EPIC
ENGINEERED PANELS IN CONSTRUCTION

Insulated panels for external roof and wall cladding




Conservation of Fuel and Power Building Regulations (2006)

England and Wales: AD-L2
Northern Ireland: Part F
Scotland: Section 6

Guidance on compliance using Insulated Panel Systems

Revised October 2007

Introduction – 2006 Energy Regulations

New regulations – non-domestic buildings

The principal aim of these new Building Regulations is to reduce the CO2 emissions to meet the UK and EU targets and to help comply with the European Energy Performance of Buildings Directive (EPBD).

The 2006 Regulations require a completely different approach to assessing the energy performance of buildings. Energy performance is expressed in terms of the mass of CO_2 emitted per year in units of $kg.m^2$ of floor area.

The traditional method of compliance based on limiting U-values for the various building elements, including an allowance for thermal bridging is withdrawn under the new regional Building Regulations.

Under the new Regulations the building is assessed using a new 'whole building methodology' that calculates the total energy performance. As it is the building services that emit CO_2 and not the building elements, the total energy building performance takes account of the CO_2 emission resulting from the provision of heating, hot water, ventilation, cooling and lighting. It is therefore based on the building's use in occupation.

The EPIC guide

This Guide has been prepared by EPIC to assist Architects and Specifiers who are using Insulated Panels in the design of Industrial, Commercial, Leisure, Transport, Education, Health and other buildings.

Sections 1-4 of the Guide cover the new requirements as they are applied to new buildings.
Sections 5 & 6 summarise the requirements applied to the refurbishment and extension of buildings.
Sections 7 & 8 summarise the requirements applied to the shell and fit out of buildings.

The EPIC Guide gives information on:

- The data that is required to be inputted for Insulated Panels including the junctions and details as well as the airtightness of the building fabric
- The SBEM Calculation Tool and the influence of the various elements that affect energy consumption
- Which systems are penalised by the methodology and discouraged from use
- Keys to achieving compliance

Availabity of New Regulations

	Title	Implementation date	Download
England and Wales	Approved Document Part L2A (New Build) and L2B (Refurbishment) – Conservation of fuel and power (2006)	6 April 2006	www.planningportal.gov.uk
Northern Ireland	DFP Technical Booklet F2 (2006) – Conservation of Fuel and Power other than dwellings	30 November 2006	www.dfpni.gov.uk
Scotland	Building (Scotland) Regulations – Technical Handbook: Section 6 Energy	1 May 2007	www.sbsa.gov.uk

Download information from the EPIC website

This Guide to Amendments to the Building Regulations 2006 together with the other EPIC Guides can be readily downloaded from the EPIC website at www.epic.uk.com

5 Refurbishment AD-L2B and Part F2 Overview and implications of the requirements

5.1 Introduction

This section of the EPIC Guide concentrates on the requirements and the rules for compliance that relate to refurbishment projects involving the building fabric including daylighting.

AD-L2B gives guidance on "what, in ordinary circumstances, will meet the requirements of Part L when carrying out work on buildings that are not dwellings". The requirements set out in Part F2: Section 3 for Northern Ireland are broadly similar. For Scottish requirements see section 6 of this guide.

The EPIC guidance follows the principles of AD-L2B (2002) in that it concentrates on practical and feasible measures that can improve the energy performance of an existing building and ways of illustrating the economic feasibility of undertaking the works.

The two main areas for improvement during refurbishment works concern

- the building fabric and
- the building services and controls

The requirements in AD-L2B (2006) and Part F do not require the use of the SBEM calculation model unless designer wishes to illustrate that performance will be better than the original building.

5.2 Insulated Panels and refurbishment works

Insulated panels by the nature of their single piece construction are ideal for re-cladding walls and roofs and have been used extensively on refurbishment projects for over 30 years. Panels offer real practical benefits in terms of speed, minimum disruption, use of existing structure (most cases), improved external and internal environment, low maintenance and increased security.

PIR cored panels have the best insulation performance for lowest thickness and weight and can transform the energy efficiency of a building to AD-L2B (2006) standards with immediate payback on investment. In addition to improved thermal performance, which is guaranteed by the factory controlled production, insulated panel systems also meet the AD-L2B requirements for maintaining continuous insulation and minimising the effect on useable floor area.

