

Improved airtightness standards for non-domestic buildings

Energy performance has become an increasingly important aspect of the design of buildings ever since the first 'energy crises in the 1980's. During this period the thermal insulation performance of the building fabric has rightly taken centre stage and the 'U-values' of roofs and walls have improved from 0.7-0.9W/m²K to better than 0.25 W/m²K.

Insulated panels have led the way in producing an energy conserving and thermally efficient building fabric. They also meet the primary criteria that buildings should provide long-term energy performance.

Having established the basis for a thermally efficient core fabric for roofs and walls, the latest set of Regulations to conserve 'Fuel and Power' have now focussed on the airtightness of buildings as the next largest potential contributor to energy loss.

History – air permeability requirements

Air permeability of buildings was first introduced in the 2002 Regulations in the form of an advisory target of 15 m³/(h.m²). Successive Regulations have introduced improvements to a regulated and tested minimum requirement of 10 m³/(h.m²) in 2010. [5 m³/(h.m²) in the NCM notional building calculation.]

The latest set of 2014 Regulations for England, Wales and Scotland (October 2015) have included further improvements to between 7 m³/(h.m²) and 3 m³/(h.m²) dependant upon the size of the building.

However recent research has indicated that a high proportion of buildings fail to achieve the former regulatory requirements, indicating that a greater attention to achieving the air tightness levels will be required if the next generation of buildings are to comply with the latest regulations.

This guidance paper lists the 2014/15 requirements implementation date April 2014, summarises the EPIC research into the air tightness of buildings and gives guidance on achieving compliance and minimising the risk and cost of failing to achieve the regulatory air tightness levels.

Conservation of Fuel and Power Building Regulations AD-L2 (2013/14) England; L2 2014 Wales and Section 6 October 2015 Scotland – Air permeability

In the new England and Wales Regulations introduced in 2014 air permeability has been significantly improved beyond the 2010 levels to between 7 m³/(h.m²) and 3 m³/(h.m²). A further major change is that air permeability levels are defined according to 'Gross Internal Area' (GIA) becoming lower as the GIA increases.

The following table illustrates the new requirements which are shown in m³/(h.m²) at 50Pa according to GIA. Following the EPIC research shown below and representations to DCLG the levels for smaller top-lit buildings (below 250 m²) have been relaxed to 7m³/m²/h.

There is a backstop level of 10 m³/(h.m²) at 50Pa. This 10 m³/(h.m²) limit is a mandatory requirement for all new buildings except those below 500m² for which 15 m³/(h.m²) can be adopted without testing.

In Scotland, the 'recommended limit' for air permeability of 10 m³/(h.m²) will be improved to between 5 m³/(h.m²) and 3 m³/(h.m²) in the new Section 6 Regulations effective from October 2015.

Testing became mandatory for warrants made after 1 May 2011.

Table Air Permeability levels in the 2014/15 Regulations for England and Wales and Scotland by Gross Internal Area (GIA)

2013 Notional building values			
	Side-lit/unlit (specification is heating only)	Side-lit/unlit (specification includes cooling)	Top-lit
$GIA \leq 250m^2$	$5m^3/(h.m^2)$	$5m^3/(h.m^2)$ England/Wales	$7m^3/(h.m^2)$
$250m^2 < GIA \leq 3500m^2$	$3m^3/(h.m^2)$	$3m^3/(h.m^2)$ England/Scotland $5m^3/(h.m^2)$ Wales	$7m^3/(h.m^2)$
$3500m^2 < GIA \leq 10000m^2$	$3m^3/(h.m^2)$	$3m^3/(h.m^2)$ England/Scotland $5m^3/(h.m^2)$ Wales	$5m^3/(h.m^2)$
$10000m^2 < GIA$	$3m^3/(h.m^2)$	$3m^3/(h.m^2)$ England/Scotland $5m^3/(h.m^2)$ Wales	$3m^3/m^2/h$

Summary of the EPIC research into the actual airtightness of buildings

In September 2010 EPIC commissioned an analysis of 245 building reports issued between January 2008 and August 2010. The objective was to obtain an understanding of how actual building performance compared against the 2006 regulatory requirement of $10 m^3/(h.m^2)$ and in particular whether it is more difficult to achieve lower air permeability values with smaller footprint areas.

- 33% of the buildings tested either failed to comply or only just passed $10 m^3/(h.m^2)$
- 80% would fail the 2010 benchmark in the SBEM Model of $5 m^3/(h.m^2)$
- Of buildings with a footprint greater than $4000m^2$, 84% achieved a measured air permeability less than $7 m^3/(h.m^2)$ and 68% achieved a value of $5 m^3/(h.m^2)$ or better
- Generally the lower the foot print area the worse the air permeability value, especially where the structures are more complex with mixed cladding types

Buildings below $4000m^2$ footprint

Research into levels of actual air permeability achieved for buildings with a footprint area under $4000 m^2$ indicate that improvements from 10 to $5 m^3/(h.m^2)$ at $50Pa$ are difficult to achieve unless specific attention is paid to the detailing at both the design and construction stages. Air tightness is very dependant on workmanship however good the joints and details from the manufacturer.

