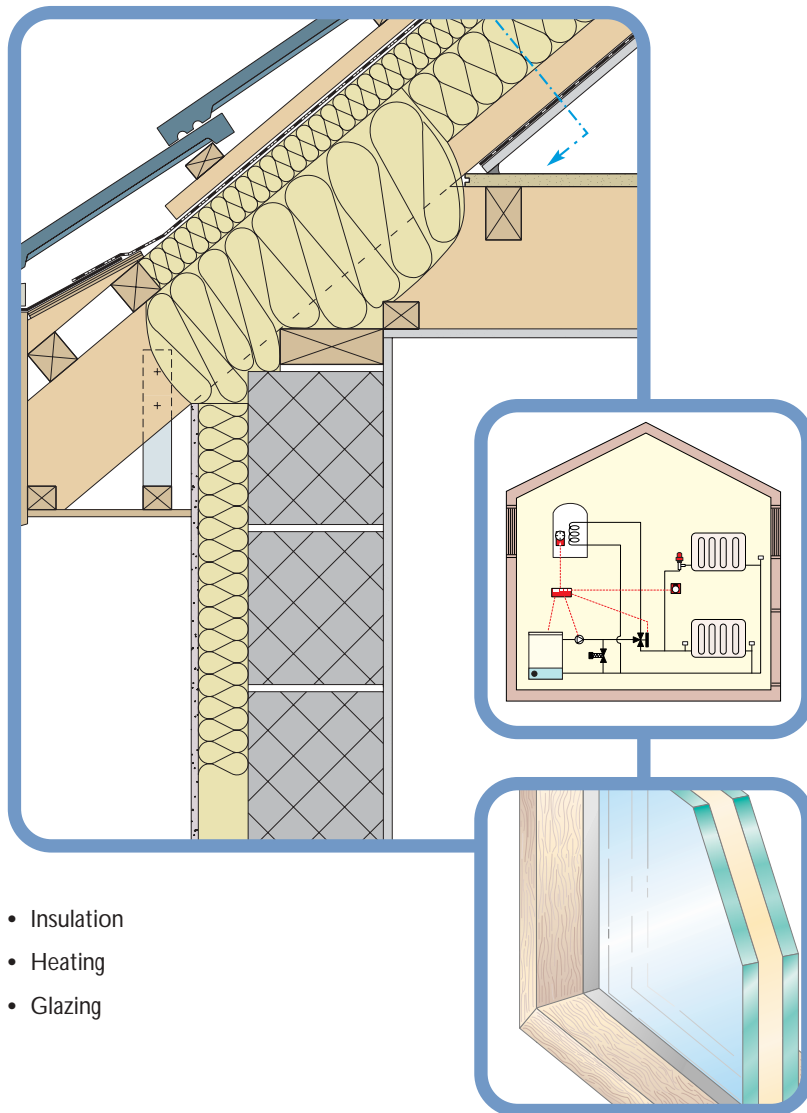




# Energy Efficiency Best Practice in Housing

## The effect of Building Regulations (Part L1 2002) on existing dwellings

Information for installers and builders for extensions  
and alterations in England and Wales



- Insulation
- Heating
- Glazing

## The Building Regulations

The Government has reviewed the Building Regulations and introduced requirements that are intended to make both new and existing buildings more energy efficient. This will reduce heating costs, conserve fuel, reduce atmospheric pollution and help to protect the environment from the effects of climate change. The Regulations are intended to reduce carbon emissions associated with the use of fuel in existing homes by 0.66 million tonnes per year, by 2010.

The new requirements are imposed by 'The Building Regulations 2000, Part L1', which came into force in England and Wales on 1 April 2002. For existing dwellings, the Regulations cover:

- Insulation of exposed walls, roof and floors in extensions
- The performance and areas of openings (windows doors and rooflights) in extensions
- Insulation of exposed walls, roofs and floors when alterations are made
- Replacement windows, doors and rooflights
- Replacement heating systems (including boilers and hot water storage cylinders)
- Heating and hot water controls
- Commissioning of heating systems and the provision of instructions for users.