See www.epic.co.uk/refurbishment.jsp

5.3 Types of work covered by 'Refurbishment'

Six main types of refurbishment activity are subject to the requirements of AD-L2B and Part F:

- Extensions
- Material change of use
- Material alterations
- Consequential improvements
- The provision or extension of a controlled service of fitting (not covered by this guide)
- The replacement or renovation of a thermal element

Each of the above activities triggers an automatic appraisal of the fabric, either in respect of the new thermal elements, i.e. used in an extension, or the existing thermal elements. The specific requirements for each type of refurbishment activity are set out in the following paragraphs and may involve the replacement and / or upgrading of the elements.

5.4 Extensions

A. Large extensions:

The regulations relating to 'large extensions' apply where the proposed extension has a total useful floor area that is both

a. greater than 100m^2; and

b. greater than 25% of the total useful floor area of the existing building

In these cases the work should be regarded as a new building and the guidance in AD-L2A followed (see sections 1 to 4 of this EPIC guide).

B. Other extensions

Reasonable provision would be for the proposed extension to meet the following performance standards: (relevant to refurbishment projects using insulated panels.)

- New thermal elements shall meet the standards of 0.20 W/m^{2}K for roofs and 0.30 W/m^{2}K for walls
- Existing opaque fabric that becomes part of the thermal envelope whereas previously was not should be improved to 0.25 W/m^{2}K for roofs and 0.35 W/m^{2}K for walls. If this is not feasible a minimum threshold performance value should be met – see section 5.8. Retained thermal elements
- Areas of windows and rooflights should not exceed the values given in table 6 unless a proportion of glazing is present in the part of the building to which the extension is attached. In such cases, reasonable provision would be to limit the proportion of glazing in the extension so that it is no greater than the proportion that exists in the building to which it is attached.

Table 6. Opening areas in an extension

Building type	Rooflights as % of area of roof	Windows and personnel doors as % of exposed wall
Industrial and storage buildings	20%	15%
Places of assembly, offices and shops	20%	40%
Residential buildings where people temporarily or permanently reside	20%	30%
Vehicle access doors and display windows and similar glazing	N/A	As required
Smoke vents	As required	N/A

Notes on the requirements for 'other extensions'

1: AD-L2B also gives a formula for greater design flexibility by recalculating the area-weighted value of the respective U-values and rooflight area (AD-L2B #29).

2: AD-L2B also allows the facility to use SBEM or an approved calculation tool to show that the calculated CO_2 emissions for the building plus proposed extension is no greater than for the for the building plus a notional extension complying with note 1 above (AD-L2B #30).

5 Refurbishment AD-L2B and Part F2
Overview and implications of the requirements

5.5 Material change of use and change of energy status

Two changes are covered by this provision:

- A material change of use as defined in AD-L2B #34
- Where a building changes its energy status

Under these changes a reasonable provision would be to meet the following performance standards: (relevant to refurbishment projects using insulated panels.)

- where the work involves the provision of a new or replacement element, the thermal elements shall meet the standards of 0.20 W/m²K for roofs and 0.30 W/m²K for walls
- Where the thermal element is to be renovated or retained the thermal element should be improved to 0.25 W/m²K for roofs and 0.35 W/m²K for walls. If this is not feasible a minimum threshold performance value should be met – see section 5.8 Retained thermal elements
- Any existing window, including roof window or rooflight, or door which separates a conditioned space from an unconditioned space or the external environment and which has a U-value worse than 3.3 W/m²K should be replaced (AD-L2B #36d).

5.6 Material alterations

In the case of AD-L2B, a material alteration relates to the non-compliance of a building or controlled service or fitting (see AD-L2B #38)

Under material alterations a reasonable provision would be to meet the following performance standards: (relevant to refurbishment projects using insulated panels.)

- Where the thermal element is to be renovated or where an existing element becomes a part of the building whereas previously it was not, the thermal element should be improved to 0.25 W/m²K for roofs and 0.35 W/m²K for walls. If this is not feasible a minimum threshold performance value should be met – see section 5.8 Retained thermal elements
- Any existing window, including roof window or rooflight, or door which separates a conditioned space from an unconditioned space or the external environment and which has a U-value worse than 3.3 W/m²K should be replaced (AD-L2B #39c).

