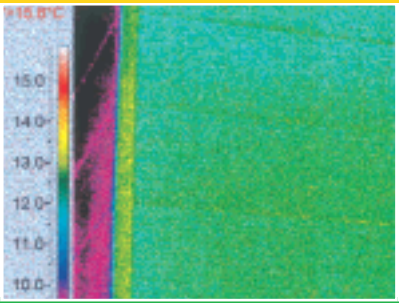
EPIC
ENGINEERED PANELS IN CONSTRUCTION

Insulated panels for external roof and wall cladding





Amendments to Building Regulations Part L2 (England and Wales) and Part J (Scotland)

Guide to requirements and compliance

Foreword

The guide summarises the requirements of the new amendments as they specifically relate to insulated panel systems and cladding systems in general.

In particular it identifies where changes of approach are required by architects, designers and installers to provide energy efficient industrial and commercial buildings that fully comply to AD-L2 and Part J.

The guide sets out a series of clearly defined steps, which are designed to minimise the risk of non-compliance.

Requirements of the new amendments will affect both design and installation

The amendments to the Building Regulations Part L2 and Technical Standards Part J, together with the complementary reference documents (*), introduce a number of major changes that directly affect the design and installation of all insulated metal roofing and cladding systems including insulated panels.

The new regulatory approach is to reduce building energy consumption by tackling five principal areas:

i) Through significantly higher insulation performance standards – U-values

ii) Through the introduction, for the first time, of building envelope air leakage limits (AD-L2 only)

iii) Provision of insulation continuity

iv) Limiting, by calculation, the effect of thermal bridging. (AD-L2 only)

v) Post construction thermal imaging and air infiltration testing (AD-L2 only)

Refurbishment of existing buildings also comes under the requirements of AD-L2 and Part J (see Appendix and Section 12 respectively).

(*) AD-L2 makes reference to MCRMA Paper 14 and BRE Information Paper IP17/01; and Part J (Scotland) to BRE Paper 262 for certain compliance requirements.

Amendments to the Building Regulations Approved Document L2 (AD-L2) – England & Wales)

Part L of the Building Regulations (2000) has been amended as part of the Government's programme to reduce the affects of global warming by limiting the greenhouse gas emissions from buildings, transport and industry.

Building energy use, specifically heating, cooling and lighting accounts for approximately half of the UK's greenhouse gas emissions. Improving energy efficiency is therefore critical and construction is required to play a major part in achieving the government's targets.

The aim of the amendment to the Building Regulations 2000 (England & Wales) Approved Document L2 is to improve the thermal performance of buildings by approximately 25-30% with a corresponding reduction in CO_2 emissions.

Reducing energy loss from buildings other than dwellings will be achieved in England & Wales through AD-L2 which came into force on 1st April 2002. The requirements for compliance are set out in Sections 1 to 11 and for Material Alterations in the Appendix.

Amendment to Building Standards (Scotland) Regulations 1990 Part J (Conservation of Fuel and Power)

The Scottish Technical Standard has been amended in parallel with AD-L2

The revisions to Part J are in general the same as AD-L2 with certain significant differences. The requirements for compliance are set out in Section 12.

Reducing the energy losses from buildings will be achieved through the amendments to Part J, which came into force on 4th March 2002.

Contents

Download information from the EPIC website

This Guide to the Amendments to the Building Regulations – Design, Installation, Testing and Compliance, together with other EPIC Guides can be readily downloaded from the EPIC website at www.epic.uk.com

1 Implications of the new regulations
England & Wales

AD- L2 introduces a number of important changes that will have a significant impact on metal roofing and cladding specifications and installation methods.

1.1 Reduced heat loss by improving U-values

Under the amendments the U-values required for roofs and walls are significantly improved, which results in substantially thicker roof and wall zones.

This has a direct implication on the design of junctions and details and will require a revised method of construction and attention to detail both for insulated panel systems and site-assembled systems. (Sections 9 & 10).

Roof thicknesses will increase to about 80 mm for insulated panel systems and can be as much as 170 mm for site-assembled systems.

1.2 Thermal bridges

More vigorous methods have been introduced for calculating the effect of thermal bridges and edge details when determining the U-values for the plane areas of the building envelope.

In the case of insulated panel systems, this has no direct implication for designers as the influence of edge details are generally taken into account in the U-values provided by the panel manufacturer.

However the new methodology has to be taken into account by the designer in the case of multi-part site assembled constructions.

1.3 Thermal transmittance at junctions & details

The amendments require that specific attention be given to thermal bridging at every junction, detail and opening. A new linear transmittance value (ψ) or 'Psi-value' has to be calculated for each detail. These psi-values are then used by the designer to calculate the overall linear transmittance loss for the building and the heat loss ratio 'α' (Section 5) to show compliance of the envelope with AD-L2.

Designers can use the computer generated finite analysis values provided by the insulated panel system manufacturers for their standard details. Alternative details will require separate computer analysis. The concept of design on site 'as-you-go' may result in non-compliance.

1.4 Risk of condensation

The amendment includes measures to reduce the risk of condensation. This requires that a temperature factor (f-value) is calculated for each detail or junction which should be greater than the stated value for four generic building types/humidity classes. (Section 6)

The f-values are generally provided by the insulated panel system manufacturers for their standard details.

1.5 Air leakage through the building envelope

The amendment introduces new measures to limit air leakage through the building envelope.
Air movement through extraneous air paths must be limited as far as practical.

Methods to achieve this include incorporating sealing measures and providing a reasonably continuous air barrier in contact with the insulation layer over the whole surface.

Of all the new measures introduced by Amendment L2 the air leakage requirement has the most significant implications for designers and contractors as retrospective correction procedures are complex, costly and often unsightly.

Air tightness presents the greatest challenge and also the greatest risk and needs to be addressed at the earliest stages of the design process.

1.6 Tests to demonstrate compliance

Compliance may be demonstrated through the use of standard approved details that have been generated by approved finite analysis programmes.

Evidence of compliance can also be demonstrated by testing. The two principle forms of testing introduced in AD-L2 are Air Permeability testing (Section 7) and continuity of insulation by conducting a thermographic survey (Section 8).

Air tightness testing is mandatory for all buildings over 1000 m^2 floor area.

EPIC recommends

that thermographic surveys are undertaken as part of the compliance programme.

2 Compliance with the new regulations
England & Wales

Five Steps to compliance

The five essential steps to designing and installing roof and wall cladding systems to comply with the new requirements of AD-L2 and minimise risk are summarised below and covered in detail in the following sections.

Step 1 Meeting the requirements for insulation performance (See Section 3)

New minimum insulation requirements (U-values) are set out in AD-L2. These list thermal transmittance values for the main plane areas – roofs, walls, windows, doors, rooflights etc.

The minimum values are significantly higher than the previous requirements with the result that the roof or wall 'zone' can increase in thickness by up to 100%. Increasing the thickness of the roof or wall system has practical implications for design detailing and contracting.

Trade-off rules apply between plane and glass areas but additional checks are required to confirm conformity for the total building.

The combined total heat loss for all the elements is then used in the formula to calculate the new 'α' conformity ratio 'alpha value' for the whole building (see step 3 below).

New Requirement

Step 2 Design requirements to limit thermal bridging (see Section 4)

Designers are required to limit the effect of thermal bridging. This means that the linear thermal transmittance factor, ψ or psi-value, for all details and junctions on the project has to be calculated by computer and used in a new compliance ratio for the total building (see step 3).

New Requirement

Step 3 Conformity of the whole building fabric (see Section 5)

For industrial and commercial buildings, designers are required to check that the sum of the heat loss at junctions/details (step 2) is not more than 10% of the heat loss through the plane areas (step 1). This ratio is termed the 'α-value' for the building fabric

If this cannot be achieved by changes to the design or the detail, then compliance may be proven through the 'notional building' approach (see 5.5).

New Requirement

Step 4 Design to limit the risk of condensation (see Section 6)

Designers are required to show that the design details at junctions and intersections do not constitute a condensation risk for the anticipated building use.

Minimum levels for the condensation f-factor are determined in according to the humidity class of the building (see Table 8, page12).

New Requirement

Step 5 Limiting air leakage through the building envelope (see Section 7)

AD-L2 requires that air leakage shall be limited to a maximum volume of 11.5$m^3/h/m^2$ (10$m^3/h/m^2$ in 2003).