These regulations impose mandatory minimum requirements. Suggested ways of meeting them are set out in Building Regulations Approved Document L1, and summarised here. The recommended Best Practice standards set out in this document are those promoted under the Energy Efficiency Best Practice in Housing programme, which provides impartial, authoritative advice on energy efficiency in dwellings.

Similar regulations are expected to be brought into force in Northern Ireland, in due course. In Scotland new requirements applicable to extensions (but not to alterations) are imposed by 'The Building Standards (Scotland) Regulations, Part J', and came into force on 4 March 2002.

Adopting the recommended Best Practice standards will reduce heating fuel use, fuel costs and the associated carbon dioxide emissions.

- It is important to ensure that all work to existing dwellings complies with the Building Regulations.
- The penalties for failing to comply include stiff fines.
- The responsibility for demonstrating compliance rests with the person ordering the work.

## Demonstrating Compliance

- For extension and alterations a 'Building Notice' or a 'Full Plans' application for approval should be sent to the local authority's Building Control department, with the appropriate form and fee. Full Plans applications must be accompanied by drawings and specifications of the proposed work, and calculations to demonstrate compliance with the Regulations.

- For replacement windows, compliance with the Regulations may be demonstrated by the issue of a certificate under the FENSA self-certification scheme, or by submitting a 'Building Notice' or 'Full Plans' application to the local authority's Building Control department.
- For replacement heating boilers, hot water storage vessels or entire heating and hot water systems, compliance may be demonstrated by the issue of a commissioning certificate by a competent person (ie. CORGI registered for gas boilers, OFTEC registered for oil boilers, or HETAS registered for solid fuel appliances). An appropriate certificate would include those produced by Benchmark, OFTEC and HETAS. If a suitably qualified certifier is not available, the person responsible for carrying out the work should nevertheless provide a written declaration of successful commissioning to the local authorities building control department.

Benchmark is a commissioning certification scheme for boilers and hot water tanks administered by the Central Heating Information Council. It is predominantly used by CORGI registered gas installers to certify the compliance of the installation. This is achieved by completing the Benchmark logbook supplied with the boiler and (if appropriate) the Benchmark label affixed to the hot water tank by the manufacturer.

### Competent persons self-certification schemes

Competent persons schemes were introduced by the Government to allow individuals and enterprises to self-certify that their work complies with the Building Regulations as an alternative to submitting a building notice or using an approved inspector.

- The Council for Registered Gas Installers (CORGI) is the national watchdog for gas safety in the United Kingdom. Registration is a legal requirement for businesses and self-employed people working on gas fittings or appliances. A person registered with CORGI is allowed to self-certify that installation of heating-producing gas appliances complies with the Building Regulations by completing a Benchmark certificate and logbook.
- For oil-fired systems, a self-certification scheme known as the Oil-Firing Registration Scheme is operated by the Oil-Firing Technical Association (OFTEC).
- For solid fuel systems a self-certification scheme known as the HETAS Registration Scheme is operated by the Heating Equipment Testing and Advisory Service (HETAS).
- For replacement windows and doors, reputable installers may complete the installation under the FENSA (Fenestration Self Assessment) Competent Persons Scheme and certify that the installation complies with Building Regulations. FENSA will then notify the appropriate Local Authority and send a certificate confirming compliance to the house owner. If the work involves new windows being fitted in an extension which is covered by a building application, then it is normal for the windows to be covered by this application. In these circumstances FENSA is not involved.

Exposed element	Maximum U-value (W/m <sup>2</sup> K)	Best Practice U-value (W/m <sup>2</sup> K)
Pitched roof (insulation between rafters)	0.20	0.13
Pitched roof (insulation between ceiling joists)	0.16	0.13
Flat roof (or prefabricated pitched roof with integral insulation)	0.25	0.13
Walls (including basement walls)	0.35	0.25
Floors (including ground floors and basement floors)	0.25	0.20
Windows, doors and rooflights (metal frames)	2.20	1.80
Windows, doors and rooflights (timber or PVCu frames)	2.00	1.80

**Table 1** Maximum thermal transmittances (U-values) for exposed elements of extensions. The values for openings (windows, doors and rooflights) are area-weighted averages.

