1 Introduction
Approved Document L of the Building Regulations includes requirements for demonstrating the thermal transmittance of buildings and their elements, including doors and windows.

2 Requirements
As part of achieving the UK’s Kyoto commitment to reduced CO$_2$ emissions, Part L of the Building Regulations require that thermal performance values of buildings and their components be calculated and limits maintained to ensure heat loss is minimised.

2.1 Proving that buildings comply
The Building Regulations require that buildings meet target values for CO$_2$ emissions. These values vary depending upon area and building type. As windows and doors form part of the building envelope it is necessary to provide thermal performance data for each element for inclusion into the calculations. Please refer to the current version of Approved Document L for full details of the requirements.

2.2 Requirements for doors and windows (UK)
It is a requirement of the Building Regulations that the thermal conductivity of windows and doors is declared. This value can also be used in the energy rating value of the whole building.

Building regulations have various minimum requirements for both the U-Value and BFRC Energy Ratings for windows and doors. Depending upon building type, distinctions are made between new build, refurbishment and extensions. Required values differ by area and building type, as they are likely to change over time.

3 Proving performance
There are three recognised methods for demonstrating thermal performance of doors and windows:

- Whole Element U-Value from thermal simulation using proven computer modelling software performed by a BFRC Certified Simulator
- Whole Element U-Value from a hot box test to an accepted standard
- BFRC Energy Rating performed by a BFRC Certified Simulator.
BFRC Energy Ratings can now be used to demonstrate compliance with some parts of Approved Document Part L by assessing the total energy performance of a product. The energy efficiency of the product is not purely determined by its ability to minimise the transfer of heat, a number of other factors, including solar heat gain and air permeability also have an impact. Energy Ratings take account of these factors in producing an overall rating of energy lost (or gained) by the sample product over a 12 month period which provides a clear comparison between different systems and manufacturers.

4 Thermal simulation
Chiltern Dynamics (as part of Chiltern International Fire) offers a BFRC thermal simulation service for modelling the thermal performance of external windows and doors to BS EN ISO 10077-2 (calculated to BS EN ISO 10077-1) and BFRC requirements. Simulation has the great advantage of being able to substitute materials within the product design without any physical testing. This helps to achieve the desired performance for the lowest cost, as well as addressing the material and glazing variants that exist within any range of products.

Simulation is carried out via computer modelling (Finite Element Analysis). In order to carry out a simulation the manufacturer needs to supply geometry and technical details of the product (a checklist of requirements is provided at the back of this document).

5 Energy ratings
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:

i. Thermal transmittance (U-value, measured in W/m².K), which measures how well a product prevents energy escaping. The lower the number the better the U-value. This is obtained via testing or certified simulation.

ii. 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 glass supplier as a calculation to EN 410.

iii. Air Leakage (L-Value, measured in m³/m²/h), which measures how much air permeates through the weatherseals of the product at 50 Pa when it is closed. This is obtained by testing to BS 6375: Part 1 or EN1026.

The BFRC has devised an Energy Rating equation based on values for these components and taking UK climate data into account. The results of this equations are expressed as a number. The results are then converted into a grade between A and G, with A being the most energy efficient at energy neutral (0) or positive (†), and B or lower being energy negative (§).

The BFRC provides labelling and web database facilities upon registration through an independent agency. BM TRADA Certification is BFRC Independent Agency number 001 and can provide third party certification of thermal performance based on energy rating calculations and specifications through initial assessment and continual monitoring of the manufacturers production process.

Certified products are awarded a manufacturer specific label format with the A-G grade and values for the above factors clearly indicated. This label is to accompany rated products to provide the consumer with evidence of the energy performance of the purchased product. Additionally, each rated product must have a permanent identifying mark or label to clearly identify the product as being certified as Energy Rated though the BFRC.
5.1 Benefits
The BFRC rating is an ideal way of showing the energy efficiency of your products:

- improved energy efficiency can be linked to reduced heating bills and environmental benefits when selling your products.
- it 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 will be particularly advantageous for the replacement market because it will prove compliance with building regulations and demonstrate a commitment by the manufacturer to provide energy efficient products.
- achieving a low U-value can be costly. A lower U-value does not necessarily mean higher energy efficiency when included into the energy rating equation. Alternative specifications may provide a lower cost product that achieves a comparable Energy Rating.
- element performance data from energy ratings can now be used in Standard Assessment Programme (SAP) for whole house energy assessment.
- manufacturers who have achieved an A, B or C rating and are certified and registered with the BFRC, can apply for Energy Savings Trust (EST) recommended status. Further requirements may need to be verified by the EST to gain approval.

5.2 Process
For products to become BFRC certified and receive a rating, the following must be in place:

- evidence of thermal performance – valid simulation report from a BFRC certified simulator or hot box test from a UKAS accredited laboratory.
- a suitable management system, including factory production control (FPC), sufficient to control the specification of rated products.
- verification by an independent agency (IA) (e.g. BM TRADA Certification) who will validate the simulation and/or test evidence and assess the FPC system of the manufacturer.
- the IA will then inform the BFRC of successful completion of the verification process. The BFRC will list the company and rated products on their website (www.bfrc.org) and provide the BFRC Energy Rating Label for each of the certified products.

6 Verification and Certification
Chiltern Dynamics’ sister company, BM TRADA Certification, provides a competitively priced service for the BFRC scheme. Coupled with the provision of in-house testing and simulation services, Chiltern International Fire is a single point of contact for the BFRC energy rating scheme.

6.1 Requirements

6.1.1 Initial
- Evidence of thermal simulation by a BFRC Certified Simulator or a hot box test with BFRC rating calculation.
- Testing to BS 6375: Part 1 or EN1026 (air permeability at 50Pa).
- All glazing units supplied for Energy Rated products must be proven to comply with the requirements of EN1279-5.
- Initial audit visit to check that the produced product is the same specification as the product which was simulated/tested.

6.1.2 Ongoing
- Audit visit periodically by BM TRADA Certification to ensure ongoing compliance of the product and management system to the as tested specification and latest requirements of the BFRC scheme.
7 Thermal Simulation Check List

Thermal simulation is fast, accurate, flexible and straightforward. All we require is the following information.

- Completed BFRC technical data sheet detailing each product specification to be simulated.

- Electronic cross sectional drawings (horizontal and vertical) in DWG or DXF formats. Non-CAD drawings may be accepted at additional cost. Additional requirements:
  - 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 as defined by the BFRC.
  - 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.

- Electronic drawing or specification of the glazing spacer bar.

- All frame and bead materials defined (including density and thermal conductance).

- All weather seals defined (manufacturer, materials and thermal conductance).

- All glazing seals defined (manufacturer, materials and thermal conductance).

- All additional sealant materials defined (type and application).

- Glazing system defined (e.g. 4-16-4). To include inner and outer pane manufacturer, type and normal emissivities, spacer bar manufacturer and type, gas fill type, primary (inner) edge sealant material, secondary (outer) edge sealant material & thickness and desiccant type.

- Any additional material or system geometry variants to be defined.

- Any additional glazing systems defined as above.