This requirement includes floors as well as external roofs and walls and applies to the total building envelope including the junctions between all the elements.

Proof of conformity is by pressure testing on all buildings above 1000m^2 floor area.

3 Requirements for insulation performance
England & Wales

3.1 Requirements of AD-L2

Three design methods are permitted for demonstrating compliance with the standard. All involve integration of the design and construction of the building fabric and the design and operation of HVAC services.

The methods are:

a) Elemental Method:

This method considers the performance of each aspect of the building individually. To comply with the provisions of AD-L2, a minimum level of performance should be achieved in each of the elements. Some flexibility is provided for trading off between different elements of the construction, and between insulation standards and heating system performance.

This is the preferred method for insulated panel systems – see 3.2 below.

b) Whole Building Method:

This method considers the performance of the whole building.

For office buildings, the heating, ventilation, air conditioning and lighting systems should be capable of being operated such that they will 'emit no more carbon' per square metre per annum than a benchmark based on the ECON 19 data. Alternative methods are also provided for schools and hospitals.

c) Carbon Emissions Calculation Method:

This method also considers the performance of the whole building, but can be applied to any building type. To comply with the provisions of AD-L2, the annual carbon emissions from the building should be no greater than that from a notional building that meets the compliance criteria of the Elemental Method. The carbon emissions from the proposed building and the notional building need to be estimated using an appropriate calculation tool.

AD-L2 contains a guide to the use of all three compliance methods.

3.2 The Elemental Method

In practical terms, the elemental method is the preferred method for proving compliance for metal clad industrial and commercial buildings.

To comply with AD-L2 following the Elemental Method, the building envelope has to provide certain minimum levels of insulation of each element. These are illustrated in Figure 1.

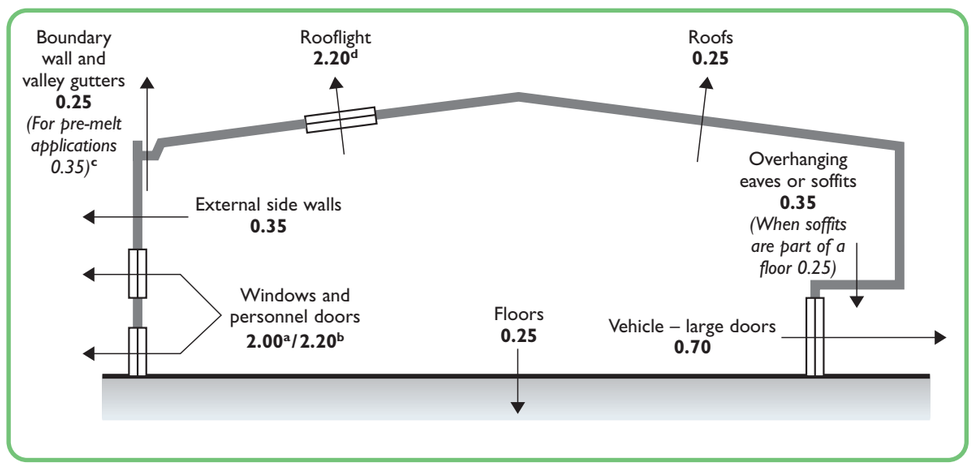


Figure 1. Standard U-values (W/m²K) for insulated metal roof and wall cladding systems – AD-L2 Elemental Method

Notes

a. If windows have wood or PVC frames

b. If windows have metal frames

c. For pre-melt gutter specifications obtain building control approval at design stage

d. Rooflights may be permitted up to 12% of roof area at 3.0W/m²K by using the 'Whole building' or 'Carbon emission' method of calculation, however, there is a significant risk of condensation.

The requirements will be met if the thermal performances of the construction elements are no worse than the values given in Table 1.

Table 1. Standard U-values of construction elements – AD-L2

Construction element	U-value W/m²K
Roof with integral insulation (1)	0.25
Walls including basement walls	0.35
Floors including ground/basement floors	0.25
Windows, roof windows & personnel doors – glazing in metal frames (2)	2.2
Windows, roof windows & personnel doors – glazing in wood/pvc frames (2)	2.0
Rooflights	2.2
Vehicle access and similar large doors	0.7

(1) Insulated panels are regarded as having integral insulation
(2) Area weighted average for the whole building

3.3 Maximum areas of windows, doors and rooflights

AD-L2 states that provision should be made to limit the rate of heat loss through glazed elements of the building.

One way of demonstrating compliance is if the total area of windows, doors and rooflights does not exceed the values given in Table 2 below, unless compensated for in some other way.

Table 2. Maximum area of openings – AD-L2

Building type	Windows and doors as a % of the area of exposed wall	Rooflights as % of roof area
Places of assembly, offices and shops	40%	20%
Industrial and storage buildings	15%	20%
Vehicle access doors	As required	As required

In addition AD-L2 requires that solar gain should be limited through the appropriate specification of glazing. A way of achieving compliance for spaces with glazing facing in one direction, i.e. rooflights, would be to limit the area of glazed opening as a percentage of the internal area of the element – Table 3.

Table 3. Maximum allowable area of glazing (taken from AD-L2 Table 4)

Orientation of opening	Maximum allowable area of opening (%)
Horizontal	12

3.4 Rooflights

AD-L2 increased the required insulation level for rooflights to 2.2W/m²K at a maximum of 20% of the roof area. This can be met by the use of triple-skin rooflights. Triple-skin rooflights are generally necessary where the rooflight area exceeds 14%.

Installation of 10%-12% of factory insulated triple-skin rooflights achieves the correct level of heat retention and energy conservation at the same time allowing a margin for junction details and site-built quality.

EPIC recommends

the use of triple-skin rooflights in conjunction with insulated panel systems

Double skin rooflights have a typical U-value of 3.1W/m²K, which significantly increases the heat loss per unit area. The internal temperature of double skin rooflights will be significantly lower, which can cause condensation risk.

3.5 Trade off between construction elements

In order to provide greater design flexibility, the U-values of construction elements and the areas of windows, doors and rooflights may vary from Tables 1-2 provided that suitable compensation measures are taken.

If glazing areas are reduced from those in Table 2, special care needs to be given to confirm that levels of daylight are adequate. (Guidance on designing for daylight is contained in CIBSE LG10).

Additional constraints on trade off and rules concerning compliance of revised U-values of roof and wall elements are detailed in clauses 1.15 and 1.16 of AD-L2.

New Requirement

4 Limiting thermal bridging – linear heat transmission – ψ (Psi)-value
England & Wales

4.1 Introduction

AD-L2 requires that specific attention is given to heat loss through thermal bridging at every junction, detail and opening.

Heat loss is determined for each detail using a sophisticated computer programme involving a finite element analysis calculation of that specific detail.

4.2 Linear thermal transmittance (ψ-value)

Heat loss through linear thermal bridges or construction details is expressed in terms of the linear thermal transmittance or ψ-value and is calculated using a two-dimensional thermal model to determine the heat flow from the inside to outside.

4.3 Compliance of ψ-values

Calculation of the ψ-value for details and junctions is complex requiring a specialised computer programme to assess the detail in its entirety, not just separate components. The standard details developed by most insulated panel manufacturers for their systems have been substantiated on certified computer software.

It is not accurate or permissible for compliance purposes to assume that ψ- values from other 'similar' details can be used for compliance calculations. They should be regarded as guidance values only.

4.4 ψ-values at the design stage

The heat loss at a detail/junction is expressed as ψ.L where L is the linear length of the detail in metres. The sum of the heat loss at all the junctions in the building (Σψ.L) is then used by the designer or a competent person in calculating the numerical ratio 'α' for the whole building to show compliance with AD-L2. (see Section 5)

The majority of ψ- values for standard insulated panel details are numerically quite low and should not result in non-compliance when the 'α' check for the building is made.

However designers should make themselves aware of those details that generally have both high values and are associated with long lengths resulting in a large ψ.L value. The following elements fall into that category:

- Gutters – ψ can range from 0.9 to 0.13.
- Drip details specifically at the foot of elevations, at dado walls etc.

EPIC recommends

that designers use the certified standard details provided by the insulated panel system manufacturers. (Example, see Figure 2) Also that a spreadsheet should be set up at an early stage in a project to establish a running total for ψ.L (see Table 4).

Building Regulations Part L2 Thermal Data

f_{min} = 0.97 ψ = 0.004

The above values are only applicable to the components on this detail. Changes to the components will have an effect on the given values.