## The Building Regulations (extensions, alterations)

- The Building Regulations impose minimum insulation standards for domestic extensions and alterations. These standards apply to extensions of more than 6 m<sup>2</sup> floor area, and to 'material alterations'. New standards for replacement windows apply to all dwellings.
- There are also requirements for new and replacement heating systems, including replacement boilers and hot water storage tanks. These Regulations apply to dwellings of more than 50 m<sup>2</sup> floor area.

### Extensions

- The thermal transmittances (U-values) of exposed walls, roofs, floors and openings must not exceed the maximum values shown in Table 1.
- Alternatively, it is acceptable to 'trade off' less insulation in one element against more in another, but the overall heat loss must be no more than if all the elements had the maximum U-values.
- The Best Practice U-values provide a better standard of insulation, consistent with Best Practice. The cost of the additional insulation may be offset against a smaller heating system.
- The area of windows, doors and rooflights in an extension must not exceed 25% of its floor area, plus the area of any existing openings that are no longer exposed. Or, the area of openings in the enlarged dwelling should not exceed the area of openings in the original dwelling, or 25% of the floor area of the enlarged dwelling.

### Alterations

- 'Material alterations' to walls, roofs or floors must include insulation. Such alterations include: substantial replacement of any part of a roof (eg re-tiling or replacing the felt); substantial replacement of a floor, including renewing most joists, or re-boarding; substantial replacement of an exposed wall or its external rendering or internal finishes (including plaster but not decorations).
- Improved roofs and floors must be insulated to the maximum U-values shown in Table 1.
- Walls must include 'reasonable insulation'. This means cavity wall insulation, or external insulation (behind render or cladding) or internal insulated dry-lining (eg insulation behind plasterboard).
- The Best Practice U-value for walls with external insulation is 0.35 W/m<sup>2</sup>K and the Best Practice U-value for walls with internal insulated dry-lining is 0.45 W/m<sup>2</sup>K.

## The Building Regulations (thermal bridging, air leakage)

### Meeting the required maximum U-values

- Methods of calculating the thicknesses of insulation that are necessary to achieve the required maximum U-values are given in Appendices A and B of Building Regulations Approved Document L1.

### Limiting thermal bridging and air leakage

- For extensions, the building should be constructed so that there are no 'thermal bridges', or gaps in the insulation layers within the various elements of the fabric (ie walls, roofs and floors), at the joints between elements or around openings such as windows and doors.
- All new construction and all substantial improvements to walls, roofs and floors must include reasonable sealing measures to reduce unwanted air infiltration.
- A way of meeting both of these requirements is to adopt the 'robust construction details' illustrated in 'Limiting thermal bridging and air leakage: robust construction details for dwellings and similar buildings'.

- Single glazing has a U-value of 4.8 W/m<sup>2</sup>K in timber or PVCu frames, and 5.7 W/m<sup>2</sup>K in metal frames.
- A solid timber door has a U-value of 3.0 W/m<sup>2</sup>K.
- For rooflights with timber or PVCu frames, add 0.2 W/m<sup>2</sup>K to the values in Table 2.
- Metal framed windows must include 'thermal breaks' to reduce heat loss through the frames.
- For metal frames without thermal breaks add 0.3 W/m<sup>2</sup>K for windows and 0.7 W/m<sup>2</sup>K for rooflights.

### Replacement windows and doors

- Replacement windows and doors must be draughtstripped and must not exceed the maximum U-values shown in Table 1. Alternatively, windows with centre-pane U-values not exceeding 1.2 W/m<sup>2</sup>K, may be used.
- Indicative U-values for typical frame and glazing combinations are given in Table 2. Windows that meet the minimum requirements are shown in **bold blue type**.
- The Best Practice standards in Table 1 can be achieved by using an appropriate combination of wider glazing gap with or without gas filling, and a low emissivity coating.
- Low emissivity ('low-E') coatings are of two main types, known as 'hard' and 'soft'. The soft coatings provide better performance at little additional cost.
- The most common form of gas filling is with argon; however, better performance can be obtained (at higher cost) by filling with krypton or xenon.