5.7 Consequential improvements

Consequential improvements means those energy efficiency improvements required when an existing building is extended or renovated.

Consequential improvements apply to existing buildings over 1000m² where the work consists of:

a. an extension

b. the initial provision of a fixed building service or

c. an increase to the installed capacity of any fixed building service

Consequential improvements are in addition to the proposed building works and should be made to ensure that the building complies with Part AD-L2A or Part F2 provided that any such improvements are technically, functionally and economically feasible.

The following improvements relating to the building fabric are considered to be practical and economically feasible in ordinary circumstances:

1. Upgrading thermal elements which have U-values worse than 0.70 W/m²K for walls and 0.35 W/m²K for roofs
2. Replacing existing windows, roof windows or rooflights or doors which have a U-value worse than 3.3 W/m²K (AD-L2B #75-78)

Consequential improvements on installing building services

Where the installed capacity per unit area of a heating system is increased the following improvements relating to the building fabric are considered to be practical and economically feasible in ordinary circumstances

- to upgrade or replace the thermal elements within the area served which have a U-value worse than 0.7 W/m²K (to 0.35 W/m²K) for walls and 0.35 W/m²K (to 0.25 W/m²K) for roofs and
- Replace existing rooflights that have a U-value worse than 3.3 W/m²K

Where the installed capacity per unit area of a cooling system is increased the following improvements relating to the building fabric are considered to be practical and economically feasible in ordinary circumstances

- to upgrade or replace the thermal elements within the heated areas which have a U-value worse than 0.7 W/m²K (to 0.35 W/m²K) for walls and 0.35 W/m²K (to 0.25 W/m²K) for roofs and
- if the windows, roof windows within the area served exceeds 40% of the façade area or the area of the rooflights exceeds 20% of the area of the roof and the design solar load exceeds 25W/m², then the solar control provisions should be upgraded (see AD-L2B #23b)
- any lighting system within the area served with a lamp efficacy of less than 40 lamp-lumens per circuit watt shall be upgraded to reduce the lighting load and the space cooling demand (AD-L2B #23c).

5.8 Guidance on thermal elements

This section summarises the requirements listed above under various refurbishment categories.

Newly constructed or replacement elements.

Reasonable provision is given as follows in AD-L2B:

- For newly constructed thermal elements such as those constructed as part of an extension – Table 7 column (a)
- For those thermal elements constructed as replacements – Table 7 column (b)
- No individual element should have a U-value worse than those set out in – Table 7 column (c).

5 Refurbishment AD-L2B and Part F2
Overview and implications of the requirements

Table 7. Standard for use of new insulated panels in refurbishment

Element	(a) Standard for new thermal elements	(b) Standard for replacement thermal elements	(c) Limiting U-value for existing elements – not worse than
Walls	0.30*	0.35*	0.70
Roofs (with integral insulation)	0.20*	0.25*	0.35

* See section 3.2 Table 2 for indicative panel thickness for the above U-values

Renovation (replacement) of thermal elements.

AD-L2B states that reasonable provision would be to achieve the standard set out in Table 8 (b) where works cover more than 25% of the surface area.

However if the area is less than 25% reasonable provision could be to do nothing to improve the energy performance.

If such an upgrade is not technically or functionally feasible or would not achieve a payback of 15 years or less the element should be upgraded to the best standard that is technically or functionally feasible and which can be achieved within a simple payback no greater than 15 years.

Retained thermal elements

Retained thermal elements refers to the following circumstances:

- where an existing element is part of a building subject to a material change of use
- where an existing element is to become part of the thermal envelope and is to be upgraded
- where an existing element is being upgraded as a consequential improvement

AD-L2B states that reasonable provision would be to upgrade those thermal elements whose U-value is worse than the threshold value in Table 8 column (a) to achieve the U-value given in column (b) providing this is technically and economically feasible.