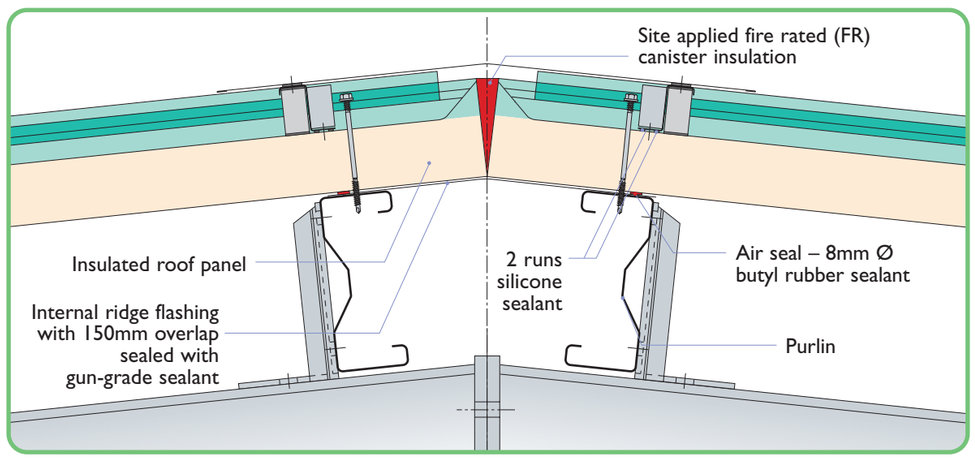


Figure 2. Example of typical detail with associated 'ψ' & 'f' values

New Requirement

5 Heat loss ratio for the building fabric – α-value
England & Wales

5.1 Conformity of the whole building fabric

For industrial and commercial buildings, designers are required to check that the sum of the heat loss (Σψ.L) at junctions/details is not more than 10% of the heat loss through the plane areas (ΣA.U). This ratio is termed the 'α-value' for the building fabric.

$$\alpha = \frac{\Sigma\psi.L}{\Sigma A.U} = \frac{\text{(sum of heat loss at junctions)}}{\text{(sum of heat loss through plane areas)}}$$

α < 0.1 for compliance

The α-value must be calculated by the building designer, architect or competent person and take into account the plane areas and junctions of non-metallic elements as well as the metal claddings.

Alternative check for compliance.

Compliance can also be proved by comparing the total heat loss (Σ ψ.L + Σ A.U) of the project building with that of a 'notional building' of the same dimensions – see 5.5.

5.2 Building A – example of compliance

The following example calculation for 'α' compliance is based on a typical industrial building of 2400m² footprint area. Taking the values for Σψ.L from Table 4 and the values of ΣA.U from Table 5, the calculation of 'α'_A' for Building A is shown below.

Table 5. Calculation of elemental U-values (A.U): Example Building A

Element	Area (m^2)	U-value (W/m^2K)	A.U (W/K)
Total roof area	2647.00	–	–
Roof	2382.30	0.25	595.58
Rooflights (10%)	264.70	2.20	582.34
Total wall area	1194.80	–	–
Exposed walls	1164.80	0.35	407.68
Windows & personnel doors	14.00	2.00	28.00
Vehicle unloading bay doors	16.00	0.70	11.20
Ground floor	2400.00	0.25	600.00
		Actual ΣA.U =	2224.80

$$\alpha_A = \frac{\Sigma\psi.L}{\Sigma A.U} = \frac{139.71}{2224.80} = 0.063$$

Table 4. Calculation of ψ.L values: Example Building A

Object name	Length (m)	ψ value (W/mK)	L.ψ (W/K)
A. Ridge	120.00	0.004	0.48
B. Eaves	120.00	0.11	13.20
C. Verge	80.00	0.01	0.80
D. Valley gutter	60.00	0.13	7.80
E1. Cladding drip	195.00	0.25	48.75
E2. Ground floor*	195.00	0.16	31.20
F. Corner	24.00	0.01	0.24
G1. Cladding window or personnel door head	34.00	0.61	20.74
G2. Window frame head*	30.00	0.04	1.20
G3. Personnel door head*	4.00	0.04	0.16
H1. Cladding window cill	30.00	0.07	2.10
H2. Window frame cill*	30.00	0.04	1.20
I1. Window & personnel door jambs	20.00	0.08	1.60
I2. Window frame jambs*	4.00	0.04	0.16
I3. Personnel door jambs*	16.00	0.04	0.64
J1. Cladding head to vehicle bay door	4.00	0.62	2.48
J2. Vehicle unloading bay door head*	4.00	0.04	0.16
K1. Cladding jamb to vehicle bay door	8.00	0.81	6.48
K2. Vehicle unloading bay door jambs	8.00	0.04	0.32
* Assumed value		Σψ.L =	139.71

This example shows that α_A is less than 0.10 and therefore complies with the requirements of AD-L2

5 Heat loss ratio for the building fabric – 'α'-value
England & Wales

5.3 Building B – illustration of non-compliance

Building B is assumed to be of the same footprint area as Building A but with different details, in particular the valley gutter and the cladding drip, which have a higher ψ-value and a long linear length. This results in a significant increase in Σψ.L – Table 6

Taking the new values for Σψ.L from Table 6 and the values of ΣA.U repeated as before from Table 5, the calculation for 'α'_B is shown below:

Table 5. Calculation of elemental U-values (A.U): Example Building B.

Element	Area (m^2)	U-value (W/m^2K)	A.U (W/K)
Total roof area	2647.00	–	–
Roof	2382.30	0.25	595.58
Rooflights (10%)	264.70	2.20	582.34
Total wall area	1194.80	–	–
Exposed walls	1164.80	0.35	407.68
Windows & personnel doors	14.00	2.00	28.00
Vehicle unloading bay doors	16.00	0.70	11.20
Ground floor	2400.00	0.25	600.00
		Actual ΣA.U =	2224.80

Table 6. Calculation of ψ.L values: Example Building B.

Object name	Length (m)	ψ value (W/mK)	L.ψ (W/K)
A. Ridge	120.00	0.004	0.48
B. Eaves	120.00	0.10	12.00
C. Verge	80.00	0.01	0.80
D. Valley gutter*	60.00	0.83	49.80
E1. Cladding drip	195.00	0.60	117.00
E2. Ground floor*	195.00	0.16	31.20
F. Corner	24.00	0.01	0.24
G1. Cladding window or personnel door head	34.00	0.62	21.80
G2. Window frame head*	30.00	0.04	1.20
G3. Personnel door head*	4.00	0.04	0.16
H1. Cladding window cill	30.00	0.10	3.00
H2. Window frame cill*	30.00	0.04	1.20
I1. Window & personnel door jambs	20.00	0.08	1.60
I2. Window frame jambs*	4.00	0.04	0.16
I3. Personnel door jambs*	16.00	0.04	0.64
J1. Cladding head to vehicle bay door	4.00	0.62	2.48
J2. Vehicle unloading bay door head*	4.00	0.04	0.16
K1. Cladding jamb to vehicle bay door	8.00	0.71	5.68
K2. Vehicle unloading bay door jambs	8.00	0.04	0.32
* Assumed value		Σψ.L =	249.20

$$\alpha_B = \frac{\Sigma\psi.L}{\Sigma A.U} = \frac{249.20}{2224.80} = 0.11$$

This example shows that for Building B 'α_B' is greater than 0.10 and therefore does not comply with the requirements of AD-L2

5.4 Actions in cases of non-conformity

a) It may be possible to amend the junction details and to reduce the levels of heat loss (ψ.L) until the 10% threshold is achieved.

b) In some cases it may not be possible or economical to amend the detailing to achieve the necessary reductions in ψ.L. In such situations an alternative procedure may be followed by comparing total heat losses for the project building with those of a 'notional building' of the same size and configuration – see 5.5.

This methodology can provide a significantly easier route to compliance for many buildings.

5.5 Alternative means of proving compliance using a 'notional building'

BRE Information Paper 17/01, to which AD-L2 makes direct reference, permits compliance to be proven via a trade off calculation.

If the project building does not contain the full allowable percentage of rooflights (20%) and windows/personnel doors (15% in industrial/ storage buildings, or 40% in places of assembly/ offices/shops) and these allowances have not been traded off elsewhere, then they can be used as a trade off to re-calculate the heat loss through the plane elements ΣA.U.

