



Technical information

Thermal performance of fenestration products

U-values, energy ratings and certification

01 Introduction

From 1st July 2013, all windows and external pedestrian doorsets sold in the UK will require a CE Mark and Declaration of Performance (DOP) as required by the European Construction Products Regulation (CPR).

Manufacturers of complete windows and external pedestrian doors must comply with the Harmonised European Standard BS EN 14351-1:2006 +A1:2010: *Windows and Doors – Product standard, performance characteristics – Part 1: Windows and external pedestrian doorsets without resistance to fire and / or smoke leakage characteristics.*

The standard requires all compliant products to have a declared U-value if the member state requires this in its own regulatory publications. In the UK, Building Regulations have set both requirements and limits for thermal performance in new and existing dwellings and non-dwellings.

Additionally, UK Building Regulations contain an alternative compliance mechanism through energy ratings; energy ratings cannot be used as compliance to BS EN 14351, however a U-value within an energy rating report can be used to demonstrate compliance with BS EN 14351, providing the calculation is verified by a Notified Body.

BM TRADA has achieved accreditation for the purpose of Notified Body activity for evaluation of thermal performance by calculation to BS EN 14351-1.

For further information on the requirements of CE marking, see TI-16: CE marking of windows & external pedestrian doorsets: guidance for manufacturers

02 Proving performance

There are three methods of demonstrating compliance to BS EN 14351 for the thermal performance of windows and external pedestrian doors:

- U-value calculation to BS EN ISO 10077-1
- U-value calculation to BS EN ISO 10077-1 and BS EN ISO 10077-2
- U-value measurement to BS EN ISO 12567-1 or BS EN ISO 12567-2

It is the manufacturer's responsibility to determine the requirements for CE marking their products. Windows and external pedestrian doorsets, where the intended use does not include fire / smoke compartmentation or escape routes, are not considered as safety critical and are covered by Assessment and Verification of Constancy of Performance (AVCP) system 3, though micro-enterprises (as defined in Commission Recommendation 2003/361/EC 6 May 2003) may treat their products as being covered by the provisions of system 4.

03 U-value calculations

BM TRADA offer UKAS accredited thermal calculation services to meet the needs of every type and size of manufacturer. We can provide calculations for most types of windows, system doors (e.g. manufactured from stiles and rails with glazing or opaque panels) and non-system doors (e.g. composite doors or solid core doors).

3.1 U-value calculation to BS EN ISO 10077-1

This method uses a numerical calculation of the whole product's thermal performance using empirical data taken from tables. It is often the simplest calculation; however the results can often be seen to be on the conservative side and may not be relevant to all types and styles of product, or provide results which comply with the limiting parameters of the UK Building Regulations without substitution of higher performance glazing components.

3.2 U-value calculation to BS EN ISO 10077-1 and BS EN ISO 10077-2

This method is more complex as it involves a more detailed calculation by thermal modelling (also referred to as thermal simulation) via Finite Element Analysis which uses computer modelling. The exact geometry and materials used must be supplied by the manufacturer (see thermal calculations or energy rating services check list).

This method can offer a greater level of flexibility over a physical test as substitution of alternative materials and geometry can be made once a base model is established, allowing assessment of the impact of material and glazing variants that exist within any range of products. This method is a very cost-effective way of evaluating

multiple configurations in the quest for achieving the desired product performance against cost, particularly at the design stage.

3.3 U-value measurement to BS EN ISO 12567-1

This method is a physical, non-destructive test on sample products, referred to as a hot box test. The U-value taken from the hot box test will produce a result specific to the product specification tested.

04 Confirmation of U-value performance for EN 14351-1

In addition to full calculation services, BM TRADA is able to offer a confirmation service for third party U-value calculations contained in reports from non-accredited sources to verify these are correct for use in CE marking.

05 Energy ratings and certification

Conventional approaches (such as a whole element U-value) simply assess how much energy a product loses through thermal transmittance. They do not take into account how much energy an element can gain or lose through other means. The total energy flow in an element consists of three major components:

- Thermal transmittance (U-value), which measures how well a product prevents energy escaping. The lower the number, the better the U-value. This is obtained via either calculation or measurement.
- Solar factor (g-value), which measures how much energy is transmitted through the glazing. Solar heat gain is expressed as a number between 0 and 1, this being the percentage of energy transmitted into a building. A lower figure means less heat gain. This is obtained from the glass supplier as a calculation to EN 410.
- Air Leakage (L-value), which measures how much energy is lost as air permeates through the weatherseals of the product at 50 Pa when it is closed. This is obtained by testing to EN1026 (often as part of a weathertightness test programme conducted to BS 6375 Part 1).

UK Building Regulations contain an energy rating equation based on values for these components and taking UK climate data into account. The result of this calculation is expressed as a numerical value which indicates the energy band (A to G) of the product, with A being the most energy efficient at energy neutral or positive, and B or lower being energy negative.