A reasonable test of economic feasibility is to achieve a simple payback of 15 years or less. Where the standard given in column (b) is not technically or functionally feasible, then the element should be upgraded to the best standard that is technically or functionally feasible and which can be achieved within a simple payback no greater than 15 years

Table 8. Replacement and upgrading retained thermal elements

Element	(a) Threshold U-value	(b) Improved U-value
Walls	0.70*	0.35*
Roofs (with integral insulation)	0.35*	0.25*

* See section 3.2 Table 2 for indicative panel thickness for the above U-values

6 Refurbishment – Scotland
Overview of the requirements

6.1 Requirements

Guidance on refurbishment is set out in Section 6.2 of the Standard as follows.

- 6.2.6 Conversions
- 6.2.7 Extensions
- 6.2.8 Alterations

This section of the EPIC Guide summarises the basic requirements in terms of refurbishment of the building element. Although many of the values for insulating elements are similar to those set for England, Wales and Northern Ireland, Section 6 for Scotland aims to set higher basic levels for Extensions to heated buildings especially for walls.

There is also a strong emphasis on the need to upgrade to the highest standards and Section 6 (Scotland) recommends consultation with the verifier of the relevant local authority on refurbishment issues at an early stage of the works.

6.2 Conversions

Section 6.2.6 of the Standard states that in the case of the conversion of an unheated building it is appropriate to treat the building as if it were an extension – see 6.3 below. In certain instances it may be more worthwhile to demolish these buildings and rebuild to the latest standards.

In the case of a building that was previously designed to be heated, it is appropriate to examine the insulation envelope and upgrade, if necessary, to the values shown in table 9.

Table 9. Conversion of a heated building that remains heated after conversion (Scotland)

Maximum U-values (W/m²K) for building elements of the insulation envelope	
Type of element (excluding separating walls and separating floors)	Area weighted average value for elements of the same type
Wall[1]	0.7
Roof [Insulated Panels][1]	0.35
Floor[1]	0.7
New and replacement windows, doors, roof windows and rooflights	1.8

[1] Where upgrading work is necessary to achieve the U-values, reference should be made to 'Reconstruction of elements' (see 6.4 below) and more demanding U-values achieved where appropriate.

6 Refurbishment – Scotland
Overview of the requirements

6.3 Extensions

Section 6 of the Standard anticipates that in the case of extensions to the building envelope, the majority of the construction will be 'new-build and seldom will there be a need to construct to a lesser specification.

Where the insulation envelope of a building is extended, the new building fabric should be designed (or Upgraded) in accordance with Table 10 below.

The extended part of an insulation envelope or the unheated to heated category of an extension should be constructed in such a way that there are no substantial thermal bridges or gaps where the layers of insulation occur.

Table 10. Extensions to the insulation envelope of buildings [Scotland]

Maximum U-values (W/m²K) for building elements of the insulation envelope		
Type of element (excluding separating walls and separating floors)	(a) Area weighted average value for elements of the same type	(b) Individual element U-value
Wall	0.27	0.7
Roof with integral insulation [includes insulated panels]	0.20	0.35
Floor	0.22	0.7
Windows, doors, roof windows and rooflights	1.8	3.3

Where the insulation envelope of a building is extended, the new opening areas should be designed in accordance with Table 11.

Table 11. Maximum window and rooflight areas for extensions [Scotland]

Building type	Rooflights as % of area of roof	Windows and doors as % of exposed wall
Industrial and storage buildings	20%	15%
Offices, shops and buildings for entertainment and assembly purposes	20%	40%
Residential buildings (non-domestic)	20%	30%
High usage entrance doors and display windows and similar glazing	As required	

Compensatory arrangements – area weighted average U-values

Table 10 illustrates that the Building (Scotland) Regulations – Section 6 sets tighter (lower) values for the thermal elements in Refurbishment than for new constructions. This also applies for Shell and fit-out (see section 8 of this guide).

However Table 11, taken from Section 6.2.3 of the Standard, also contains a table of maximum opening areas for widows, doors and rooflights and SBSA have confirmed that it is permissible to trade off between panel and opening areas to achieve the require area weighted average U-values for the whole roof or wall construction based on the values in Table 10 column a.