Table 7 takes the example building in Table 5 recalculated as a notional building of the same size and configuration but using the maximum allowable 20% rooflights and 15% windows/doors. The total heat loss of the plane areas is then calculated as before.

Table 7. Example Building B. Heat loss through the plane elements re-calculated as a 'notional' building

Notional building element	Area (m^2)	U-value (W/m^2K)	Heat loss
Total roof area	2647.00	–	–
Roof	2117.60	0.25	529.40
Rooflights (20%)	529.40	2.20	1164.68
Total wall area	1194.80	–	–
Exposed walls	999.58	0.35	349.85
Windows & personnel doors (15%)	179.22	2.00	358.44
Vehicle unloading bay doors	16.00	0.70	11.20
Ground floor	2400.00	0.25	600.00
		Total heat loss (C)	3013.57

Comparison between example building B and notional building:

Example building B

The total heat loss for the project building is the sum of the heat loss through the junctions (Σψ.L) and the heat loss through the plane elements (ΣA.U).

Heat loss through the junctions Σψ.L from Table 6 = 249.20

Heat loss through the plane elements ΣA.U From Table 5 = 2224.80

Total heat loss for Building B 2474.00

Notional building

From Table 7 ΣA.U for the notional building is 3013.57. To this a 10% allowance for heat loss through the notional junctions has to be added in order to arrive at the total heat loss for the notional building.

Heat loss from Table 7 = 3013.57

Additional 10% allowance for junctions = 301.36

Total heat loss for the notional building 3314.93

Compliance

From the above comparisons, the total heat loss for example building B is less than for the equivalent notional building and therefore the requirements of IP 17/01 and AD-L2 are satisfied.

New Requirement

6 Limiting the risk of condensation- minimum temperature factor (f)
England & Wales

6.1 Calculation

AD-L2 requires that details are designed to limit the risk of condensation and mould growth.

To determine the risk of condensation or whether mould growth will occur it is necessary for all details to satisfy a minimum temperature factor (f), which is calculated by modelling the structure or detail.

A new Standard BS EN ISO 13788:2001 contains calculation procedures for surface and interstitial condensation risk and also a method for calculating the necessary thermal quality of building envelopes to avoid condensation or mould growth.

The Standard defines a methodology for establishing surface temperature criteria appropriate for industrial buildings and metal cladding details. From this a surface temperature factor (f) can be measured or calculated.

6.2 Building humidity classes

The Standard also categorises buildings into a number of 'climate classes' depending upon their likely environment. Different building types fall into different classes as shown in Table 8 together with minimum temperature factors above which there is unlikely to be a risk of condensation.

Table 8. Internal humidity classes for non-domestic buildings

Humidity class	Building type	Minimum (f) value
1	Storage areas	0.30
2	Offices, shops	0.50
4	Sports halls, kitchens, canteens, buildings heated with un-flued gas heaters and dwellings with high occupancy	0.80
5	Special buildings, e.g. laundry, brewery, swimming pool	0.90

6.3 Compliance

The f-factor for the design detail (see Figure 2 as an example) shall be greater than the minimum value for the humidity class for the building.

Insulated panel manufacturers generally provide f-factors for their standard details to enable designers to confirm that the design detail exceeds the minimum value for the anticipated building use as described in Table 8.

Details outside the range of standard details or which are site designed or assembled should be calculated individually.

EPIC recommends

Most standard metal cladding details satisfy the minimum f-factor requirements for classes 1 and 2. Details should always be checked for projects designated under other humidity classes.

New Requirement

7 Air tightness – requirements testing and compliance
England & Wales

AD-L2 lays particular stress on the importance of achieving a reasonable standard of air tightness and contains general advice on appropriate sealing measures to achieve the requirements.

Sections 7.2 – 7.5 describe in detail the requirements and tests for compliance as set out in AD-L2. These are mandatory requirements.

7.1 Air tightness – challenge and risk

Building envelope air leakage is defined as the uncontrolled movement of air through the external fabric and is caused by a combination of wind, stack effect and mechanical systems, which produce varying pressures on the envelope.

It is estimated that air leakage is the single greatest contributor to energy loss and accounts for more than 50% of space conditioning energy costs in non-domestic buildings. This percentage rises with improving insulaton standards of the plane elements as less heat is lost by conduction.

Only a few construction sectors e.g. food, electronic, pharmaceutical currently design to specific air tightness standards.

For the majority of commercial and industrial buildings, air tightness criteria are not currently written into specifications. The concept of air tightness introduced by AD-L2 is a challenge requiring new disciplines for both designers and contractors with a high potential risk if disregarded.

Over 50% of buildings constructed before 2002 would fail the air permeability requirements of AD-L2.

Studies carried out by BSRIA (Building Services Research and Information Association) indicate the average air permeability for non-domestic buildings is 21.8$m^3/h/m^2$ (AD-L2 requires 10$m^3/h/m^2$).

For industrial buildings alone the average worsens to 25-30 $m^3/h/m^2$ with levels as high as 35$m^3/h/m^2$ not being uncommon.

7.2 Requirements of AD-L2

Building Standard AD-L2 introduces for the first time a mandatory requirement to ensure a reasonable standard of air tightness is achieved and to demonstrate compliance by:

- showing that appropriate design detail and building techniques have been used
- or for all buildings over 1000m^2 gross floor area by undertaking an air permeability test

Metal roof and wall claddings are only one of the elements comprising the external envelope, which may contribute to air leakage. Analysis has shown that junctions and openings are the more important contributors to air leakage e.g. at doors, windows, loading bays, vents and penetrations.

AD-L2 suggests various measures if the requirements of the air leakage standard are to be achieved:

i) Buildings should be reasonably airtight to comply with the air leakage standard to avoid unnecessary space heating and cooling demand and to enable the effective performance of ventilation systems.

ii) The need to provide for adequate ventilation for health (Part F) should be particularly taken into account.

iii) A way of meeting the requirement would be to incorporate sealing measures to achieve the performance standard given in 'Certificates & Testing' (see 7.3 below). Some ways of achieving satisfactory air tightness include:

– providing a reasonably continuous air barrier in contact with the insulation layer over the whole thermal envelope (including separating walls). Special care should be taken at junctions between elements and around door and window openings.

– sealing gaps around service penetrations.

– draught-proofing external doors and windows

Insulated panel manufacturers provide specific guidance on achieving air tightness including robust details and good installation practice. The information also covers junctions between insulated panels and other envelope elements – brick/masonry, glazing, doors – and for all major panel junctions.

7 Air tightness – requirements testing and compliance
England & Wales

Figure 3. Air pressurisation testing equipment

7.3 Compliance and testing

7.3.1 Buildings less than 1000m²

Air barriers should be installed to minimise air infiltration through the building fabric. Certificates or declarations should be provided or obtained by the person carrying out the work, stating that:

a) appropriate design details and building techniques have been used

and

b) the work has been carried out in ways that can be expected to achieve reasonable conformity with the specifications that have been approved for the purposes of compliance with AD-L2.

Certificates or declarations such as those mentioned above may be accepted by building control bodies as evidence of compliance. The building control body will, however, wish to establish, in advance of the work, that the person who will be giving the certificates or declarations is suitably qualified.

7.3.2 Buildings with a floor area greater than 1000m²

Compliance for all buildings with a gross floor area greater than 1000m² (or buildings of any size) is demonstrated by the results of air leakage tests carried out accordance with CIBSE TM 23.

When using the CIBSE TM 23 pressure test procedures as the means of showing compliance the regulatory requirements are:-

a) With effect from 1 October 2003, test results showing that the air permeability does not exceed 10m³/h/m² at an applied pressure difference of 50pa.

b) In the period up to and including 30 September 2003 in the event that initial test results are unsatisfactory, reasonable provision would be that after appropriate remedial work further tests must show:

i) an improvement of 75% of the difference between the initial test result and the target standard of 10m³/h/m² at 50pa;

or, if less demanding

ii) a performance no worse than 11.5m³/h/m² at 50pa

7.4 Test methods and test requirements

7.4.1 Fan pressurisation testing

Whole building pressurisation tests can be undertaken by utilising single or multiple fan units to induce an artificial pressure within a building. Air is supplied through the fan(s) over a range of measured flow rates and the resulting pressure differential between the building and the exterior is measured at each range.

Internal and external temperatures and the external barometric pressure are measured to allow corrections to be made for changes in the air volume flow rate. A regression analysis is carried out on the pressure differentials through the building envelope and the corrected flow rates to calculate the correction coefficients.