5.1 Benefits of energy ratings

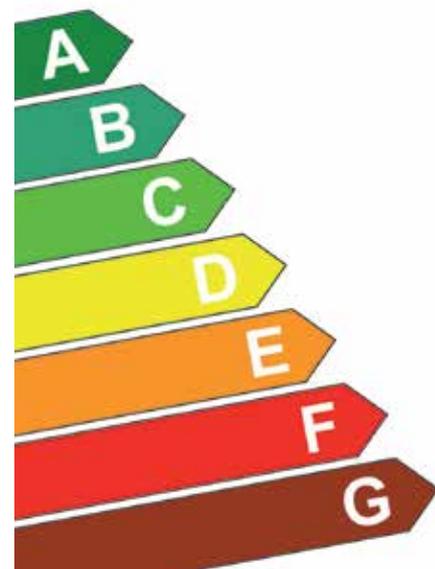
The energy rating is an ideal way of showing the energy efficiency of your products for the following reasons:

- Improved energy efficiency can be linked to reduced heating bills and environmental benefits when selling your products.
- The A-G banding system is recognised by the public as the same scale used to rate the energy performance of domestic appliances such as fridges, washing machines, light bulbs etc.
- Ratings are advantageous for the replacement market because it can prove compliance with Building Regulations and demonstrate a commitment by the manufacturer to provide energy efficient products.
- Element performance data from energy ratings can now be used in the Standard Assessment Programme (SAP) for whole house energy assessment.
- Manufacturers who have achieved an A, B or C rating and are certified and registered for energy ratings, can apply for Energy Savings Trust (EST) recommended status. Further requirements may need to be verified by the EST to gain approval.

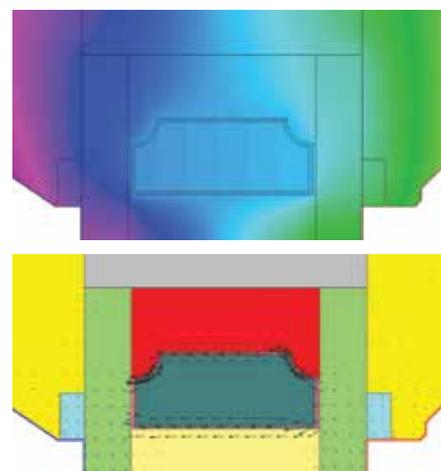
5.2 Energy rating certification process

To comply with UK Building Regulations for energy ratings, a manufacturer must be a member of a certification scheme, with the following requirements being met:

- Evidence of energy rating – valid energy rating report from a certified simulator (NB: a hot box test from a UKAS accredited laboratory can be used with additional calculations by a certified simulator).
- A suitable management system, including factory production control (FPC), sufficient to control the specification of rated products.
- A system for permanently marking each rated product along with performance data supplied to the end user.
- All Insulating Glass Units fitted to registered products comply with EN 1279-5.
- Verification by an independent agency (IA) (e.g. BM TRADA) of the energy rating report(s) and an initial inspection of the FPC system to ensure consistent specification is maintained.
- Registration by the IA of the energy rated products (additional scheme registration may be required).
- Following completion and registration, periodic surveillance inspections of the FPC by the IA are required to ensure product consistency is maintained in line with the registered specifications.



Energy window rating.



A typical metallic spacer bar model demonstrating temperature zones through the product and how the heat flows.



Heat loss from a house.

06 Thermal calculations or energy rating services check list

For a detailed calculation to be made the following information is required:

- Complete technical details of each product specification to be calculated.
- All frame and bead materials defined (including density and thermal conductance).
- All proprietary components, e.g. weather seals, glazing gaskets, beads and threshold defined (manufacturer, materials and thermal conductance).
- All additional sealant materials defined (type and application).
- Glazing system defined. To include inner and outer pane manufacturer, type and normal emissivity, spacer bar manufacturer and type, gas fill type, primary (inner) edge sealant material, secondary (outer) edge sealant material & thickness and desiccant type.
- Electronic cross sectional drawings (horizontal and vertical) in DWG or DXF formats.
 - Cross sections must be supplied through each frame element (e.g. head with casement, head with direct glazing, jamb with casement, jamb with direct glazing) to provide full details of the sample product
 - Drawings must contain all components of the product, excluding hardware, in design positions
 - Weather seals must be shown in compressed state
 - Glazing and glazing gasket systems must be detailed
 - CAD Drawings must have all geometry in 2D.
- Any additional or alternative materials or system geometry variants to be defined.
- Any additional glazing systems defined as above.
- For energy ratings only, a full copy of a relevant air permeability report to EN1026 showing the air permeability at 50 Pa (+ and -) is required for the product being calculated.

BM TRADA provides independent certification, testing, inspection, training, technical services information around the world. We help customers large and small to prove their business and product credentials and to improve performance and compliance.



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