This ability to make compensatory arrangements by reducing the opening areas allows panels of the standard thickness required for new constructions to be used i.e. 0.25 W/m²K for roofs and 0.30 W/m²K for walls.

Example calculation

Roof refurbishment project – example of compensatory arrangement between roof panel and rooflights using heat loss calculation

A. Building to be refurbished/extended – footprint area 1000m². Using a proposed standard panel U-value of 0.25 W/m².K

Exposed element	Exposed surface area (m²)	U-value (W/m²K)	Rate of heat loss (W/K)
Roof	870 (87%)	x 0.25 (U-value of standard panel)	217.5
Rooflight[(1)]	130 (13%)	x 2.20 (most common rooflight U-value)	286.0
Total rate of heat loss			503.5

[(1)] reduced percentage area from 20% maximum level in Notional Building calculation.

B. Notional refurbishment/extension – footprint area 1000m²

Exposed element	Exposed surface area (m²)	U-value (W/m²K)	Rate of heat loss (W/K)
Roof	800 (80%)	x 0.20	160.0
Rooflight (max. allowable area)	200 (20%)	x 1.80	360.0
Total rate of heat loss			520.0

The rate of heat loss from the roof element of the proposed refurbishment/extension (A) is less than that from the notional extension (B). The revised proportions between roof and rooflight have followed the guidance to Clause 6.2.10 of the Technical Standard.

Note. Section 6 of the Standard recommends consultation with the verifier of the relevant local authority at the time of application for the initial building warrant or at an early stage of the project.

6 Refurbishment – Scotland
Overview of the requirements

6.4 Alterations

Reconstruction of elements

Section 6.2.8 of the Standard states that where the element forming part of the insulation envelope is to be altered or replaced the opportunity should be taken to improve the level of thermal insulation. Column (a) of Table 10 gives 'benchmark' U-values that in many cases can be achieved without technical risk, within the constraints of the existing construction.

The Standard recognises that there are certain constructions that lend themselves better than others as candidates for upgrading. Where it is inappropriate for these changes to be made, due to reductions of internal space or by causing excessive enabling alterations or impact on other building standards, worse levels may be acceptable. The Standard states that 'there are not many cases however, where after an alteration to the insulation envelope, a roof or wall cannot achieve the values given in column (b) of Table 10.

When an alteration is carried out, attention should be paid to limiting thermal bridging at junctions and around openings and also limiting air infiltration

Infill of openings

Where the opening is less than 4m^2, the infill should match the thermal performance of the surrounding fabric and not be worse than 0.35W/m^2K for a roof and 0.7 W/m^2K for a wall.

In the case of larger openings the infill should achieve the values in column (a) of table 10, or by compensating for the energy efficiency deficit by improving the U-value of other parts of the envelope.

Additional guidance

Section 6.2.8 of the Standard also give guidance on the creation or replacement of windows and where internal parts or elements become part of the insulating envelope.

7 Shell and fit out buildings
Requirements – England and Wales and Northern Ireland

The Notional Building assumes that the most energy intensive fit out specifications will be adopted throughout where a building is proposed as a shell and core building – e.g. as building development or business park units – where space is to be offered with a range of service options.

Spaces that have the potential for fitting out without air-conditioning should also have 'appropriate' control measures to limit solar gains.

If a speculative shell and core office building has the potential to be fitted out as heated and naturally ventilated or air-conditioned, the BER and TER at completion will be based on assuming that air-conditioning will be installed throughout. The shell and core building should also meet the criterion for measures to limit solar gains above.

If a speculative shell and core office building has the potential to be fitted out as heated and naturally ventilated or air-conditioned, the compliance calculations will be based on assuming that air-conditioning will be installed throughout.

Guidance on ways of showing how fit out works comply is given in AD-L2B and Part F2. These are summarised in Section 5.7 of this document – Consequential Improvements on installing building services. The specific requirements are:

- For walls a U-value no worse than 0.35 W/m^{2}K
- For roofs a U-value no worse than 0.25 W/m^{2}K
- For rooflights a U-value no worse than 3.3 W/m^{2}K
- Solar control provisions
- Lighting system provisions to reduce the lighting load and any space cooling demand

8 Shell and fit out buildings
Requirements – Scotland

Shell and fit out projects may be treated in two ways when applying for a building warrant.
A. As a staged application with the internal fit out being at a final stage.
B. With separate warrants for the shell and fit out.