The air flow rate to pressurise the building to 50 pascals is then determined and converted to m³/h. This is divided by the calculated envelope area of the building to give the air permeability rate in m³/h/m².

7.4.2 Test conditions

a) The wind speed should be less than 4m/sec

b) all ventilation openings must be sealed during the test

c) all external doors and windows must be closed but not temporarily sealed to provide a realistic measurement of air leakage

d) all internal doors should be wedged open to allow rapid pressure equalisation within the building

e) combustion appliances must be switched off and any flues or supply openings temporarily sealed

f) mechanical ventilation systems must be turned off and inlet and outlet grills sealed

g) fire dampers and ventilation louvers must be closed

h) drainage traps should contain water.

Figure 4. Large building air pressurisation testing equipment

EPIC recommends

that tests are only carried out by specialist contractors. A list of specialist air pressurisation contractors can be found on the EPIC website www.epic.uk.com

7.5 Air leakage identification

Pressurisation testing of the whole building measures the total air leakage loss. The metal roof and wall cladding system is just one of the potential air leakage routes and the pressure test does not directly identify the leakage paths.

There are a number of tests that can be carried out to provide further information:

Smoke 'bombs'

The building is fully filled with smoke from large scale smoke generators. The building is then pressurised using a fan pressurisation unit which blows the smoke out through discontinuities in the external envelope so that specific leakage paths can be identified.

Note: the point of exfiltration will not necessarily correspond to the areas requiring remedial sealing

Hand held smoke generators

Hand held generators can be used to pinpoint leakage through the external envelope. They can be used to identify areas of leakage that require remedial sealing allowing targeted remedial works to be undertaken. This method can be used either before or as a result of a pressurisation test.

Infra-red thermography

Thermography can be used to identify air leakage paths with either natural driving forces acting on the envelope or with artificially induced pressures. Surveying a building from inside allows the identification of generally colder external infiltrating air, especially if there is a negatively induced pressure within the building.

External surveys can also be undertaken to identify air exfiltration paths especially when used in conjunction with positive internal pressures. However, as with the smoke 'bomb' test the point of exfiltration will not necessarily correspond to the areas requiring remedial sealing.

Selective compartmentation or testing of selected elements can assess and quantify the performance of smaller areas e.g. around doors, windows etc. This method has the advantage of specific targeting and only requiring a smaller fan.

New Requirement

8 Infra-red thermographic testing
England & Wales

8.1 Requirements of AD-L2

EPIC recommends that infra-red tests are carried out as part of the specification requirements for projects. They are recommended actions in AD-L2 but are not a mandatory requirement of the new regulations.

Infra-red thermography inspection has been incorporated within AD-L2 as one way of demonstrating compliance with the new regulations.

This is achieved by submitting evidence from an infra-red thermographic inspection which:

a) illustrates conformity by proving acceptable insulation continuity

b) identifies any areas of thermal deficiency which may require remedial attention.

c) assists in the identification of air leakage paths as part of the compliance procedures for air tightness

d) confirms design and construction build quality prior to project handover

8.2 Infra-red thermography testing

Infra-red thermography can be described as a means of producing a visual representation of the surface temperatures of the object surveyed. Under this technique large areas can be surveyed in a relatively short period by a non-destructive method of testing and visual records produced as the survey progresses.

The conditions for a successful thermographic survey are fairly restrictive and what appears to be a simple technique requires a skilled and experienced operator. Interpretation of the images requires a detailed knowledge of thermography and construction practice

8.3 Thermographic surveys and constraints

The survey should be undertaken in accordance with the relevant British Standard BS EN 13187: 1999.

A minimum internal/external temperature differential of 10°C must exist at the time of the survey.

The envelope surface areas being surveyed must be completely dry and should not have been subjected to direct solar radiation for a period of 3 to 8 hours prior to the survey (timescale depends on construction type).

EPIC recommends

that surveys are only carried out by specialist contractors. A list of specialist thermographic contractors can be found on the EPIC website www.epic.uk.com

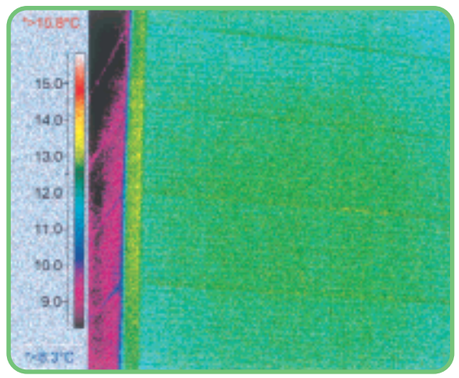


Figure 5. Infra-red image – external – wall
(solid green area showing uniformity of insulation and good air tightness over panels and joints)

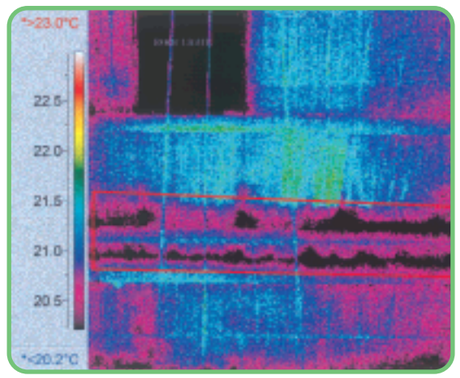


Figure 6. Infra-red image – internal – roof
(red and black areas showing discontinuous/defective insulation)

9 Designing for compliance with minimum risk
England & Wales

9.1 Introduction

Buildings will only comply and operate to AD-L2 if they are designed, constructed and commissioned to a high standard.

The design brief and specifications need to be precise and clearly communicated if the risk of non-compliance is to be avoided.

Similarly construction needs to be monitored to ensure that construction quality matches design specification and will therefore pass post-construction handover, air pressurisation testing and thermographic inspection.

The new requirements of AD-L2 increase the probability of having to remedy design and/or construction quality defects should the building not comply with the regulatory standards. This imposes additional risk on the design and construction teams and has obvious client consequences in the event of non-compliance.

9.2 Insulated panels reduce the risk of non-compliance

In addition to the well recognised benefits accruing from the use of a single-piece, factory engineered panel of speed, cost, security etc, Insulated Panels also assist in reducing the risk of non-compliance against AD-L2 through:

- Guaranteed insulation values for the roof and wall elements
- Accurate computed U-values for the panel system including joints and fixings for use with the elemental calculation method
- Guaranteed continuity of insulation
- Approved robust details to match the panel design
- Computer substantiated 'ψ' and 'f'-values for the standard approved details

9.3 Design responsibilities for AD-L2

9.3.1 Insulation (U-value) requirements

The individual U-values for the roof and wall 'plane' elements should be determined together with rooflights or glazing requirements, and the degree of solar gain calculated. Potential trade off between elements should be considered at this stage.

The effect of the panel-to-panel joint details and any possible cold bridges in insulated panels are generally taken care of in the panel manufacturer's calculations.

The sum of the heat losses for all the plane elements ($\Sigma A.U$) should be calculated to show compliance of the α-value for the whole building (see Section 5).

9.3.2 Thermal transmittance and condensation compliance

The designer is required to specify, or develop designs for details; junctions; gutters; penetrations; abutments; rooflights etc., which comply with the requirements for condensation risk and thermal transmittance.

The humidity class of the building should be defined according to the anticipated building use and the intended design details checked against the minimum f-factor given for that use. (Section 6)

Thermal transmittance value (ψ) should be calculated by the finite analysis method for every detail or obtained from the insulated panel manufacturer. From these values $\Sigma\psi.L$ can be calculated for the project building. (see Section 4) Particular attention should be paid to those detail elements that have a high ψ-value and long linear lengths, as these could affect compliance of the α-value (see Section 5).

It is important to obtain confirmation of ψ and f-value figures from the provider of the insulated panels that values have been calculated according to approved computer methods. Verification may be required by the 'competent person' responsible for assessing compliance.

9 Air tightness – requirements testing and compliance
England & Wales

Figure 7. Insulated panels used on a large distribution building

9.3.3 Whole building heat loss compliance (α-value)

The compliance check on the α-value is the responsibility of the designer. This check should cover all building materials and interfaces not just those directly related to insulated panels or metal cladding systems.

Project examples showing the calculation of 'α' for compliance and also alternative procedures in cases of non-compliance are set out in Section 5.