**Table 2** Indicative U-values (W/m<sup>2</sup>K) for typical frame and glazing combinations

Timber- or PVCu-framed windows	6 mm gap	12mm gap	16+mm gap	Metal windows (with 4 mm thermal break)	6 mm gap	12mm gap	16+mm gap
Double glazing (air-filled)	3.1	2.8	2.7	Double glazing (air-filled)	3.7	3.4	3.3
Double glazing (air-filled, hard low-E coating)	2.7	2.3	2.1	Double glazing (air-filled, hard low-E coating)	3.3	2.8	2.6
Double glazing (air-filled, soft low-E coating)	2.6	2.1	<b>1.9</b>	Double glazing (air-filled, soft low-E coating)	3.2	2.6	2.5
Double glazing (argon-filled)	2.9	2.7	2.6	Double glazing (argon-filled)	3.5	3.3	3.2
Double glazing (argon-filled, hard low-E coating)	2.5	2.1	<b>2.0</b>	Double glazing (argon-filled, hard low-E coating)	3.1	2.6	2.5
Double glazing (argon-filled, soft low-E coating)	2.3	<b>1.9</b>	<b>1.8</b>	Double glazing (argon-filled, soft low-E coating)	2.9	2.4	2.3
Triple glazing (air-filled)	2.4	2.1	<b>2.0</b>	Triple glazing (air-filled)	2.9	2.6	2.5
Triple glazing (air-filled, hard low-E coating)	2.1	<b>1.7</b>	<b>1.6</b>	Triple glazing (air-filled, hard low-E coating)	2.6	<b>2.2</b>	<b>2.0</b>
Triple glazing (air-filled, soft low-E coating)	<b>2.0</b>	<b>1.6</b>	<b>1.5</b>	Triple glazing (air-filled, soft low-E coating)	2.5	<b>2.0</b>	<b>1.9</b>
Triple glazing (argon-filled)	2.2	<b>2.0</b>	<b>1.9</b>	Triple glazing (argon-filled)	2.8	2.5	2.4
Triple glazing (argon-filled, hard low-E coating)	<b>1.9</b>	<b>1.6</b>	<b>1.5</b>	Triple glazing (argon-filled, hard low-E coating)	2.4	<b>2.0</b>	<b>1.9</b>
Triple glazing (argon-filled, soft low-E coating)	<b>1.8</b>	<b>1.4</b>	<b>1.3</b>	Triple glazing (argon-filled, soft low-E coating)	<b>2.2</b>	<b>1.9</b>	<b>1.8</b>

## Central heating and hot water systems

### Central heating and hot water systems

- The Building Regulations apply to new and replacement heating and hot water systems in existing dwellings with floor areas greater than 50 m<sup>2</sup>.

### Replacement boilers

- Replacement boilers must have minimum seasonal efficiencies of 78% (for mains gas-fired boilers), 80% (for LPG fired boilers), 85% (for regular oil-fired boilers) or 82% (for oil-fired combination boilers).
- Replacement back boilers may have seasonal efficiencies 3% lower than those listed above.
- The Best Practice seasonal efficiencies are 82% (for mains gas boilers), 84% (for LPG boilers), 85% (for regular oil boilers) and 82% (for oil combination boilers).
- Good Practice Guide 284 provides advice on the selection and design of boiler-based central heating systems.

### Heating controls

- If either a boiler or an entire heating system is replaced adequate controls must be installed (or the existing controls must be upgraded). The minimum requirement is for fully pumped systems incorporating time controls, zone temperature controls and boiler interlock. Good Practice Guide 302 suggests an appropriate minimum set of controls.
- If a whole heating system is replaced there must be a full programmer to provide independent time control of the heating and hot water. Mini programmers and standard programmers do not comply.
- All new and replacement systems must include a room thermostat and 'boiler interlock' (ie the thermostat switches the boiler off when there is no demand for heating).

• Authenticated seasonal efficiencies for most boilers appear in the Boiler Efficiency Database at [www.boilers.org.uk](http://www.boilers.org.uk) and in The Little Blue Book of Boilers. Only figures from these sources, or from SAP Table 4b are acceptable.

- Small dwellings (eg single-storey open-plan flats and bed-sitters) may have a single control zone.
- Large houses should have more than two control zones, none of which should exceed 150 m<sup>2</sup> floor area, and each zone must have independent time and temperature controls.