The research data suggests that designers should give very careful thought to air permeability barriers and the design value that is put into the SBEM calculation. In many cases the new AD-L2A: 2013 Notional Building value of 7.0 , 5.0 and $3.0 m^3/(h.m^2)$ may be difficult to achieve in practice especially for the smaller footprint buildings. Failure to achieve the design air permeability value will compromise the ability of the completed building to achieve overall compliance with the Building Regulation. Failure to comply will inevitably involve project delays and additional costs.

The research suggests that to minimise the risk of compliance a conservative value for air permeability should be adopted at design stage, generally above the regulatory and notional building value but below the $10 m^3/(h.m^2)$ maximum allowed.

Buildings above $4000m^2$ footprint

In general terms as a building increases in size and volume it will be easier to achieve a low air infiltration value. However, the more complex buildings such as those with a large level of interface details, for example, offices, schools, hospitals and hotels need careful consideration as to whether an air permeability design value of $5 m^3/(h.m^2)$ at $50Pa$ is appropriate. Using a higher air permeability design value would lower the risk of failing the final SBEM calculation.

For larger, less complex buildings it may be possible to use an air permeability design value of less than $5 m^3/(h.m^2)$ at $50Pa$ however the risk of failing the final SBEM calculation and subsequent cost and program issues needs to be considered.

It is worthwhile remembering that buildings which beat the target carbon emission rate will achieve a better EPC rating and, if BREEAM assessed, will gain additional credits in the energy section.

Insulated panels – improving compliance

Since their introduction in the 1980s, Insulated Panels have become the dominant cladding system and a major contributor to energy conservation. In terms of air tightness the impervious facings and tightly engineered joints have significantly improved the envelope performance of metal clad buildings with the result that well designed buildings using insulated panels have achieved $2 \text{ m}^3/(\text{h.m}^2)$ or better.

However the above research has shown that buildings will only achieve the new lower values demanded by the 2013 regulations if they are designed, constructed and commissioned to a high standard with specific attention being paid to the many junctions in the building, especially between dissimilar elements e.g. at windows, doors, abutting brickwork etc.

The 2013 Regulations require much tighter airtightness levels than previously. Failure to achieve the design values will have a negative effect on the compliance calculation so that without other compensatory efficiencies the risk of non-compliance is increased. Buildings that exceed the $10 \text{ m}^3/(\text{h.m}^2)$ backstop value will be regarded as not complying.



Image courtesy of Gazeley and Central Photography

The use of insulated roof and wall panel systems helped to achieve an air leakage figure of $1.8 \text{ m}^3/\text{Hr/m}^2$ @ 50 Pa and, ultimately an 'Outstanding' BREEAM rating for this logistics Centre at Chatterley Valley in Staffordshire.

Design and construction pointers

Design

Few buildings are designed to specific airtightness standards. However for all buildings the designer must determine and specify the level of airtightness required and used in the SBEM compliance calculation. This should be to the requirements set out in AD-L2 2013 or better. If the backstop value of $10 \text{ m}^3/(\text{h.m}^2)$ is used, compensatory savings should be made in other areas e.g. lighting/controls etc.

Not all contractors have experience in working to the new lower air tightness levels. EPIC recommend that designers prepare a clear brief for cladding contractors stating the required standard and request the submission of a detailed method statement including supervision and training (where necessary) to achieve compliance.

All EPIC members have a full set of details for their Insulated panels and should be contacted directly for further information.

Complex detailing

Where the design calls for complex details, EPIC recommends that a sample of the detail area is made and the sealing techniques are confirmed before work commences.

Structural steelwork

The guidance tolerances for structural steelwork and tolerances should be included as part of the specification to ensure tight fitting joints and optimum air tightness performance of the Insulated Panel System. EPIC members will provide guidance tolerance levels for purlins, cladding rails and main frame as required.

Installation to achieve compliance

Insulated Panels are designed with thermally efficient and air tight panel-to-panel joints. Providing the steelwork tolerances are within specification and attention is paid to the alignment and levelling of the first panel, air leakage at the panel joints should be to the design values and should have little effect on the air permeability rates.

The most probable cause of an above regulation air permeability rate on testing will be excessive air leakage at junctions and penetrations.

- Corners
- Brick and block junctions
- Cills
- Door heads and Jambs
- Window/curtain wall heads, jambs and cills
- Penetrations
- Eaves and verges
- Ridges
- Rooflights
- Internal gutters

Note 1

Seals and canister foams can be used at junction details to provide insulation continuity and as an effective air seal. The specification should be agreed with the designer. Only specified foams and seals should be used.

Note 2

Remedial work is costly, difficult and may affect payment retentions.

Air permeability testing

The Regulations require that all non-domestic buildings are pressure tested. This is a mandatory requirement for all new buildings except those below 500m² for which 15 m³/(h.m²) can be adopted without testing.



EPIC recommends that air pressurisation testing is only carried out by specialist UKAS accredited ATTMA organisations with experience of building construction and practice. www.attma.org

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Whilst every attempt has been made to verify the guidance given, it should not be regarded as definitive. Because individual manufacturers' products vary, the performance should always be confirmed with them.