9.3.4 Air tightness compliance

The designer must determine and specify the level of air tightness required. This will be to the minimum requirements of AD-L2, or better.

The air tightness parameters should be communicated to the building services engineers for use in calculating the HVAC services. The air permeability value is also required to be included in the Building Log Book recommended by AD-L2.

Relatively few cladding contractors have experience in working to the new 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.

9.3.5 Air tightness – structural steelwork and framework tolerances

Tolerances for structural steelwork are defined in BS5950: The structural use of steelwork in building: Parts 2 & 7 1992. However no tolerances are defined for the position of purlins and cladding rails relative to the main frame and in particular no mention is made of the position of the surface of the purlins and rails to which the cladding will be fixed.

Excessive variation in this fixing plane can cause assembly problems for the cladding contractor and can affect the air tightness of insulated panel systems. As with all cladding systems, tightening up the tolerances and alignment of the structural steelwork, purlins and rails can significantly improve the air tightness efficiency at panel joints and at ancillary flashings.

The guidance tolerance for insulated panels is based on BS5950. The fixing surface of each purlin/rail should be within L/600 of the surface of the adjacent purlins/rails where L is the spacing. This equates to 3mm for a 1.8m rail spacing. The maximum variation from the theoretical cladding plane should be 20mm.

The guidance tolerances for structured 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

9.3.6 Air tightness – complex details

Where the design calls for complex details, or where remedial action to correct air leakage paths will not be possible, EPIC recommend that a sample of the detail area is made and the sealing techniques are confirmed before work commences. This is particularly important where air permeability levels below 10$m^3/h/m^2$ are specified.

9.3.7 Foams, seals and insulation

Canister foams are the preferred method for use at junction details to provide insulation continuity and as an effective air seal. Compressed rockfibre may be used for insulation continuity but will not prevent air leakage at the junction.

Tape seals, gun-grade seals and custom gaskets as well as sealant foams should be fully detailed in the specification.

Foams and seals may also be selected to provide optimum fire performance as well as air tightness. Information on suitable foams/seals suitable for long-term performance is available from insulated panel manufacturers. Only approved foams should be used.

9.3.8 Infra-red thermographic testing

EPIC recommends that designers consider the potential use of infra-red thermographic testing as a means of showing compliance of continuity of insulation at the junction/detail and the workmanship at that point.

These tests can also assist in identifying potential air leakage paths.

9.4 Building Control Compliance

Designers should liaise with Building Control to confirm that the approaches taken in the design process are satisfactory and conform to the new regulations AD-L2.

9.5 Design specification and installation

The practical demands of AD-L2 have major implications on the installation of the building envelope.

These are covered in Section 10 and particularly relate to the specification of steelwork tolerances, alignment and air tightness sealing. Designers need to take account of these issues when writing the building specification.

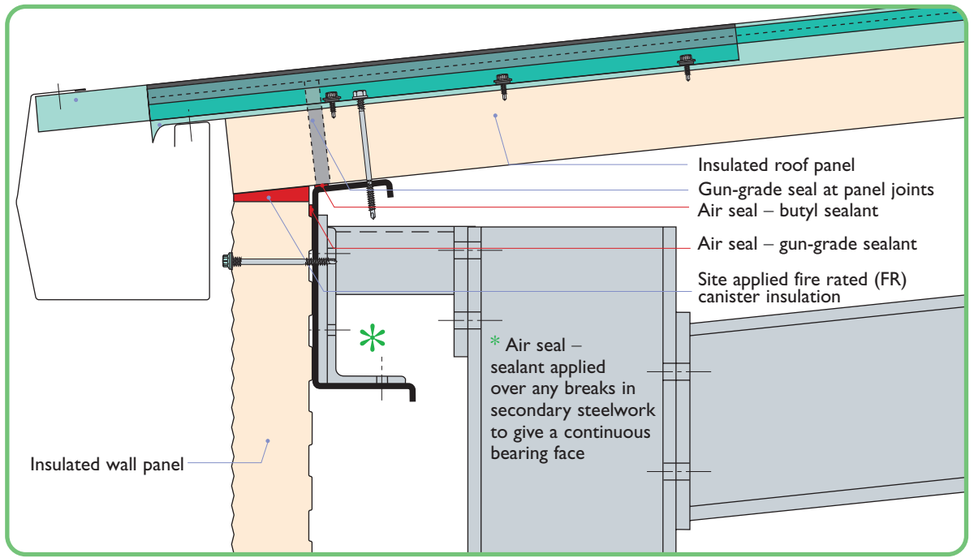


Figure 8. Typical eaves/external gutter detail showing sealing measures

10 Installation to achieve compliance with minimum risk
England & Wales

10.1 Installation to achieve compliance

Good site workmanship and installation quality are essential if the practical requirements of the new regulations and new tests to confirm compliance are to be satisfied.

Increased U-values will mean substantially thicker roof and wall systems. In the case of insulated panels the cladding industry already has considerable experience in installing panels up to 100mm in thickness. However few projects have been completed using site assembled systems requiring a roof/wall thickness of 150+mm.

Installation of the building envelope and particularly the associated detailing to meet the new air permeability levels will provide the greatest challenge and greatest risk for cladding contractors. Prior to AD-L2, only selective buildings in the food, pharmaceutical and electronics industries demanded specific air tightness levels.

Recent BSRIA research on existing buildings has shown the average air leakage rates to be more than double the AD-L2 requirements of 10$m^3/h/m^2$ and in the case of industrial buildings more than three times the permitted level.

It is clear that a more disciplined approach to installation will be required, together with extensive education and training of site supervisors and operatives to ensure compliance, reduce risk and ensure the building meets the regulations.

10.2 Thermal transmittance and heat loss values

Regulation AD-L2 covering England & Wales introduces three new values which address condensation risk and heat loss at junctions and details. ('f', 'ψ', and 'α').

These values are specific to the cladding system and to the design of the detailing and can only be determined by using a specially designed computer programme. As a result most insulated panel manufacturers have prepared a range of robust, approved details for their panel systems together with substantiated values for heat loss factor 'ψ' and condensation factor 'f'.

Compliance that the building envelope satisfies AD-L2 in terms of total heat loss – 'α' ratio – is the responsibility of the architect/designer who will in the majority of cases have used the substantiated 'ψ' values provided by the panel manufacturer or contractor.

Any change to the specified system, product or component of the approved detailing either before commencement on site, or during construction, may alter the compliance of the system. All revised details may have to be recalculated according to the official computer programmes.

Contractors can significantly reduce the risk of non-compliance by using the standard details and associated values calculated for the insulated panels systems.

Specification changes or on-site modifications resulting in unsubstantiated f and ψ-values may result in rejection of the envelope until compliance is proven.

EPIC recommends

that installers use only the approved details provided by the insulated panel system manufacturer.

10.3 Air tightness

The most probable cause of non-compliance will be an air permeability rate greater than the allowed level (See Section 7.3). Remedial work is costly, difficult and may affect payment of retentions.

Insulated panels are designed with thermally efficient and air tight panel-to-panel joints. Providing the steelwork tolerances are within the agreed maximum levels (see 9.3.6) and attention is paid to alignment and levelling of the first panels, air leakage at the panel-to-panel joints should be to the design values, and should have little effect on the air permeability rates.

The primary risk areas for air leakage are 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

Should the building fail to comply with the specified maximum air leakage rate, the contractor shall be responsible for undertaking the necessary air leakage identification, remedial sealing works and further fan pressurisation tests at their own cost until the specified level is achieved and demonstrated to the employer's representative.

Site supervision, workmanship and quality control

- Site installation teams should be provided with project specific construction assembly specifications, details and instructions.
- The treatment of complex or unusual details should be agreed with the designer in advance and a sample prepared as necessary (see 9.3.6)
- Steelwork tolerances will become increasingly important if the air tightness standards are to be met. Steelwork should rejected if the tolerances are outside the maximum guidance levels set out in 9.3.5.
- For insulated panels the alignment of the first panel is critical to ensure optimum joint tightness and air tightness.
- 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.

