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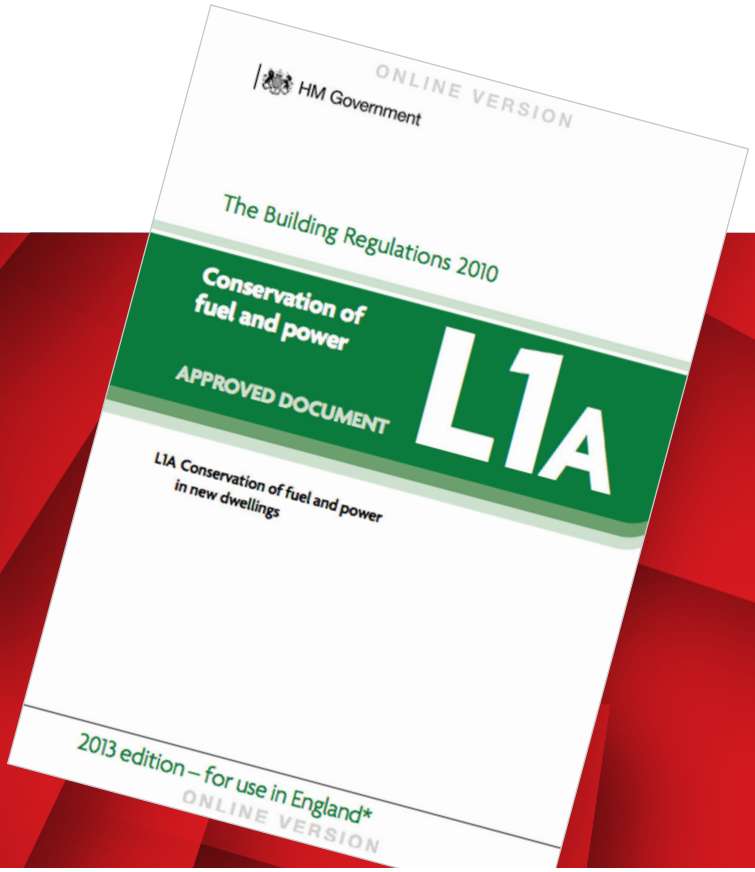
Technical Briefing Note

The Building Regulations, Part L (2013)



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Technical Briefing Note

The Building Regulations, Part L (2013)

The latest revisions to energy performance standards within the Building Regulations Part L has concentrated minds towards the performance of the building fabric. Energy Efficiency has become the number one priority in the form of FEES.

FEES is not just U-values, it's about detailing, about installation and about 'joined up thinking,' about doing things differently. At Xtratherm we've been doing exactly that over the past number of years.

Here we have published a Briefing Note on Part L 2013, it's is part of a suite of guidance information and interactive presentations that Xtratherm have created to assist you on meeting regulations and achieving low energy design.

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The Government has updated Part L of the Building Regulations for England. The update is intended to improve the energy efficiency of new dwellings by approximately 6% (compared with those that met the previous regulations), and by approximately 9% for new non-domestic buildings, across the mix of new building stock, improve the correlation between the predicted and actual performance of new buildings, continue along the path towards zero-carbon new buildings within the next decade, and to promote improvement of the existing building stock. Guidance appears in four new editions of the Part L Approved Documents, which will come into force on 6 April 2014:

- Approved Document L1A
  New Dwellings
- Approved Document L1B
  Existing Dwellings
- Approved Document L2A
  New Buildings Other Than Dwellings
- Approved Document L2B
  Existing Buildings Other Than Dwellings

These are supplemented by two 'second tier' documents:

- The Domestic Building Services Compliance Guide
- The Non-Domestic Building Services Compliance Guide

And these are supported by 'third tier' documents, including standards, codes of practice, good practice guides and reports published by BRE, etc.

Wales will from later in 2014 have its own building Regulations based upon the same methodology but with different targets. Scottish Building Regulations will follow in 2015.

Approved Document L1A
New Dwellings

For new dwellings, Approved Document L1A retains the five criteria for demonstrating compliance with the new regulations, which were introduced in 2006. Criterion 1 is a regulation, and therefore mandatory, whereas the limits on design flexibility in Criterion 2 are statutory guidance.

