts in SAP

Building Engineering Services Association (BESA)
https://www.thebesa.com/

- DW/144 Specification for sheet metal ductwork
- DW/143 A practical guide to ductwork
- DW/154 Specification of plastic ductwork