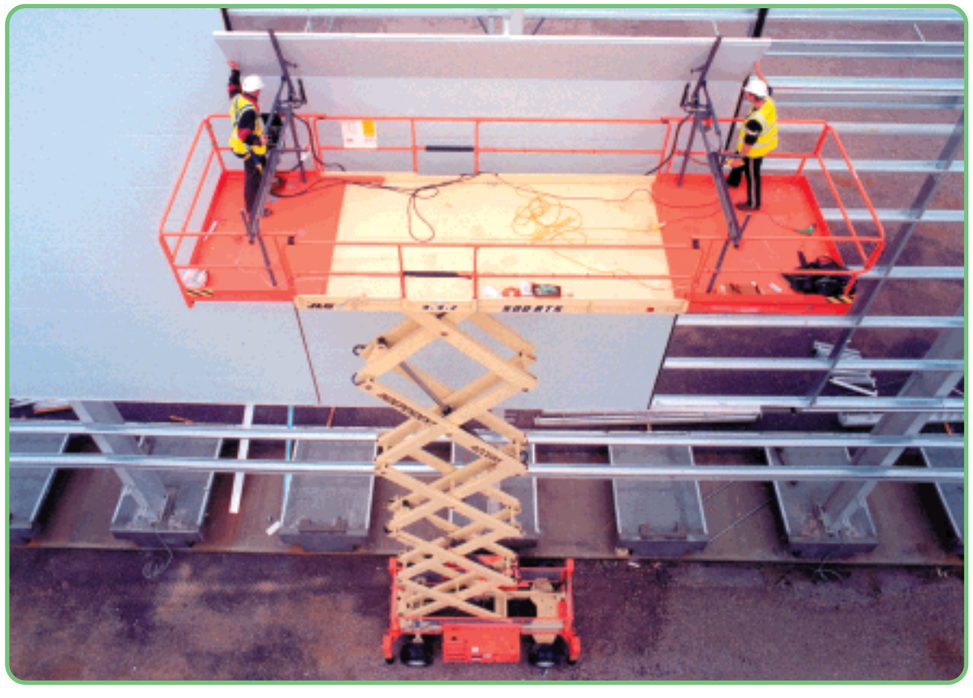


Figure 9. Insulated panels installed on a large coldstore

11 Compliance and competent persons
England & Wales

Responsibility for realising a building that will achieve compliance lies equally with the design and cladding teams.

Designers should agree with building control at the earliest stage of the project that the design and specification complies with AD-L2 requirements. Also that the person providing certificates or declarations for insulation standards, insulation continuity, air tightness and testing is suitably qualified and competent.

The suitably qualified person should issue a certificate or declaration that appropriate design details and building techniques have been used and that the work has been carried out in ways that can be expected to achieve reasonable conformity with the approved specifications.

Panel manufacturers or other providers should be able to substantiate the 'f' and 'ψ' values provided for the details used. Substitution or revision of the approved details will require a re-calculation of the 'ψ' and 'f' values.

Panel manufacturers should also be able to confirm that U-values have been evaluated to latest calculation methods.

Designers must be able to show that the heat loss ratio (α-value) for the whole building is less than 0.1 or that compliance can be proven through the 'notional building' route.

Infra-red testing may be used to show that the insulation is reasonably continuous over the whole building envelope.

For all buildings larger than 1000m² floor area, an air tightness test must be carried out to show that the whole building has conformed to the maximum air permeability rate.

Figure 10. Built in compliance using insulated panels. Insulated panels have the benefit of a guaranteed U-value and computer 'ψ' and 'f' values to confirm compliance. Factory engineered joint details restrict air leakage to a minimum.

12 Technical Standards – Part J: 6th Amendment
Scotland

12.1 Introduction

The Scottish Executive has agreed to work in partnership with the UK Government in achieving a goal of a 20% reduction in UK carbon dioxide emissions by 2010. This goal is significantly beyond and so more challenging than the UK's international target to reduce greenhouse gas emissions by 12.5% in the first commitment period (2008-2012).

Technical Standards - changes

The construction industry has a major role to play in the conservation of fuel and power. Energy use in buildings is a major source of carbon dioxide emissions which contribute to climate change.

The intention of the changes in Part J is to ensure that effective measures for the conservation of fuel and power are incorporated in a building. It contains energy conservation provisions for the building fabric and the building services.

The amendments are based on the principle that tighter building regulations are the best option for delivering improved energy efficiency in new building works, as they ensure that action is taken for the benefit of both the individual, investor and occupiers and to support the national carbon reduction targets. Building regulations ensure that the Government sets standards, and that private agents are able to achieve these standards in the most cost-effective way they can find, stimulating efficiency and innovation.

Improvements in energy efficiency have also been demonstrated to be one of the most efficient ways of reducing carbon emissions.

The primary benefit of the new regulations will be to contribute towards the achievement of the UK Government's international commitments on carbon emissions. These commitments contribute to the international efforts to reduce the impacts of climate change.

12.2 Part J Amendments

The Scottish Executive Part J amendments were effective from 4th March 2002 on approved building warrants.

A building in purpose groups 2 to 7 must have provision for conservation of fuel and power in accordance with one of the three following methods:

i) the Elemental Method (see 12.3)

ii) the Heat Loss Method (refer to Standards)

iii) the Carbon Emissions Calculation Method (refer to Standards)

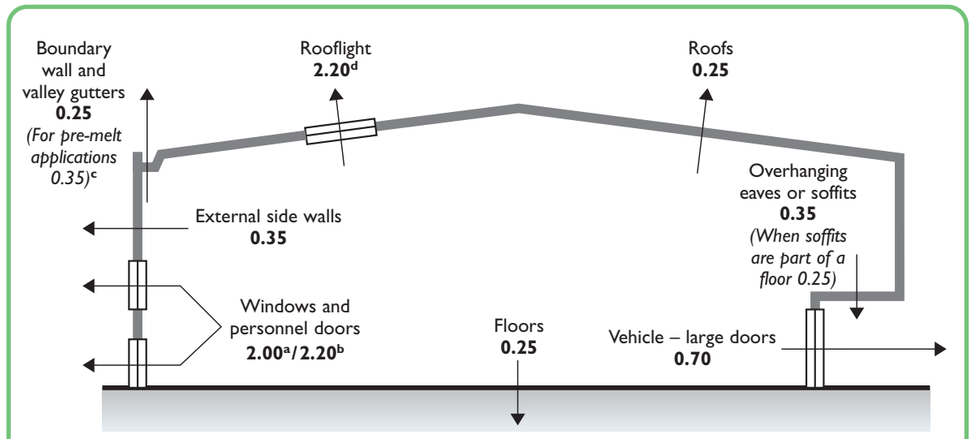
In addition to requirements for insulation of the fabric there are requirements for building services, air conditioning, mechanical ventilation and artificial lighting.

12 Technical Standards – Part J: 6th Amendment
Scotland

12.3 Elemental Method

Part J contains a guide to the use of all three compliance methods. However metal clad industrial and commercial buildings are generally constructed with insulated roof and wall systems, which are calculated according to the Elemental Method.

To comply with Part J following the Elemental Method, the building envelope has to provide certain minimum levels of insulation. The requirements will be met if the thermal performances of the construction elements are no worse than those illustrated in Figure 11 and detailed in Table 9.



Notes

a. Windows, personnel doors and rooflights (area weighted average for the whole building), glazing in wood or PVC frames.

b. Windows, personnel doors and rooflights (area weighted average for the whole building), glazing in metal frames.

c. For pre-melt gutter specifications obtain building control approval at design stage

d. Rooflights may be permitted up to 12% of roof area at 3.0W/m²K by using the 'Whole building' or 'Carbon emission' method of calculation, however, there is a significant risk of condensation.

Figure 11. Standard 'U' values for insulated metal roof and wall cladding systems – Part J Elemental Method

Table 9. Standard U-values of construction elements – Part J – Scotland

Construction element	U-value W/m²K
Roof	
Pitched roof with insulation between rafters	0.20
Pitched roof with insulation between joists	0.16
Flat roof (see note opposite)	0.25
External Walls – excl. windows/doors (1)	0.30
Floors	0.25
Windows, rooflights & personnel doors – glazing in metal frames (2)	2.2
Windows, rooflights & personnel doors – glazing in wood/pvc frames (2)	2.0
Rooflights	2.2
Vehicle access and similar large doors (3)	0.7

(1) Solid area only i.e. excluding windows, doors etc

(2) Area weighted average for the whole building

(3) No requirement where doors have to be kept open when building is in use

Interpretation of the Technical Standard is the responsibility of Local Authority Building Control.