- If a whole heating system is replaced, the controls must permit independent temperature control in two separate zones: the living and sleeping areas. This can be achieved with a single room thermostat and thermostatic radiator valves.
- The Best Practice standard is to install systems and controls to specification HR4 or HC4 in General Information Leaflet 59; these specifications include condensing boilers.

### Hot water cylinders

- New and replacement hot water storage cylinders must be insulated and meet the requirements of BS 1566 if they are vented or BS7206 if they are unvented. 'Medium duty' and uninsulated cylinders do not comply.
- All cylinders must be fitted with thermostats to switch off the supply of heat when the water in the tank is hot enough. If the whole heating system is replaced then the hot water circuit must be pumped.

### Pipework insulation

- Heating pipework outside the heated space (eg in lofts and garages) must be insulated.
- The primary hot water pipework (ie the flow and return between the boiler and the hot water cylinder) and the vent pipe must be insulated for a minimum of 1 metre from the point of connection (or until they disappear into the construction). The Best Practice standard is that the primary pipework is insulated throughout its length.

### Commissioning and user instructions

- All new and replacement heating and hot water installations must be inspected and commissioned in accordance with the manufacturers' recommendations.
- The owner or occupant of the dwelling must be provided with operating and maintenance instructions that are specific to the system installed. Generic instructions for systems of similar type do not comply.

### Electric heating

- For off-peak storage heating the minimum requirement is that heaters incorporate automatic charge control, which adjusts the charging of the heater according to the temperature inside the dwelling.
- For on-peak systems the minimum requirement is the provision of timing controls and zone temperature controls.
- This requirement can be met by a timeswitch or programmer combined with a room thermostat and/or appliance thermostats.

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### Further reading

The following Energy Efficiency Best Practice in Housing programme publications may be ordered from the programme website at [www.est.org.uk/bestpractice](http://www.est.org.uk/bestpractice) or ring **0845 120 7799**

- Good Practice Guide 26 Cavity wall insulation in existing housing
- Good Practice Guide 138 Internal wall insulation in existing housing
- Good Practice Guide 155 Energy-efficient refurbishment of existing housing
- Good Practice Guide 175 Energy efficient refurbishment of low rise cavity wall housing (archived document)
- Good Practice Guide 224 Improving airtightness in existing dwellings
- Good Practice Guide 284 Domestic central heating and hot water systems with gas- and oil-fired boilers
- Good Practice Guide 301 Domestic heating and hot water: choice of fuel and system type
- Good Practice Guide 302 Controls for domestic central heating and hot water
- General Information Leaflet 59 Central Heating Systems Specifications (CHeSS)

The detailed requirements of The Building Regulations are set out in The Building Regulations 2000, Approved Document L1 Conservation of Fuel and Power, 2002 edition, The Stationery Office, London, 2001.

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Energy Efficiency Best Practice in Housing is managed by the Energy Saving Trust on behalf of the Government.

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All technical information was produced by BRE on behalf of the EST.  
This leaflet was printed by a Carbon Neutral® company.

The 'robust construction details' are described in Limiting thermal bridging and air leakage: robust construction details for dwellings and similar buildings (DTLR/DEFRA, The Stationery Office, London, 2001).

The Little Blue Book of Boilers is published in conjunction with the Energy Saving Trust. Copies can be obtained by calling the Energy Efficiency Hotline on **0845 727 7200**, or via your local Energy Efficiency Advice Centre on **0800 512012**.

Further guidance about heating and hot water systems appears in The Domestic Heating and Hot Water Guide to the Building Regulations 2001, published by the Energy Efficiency Partnership for Homes. To obtain a copy call **0845 727 7200** or visit the Central Heating Information Council's website at [www.centralheating.co.uk](http://www.centralheating.co.uk).

The Benchmark scheme for gas-fired boilers and heating systems may be contacted via the Central Heating Information Council, telephone **01926 423284**.

The Oil-Firing Technical Association's (OFTEC) Oil-Firing Registration Scheme may be contacted by telephoning **01737 373311**.

The Heating Equipment Testing and Approval Scheme (HETAS) Registration Scheme for companies and engineers involved in the installation and maintenance of domestic solid fuel fired equipment may be contacted by telephoning **01462 634721**.

**This leaflet is based on material drafted by Rickaby Thompson Associates Limited for the Energy Efficiency Best Practice in Housing programme**