A. Staged applications

The staged application approach can be of benefit when the eventual building occupier and building use are not known.

Under staged applications the building design and construction should meet the requirements for 'New Build' set out in Section 6 of the Technical Standard (2006) including satisfying the compliance calculation method, SBEM or equivalent – see sections 3 and 4 of this Guide – at the final stage.

Internal fit out is the final stage of the shell and fit out. A Completion Certificate can only be submitted/ accepted once all the works have been completed.

NOTE: Section 6 of the Standard recommends consultation with the verifier of the relevant local authority on shell and fit out issues at the time of application for the initial building warrant.

B. Separate warrants for shell and fit out

Under the separate warrant approach the building design and construction for the shell should meet the requirements set out in # 6.2.3 of Section 6 of the Technical Standard (2006), the details of which for the building envelope are set out below.

Completion Certificates are submitted for both the shell and the fit out warrants, with the shell being subject to a continuing requirement confirming that the building may not be used until the Completion Certificate for the fit out has been accepted. No Completion Certificate or authorisation of temporary use certificate can be accepted / issued at the completion of the shell.

Building element requirements under shell and fit out – separate warrants

New buildings which have been constructed as a shell for later fit out that are not the subject of a staged building warrant should meet the maximum U-values for building elements of the insulation envelope as given in table 12 column (a).

The values are lower (better) than the requirements set for new build.

Localised areas of the same type of element may be designed to give a poorer performance. These in turn will need to be compensated by the rest of the element being designed and built to a more demanding level. These areas should be better than the figures given in Table 12 column (b).

No compensatory arrangements, such as those allowed for refurbishment projects, are allowed for shell and fit out projects..

Table 12. U-values for shell and fit out buildings

Maximum U-values (W/m²K) for building elements of the insulation envelope		
Type of element (excluding separating walls and separating floors)	(a) Area weighted average value for elements of the same type	(b) Individual element U-value
Wall	0.25	0.7
Roof [Insulated panels]	0.16	0.35
Floor	0.22	0.7
Windows, doors, roof windows and rooflights	1.8	3.3

The maximum allowable opening areas of the shell and fit out building should be designed in accordance with Table 13

Table 13. Maximum window and rooflight areas for shell buildings

Building type	Rooflights as % of area of roof	Windows and doors as % of exposed wall
Industrial and storage buildings	20%	15%
Offices, shops and buildings for entertainment and assembly	20%	40%
Residential buildings (non-domestic)	20%	30%
High usage entrance doors and display windows and similar glazing	As required	

NOTE: Section 6 of the Standard recommends consultation with the verifier of the relevant local authority on shell and fit out issues at the time of application for the initial building warrant.

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EPIC was set up in 1991 to promote quality roofing and cladding systems through the use of factory-engineered panels. Insulated panels maximise thermal efficiency whilst reducing the risk and effects of condensation and significant energy loss through air leakage.

The new building regulations and today's cost competitive and quality conscious environment require that industrial and commercial buildings are high performance designs working with maximum efficiency and minimum running costs. Rigid urethane insulated panels allow designers to achieve these goals with confidence and minimum risk.

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Download information from the EPIC website
This guide on the compliance of buildings in accordance with the 2006 Energy Conservation Regulations can be downloaded from the EPIC website at **www.epic.uk.com**

EPIC have also published a series of other Guides including:
– Fire safety, Specification and Installation of Insulated Panels
– Insulated Panels, The Fire Safety Order (2005)
These guides are available in hard copy form and through the website.

Information on CD Rom
EPIC has produced two CD Roms that provide comprehensive information on the design and performance of Insulated Panels used as the roofs and walls of buildings. These can be ordered directly from EPIC or through the EPIC website.
– Guide to the performance of insulated cladding systems: The CD covers cladding problems and solutions: thermal design and performance: and design detailing.
– Insulated cladding systems – performance in fire: The CD provides essential data about the fire performance of external cladding panels based on extensive research programmes.

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