Buildings Regulations Note 1: 2002 issued by the Scottish Office clarifies that the intention behind the regulations was that flat roofs and roofs with integral insulation are required to meet 0.25 W/m²K. Sandwich panels come under this category. The required value of 0.25W/m²K applies irrespective of roof slope.

Buildings Regulations Notes can be viewed on www.scotland.gov.uk/development/bc/brns

12.4 Rooflights etc

The specified building elements must have areas of windows, doors and rooflights not more than those prescribed in Table 10. The rooflight area of 20% assumes a U-value of 2.2 W/m²K.

Rooflights up to 12% of the roof area may be permitted with a U-value of 3.0W/m²K by applying the 'whole building' or carbon emission methods of calculation.

However, the internal temperature of double skin rooflights will be significantly lower, which can cause condensation risk.

Table 10. Maximum area of openings – Part J (Scotland)

Purpose Group	Windows and doors as a % of the area of exposed wall	Rooflights as % of roof area
2	30%	20%
3,4,5	40%	20%
6,7	15%	20%

12.5 Limiting thermal bridging at junctions and around openings

The building's fabric must be constructed to minimise thermal bridges and gaps in the insulation layer(s):

– within the various building elements

– at the junctions between building elements

– at the edges of building elements (e.g. around window and door openings)

Compliance

The requirements with regard to minimising thermal bridges and gaps in the insulation, will be met by:

a) constructing the building in accordance with Building Research Establishment (BRE) Report, BRE 262: "Thermal insulation, Avoiding risks", Second Edition, 1994 or

b) demonstrating by calculation that equivalent performance to a) has been achieved.

12.6 Limiting air leakage

Air leakage into or out of a building through extraneous air paths must be limited as far as is reasonably practical.

Compliance

The requirements as regards minimising extraneous air leakage paths in the buildings fabric will be met by constructing the building in accordance with BRE Report BRE 262: Thermal insulation, Avoiding risks, Second Edition, 1994, including,

a) sealing the gaps between dry linings and masonry walls at the edges of window, door and roof space openings, and at the junctions between walls, floors and ceilings

b) sealing vapour control membranes in timber framed and other framed panel constructions; and

c) sealing at service penetrations of the fabric or around boxing for services; and

d) fitting draught seals to the openable parts of windows, doors and rooflights; and

e) sealing around joist ends built into the inner leaf of external cavity walls

12 Technical Standards – Part J: 6th Amendment
Scotland

12.7 Building Services

The 6th Amendment states that the heating system of a building must be designed and installed to make efficient use of energy for the conservation of fuel and power.

There are specific requirements governing space heating controls; artificial lighting; and on the commissioning of building services.

Air conditioning and mechanical ventilation

Guidance and recommendations for air conditioning and mechanical ventilation directly concern the building fabric and building envelope and are as follows:

A building incorporating air conditioning or mechanical ventilation must be designed and constructed so that:

a) the form and fabric of the building do not result in a requirement for excessive installed capacity of the cooling equipment; and

b) fans, pumps, refrigeration equipment and other coolants are reasonably efficient and appropriately sized to have no more capacity for demand and standby than is necessary; and

c) there are appropriate means of managing, controlling and monitoring the operation of equipment and systems.

Given the above conditions the requirements for energy efficiency of air conditioning and mechanical ventilation equipment will be met. Designers are referred to the Technical Standard for further details.

12.8 Refurbishment and repairs

The 6th amendments to the Technical Standards, including Part J apply to 'New Build'.

Refurbishment and repair work are derived from these requirements and come under Local Authority Building Control. No specific guidance on material alterations or refurbishment is given in the Technical Standard.

It is the intention of the Technical Standard that:

- replacements should be 'as good as the element being replaced'.
- alterations should meet the current standard
- for fixtures (part A) that do not require a warrant, replacement in whole or in part should be by a material of the same general type

Note: in many cases this is interpreted as 'like for like'.

It would appear that replacement of an element, say removal of a slate or asbestos roof, is interpreted as an **alteration** and is therefore required to meet the revised standard and U-value levels.

Appendix: Material alterations
England & Wales

Insulated Panels have been used extensively for over 20 years for the upgrading and renovation of industrial and commercial buildings, particularly where there was a requirement for improved thermal efficiency of the roof/wall element.

The energy crises of the 1980's and 1990's together with the introduction of Part L of the Building Regulations further accelerated the use of panels due to the benefit of having insulation performance effectively 'built-in' in the factory.

The introduction of AD-L2 brings material alterations and material changes of use under the scope of the Amendment through a requirement to refurbish and upgrade such buildings to the new regulatory standards.

Material alterations – definition

"An alteration is material for the purposes of these Regulations (AD-L2) if the work, or any part of it, would at any stage result-

(a) in a building or controlled service or fitting not complying with relevant requirement where previously it did: or

(b) in a building or controlled service or fitting which before the work commenced did not comply with a relevant requirement, being more unsatisfactory in relation to such a requirement."

Compliance with AD-L2

For those elements or services associated with insulated panels, compliance would be met providing the following conditions are satisfied:

Element or activity	Compliance
Roof insulation When substantially replacing any of the major elements of a roof structure	by providing insulation to achieve the U-value for new buildings
Wall insulation When substantially replacing complete exposed walls or their external renderings or cladding or internal surface finishes, or the internal surfaces of separating walls to unheated spaces	by providing a reasonable thickness of insulation (to achieve the U-value for new building)
Sealing measures When carrying out any of the above work…	by including reasonable sealing measures to improve airtightness
Controlled services and fittings When replacing controlled services and fittings…	by following the guidance in Part L2

The pictures illustrate before and after refurbishment with insulated panels

Air tightness testing

AD-L2 makes no reference to air tightness in the case of a material alteration to a roof or wall element. Pressure testing would not be required in these circumstances, for example if a roof or wall is replaced as part of a refurbishment programme.

There is however a requirement to carry out reasonable sealing measures, e.g. at associated details etc., to improve airtightness. Compliance therefore would be satisfied by the use of robust approved details in conjunction with the refurbished element.

Infra-red testing

There is no mandatory requirement for infra-red testing but this technique can be used to illustrate compliance for continuous insulation throughout the new element.

Note: Additional advice on the interpretation of AD-L2 can be obtained from www.odpm.gsi.gov.uk

EPIC
ENGINEERED PANELS IN CONSTRUCTION

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.

Contact EPIC 29 High Street, Ewell, Surrey KT17 ISB Telephone: 020 8786 3619 Fax: 020 8786 8887 www.epic.uk.com

Download information from the EPIC website

This guide to requirements and compliance for insulated external roof and wall panels following the amendments to Building Regulations Part L2 and Technical Standard Part J can be readily downloaded from the website at www.epic.uk.com

EPIC have published a series of other guides including the Fire Safety, Specification and Installation of external insulated panels that are available in hard copy form and through the website.

Information on CD Rom

EPIC have produced two CD Roms which provide comprehensive information on the design and performance of insulated panels used as the roofs and walls of buildings:

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 fire research programmes.

THE EPIC MEMBERS ARE:

Advanced Thermal Composites Limited
Hangar 1A, Wrights Lane
Burtonwood, Cheshire WA5 4DB
Telephone: 01925 711157 Fax: 01925 711158
sales@thermal-composites.co.uk
www.thermal-composites.co.uk

Corus Building Systems
Llandybie, Ammanford,
Carmarthenshire SA18 3JG
Telephone: 01269 850691 Fax: 01269 851081
www.corusgroup.com

Kingspan (Insulated Panels) Limited
Greenfield Business Park No 2, Greenfield,
Holywell, Flintshire CH8 7HU
Telephone: 01352 716100 Fax: 01352 710161
info@kingspanpanels.com
www.kingspanpanels.com

A. Steadman & Son Ltd
Warnell, Welton,
Carlisle CA5 7HH
Tel: 0169 74 78277 Fax: 0169 74 78530
info@steadmans.co.uk
www.steadmans.co.uk

Ward Building Components Limited
Sherburn, Malton,
North Yorkshire YO17 8PQ
Telephone: 01944 710591 Fax: 01944 711140
wbc@wards.co.uk
www.wards.co.uk

ASSOCIATE MEMBER:

Huntsman Polyurethanes
Hitchen Lane, Shepton Mallet, Somerset BA4 5TZ
Telephone: 01749 335333
www.huntsmanpolyurethanes.com

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The Forge, Home Farm, Ardington,
Wantage, Oxon OX12 8PN