1. The Dwelling Carbon Dioxide Emissions Rate (DER) must not exceed the Target Carbon Dioxide Emissions Rate (TER), and the Dwelling Fabric Energy Efficiency (DFEE) must not exceed the Target Fabric Energy Efficiency (TFEE).

The DER (in kg/m^2/yr) is calculated as part of a Standard Assessment Procedure (SAP 2012) energy rating calculation, for the dwelling as proposed.

The TER (also in kg/m^2/yr) is also calculated as part of the SAP 2012 energy rating, but for a notional dwelling of the same size and shape as the one proposed, with gasfired central heating, using the specifications for the building fabric and services of the notional dwelling is published in SAP 2012, Appendix R. The improvement factors (which reduced the TER calculated in SAP 2005 by 20% in Part L 2006 and a further 25% in Part L 2010) no longer apply.

To establish the TER, if the proposed dwelling uses a more carbon dioxide intensive fuel (e.g. grid electricity) than mains gas, the calculated emissions rate associated with energy use by the heating and hot water systems is adjusted by a fuel factor that raises the emissions target then added to the calculated emissions rate associated with energy use for pumps, fans and fixed internal lighting. This makes it easier for dwellings that use such fuels to comply, but for example an electrically heated dwelling will still require more insulation (or other energy efficiency features) than an identical dwelling that is heated by gas.

The TER and the *as-designed* DER must be reported to the Building Control Body (BCB) or Approved Inspector (AI) before work commences on site. The *as-built* DER must be reported to the BCB or AI before compliance with Part L is certified.

The TFEE (in kWh/m^2/yr) is calculated by determining the fabric energy efficiency of a notional dwelling of the same size and shape as the actual dwelling, using the dwelling specification summarised in Table 4 of Approved Document Part L1A and set out in full in SAP 2012, Appendix R (see Appendix A of this document).

The calculated fabric energy efficiency is the annual heating and cooling energy use divided by the total floor area; it is then multiplied by 1.15 to determine the TFEE.

The DFEE (in kWh/m^2/yr) is calculated by dividing the annual heating and cooling energy use of the actual dwelling by the total floor area. In order to comply, the DFEE must not exceed the TFEE. Thus building a dwelling to the specification in SAP 2012, Appendix R, will result in the dwelling's DFEE being lower than the TFEE.

Consideration of high-efficiency alternative systems for new buildings

Regulation 25A of the Building Regulations 2010 states that consideration of high-efficiency alternative systems must be given before construction of a new building starts. The systems to be considered include:

- Decentralised energy supply systems based on renewable energy sources
- Cogeneration (combined heat and power or combined heat and mechanical energy)
- District heating, especially if some or all of the energy is from renewable sources
- Heat pumps (air, ground or water source)

The person carrying out the building work must inform the BCB that the analysis has been undertaken, is documented and is available for inspection by the BCB. This must be done no later than the morning of the day before work is due to commence.

The analysis should state whether high-efficiency alternative systems have or have not been included in the design, although there is no requirement that high-efficiency systems have to be used.

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SAP 2012

The version of the Standard Assessment Procedure (SAP) energy rating referred to in Approved Document L1A is SAP 2012. This differs from the previous version (SAP 2009) in several ways:

- Weather data has been extended to allow calculations using regional weather
- An allowance for height above sea level is incorporated into external temperature data
- Carbon dioxide emissions factors have been updated
- Fuel prices and primary energy factors have been revised

Weather data is included a new Appendix U. At present the effect of feed-in tariffs has not been factored into SAP. This is under consideration and the government will consult on proposals.

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2. Design limits for the building fabric and services must not be exceeded.

For the building fabric, there are maximum thermal transmittances (U values) expressed as area-weighted averages for all the elements of each type. The maximum area-weighted average U values are: roofs 0.20 W/m²K; walls 0.30 W/m²K; floors 0.25 W/m²K; party walls 0.20 W/m²K; windows and external doors 2.00 W/m²K; and swimming pool basins 0.25 W/m²K. The overall air permeability of the building fabric must not exceed 10 m³/m²h in a 50 Pa pressure test.

In general, fabric performance will have to be significantly better than the design limits to achieve the TER and TFEE.

For building services, the *Domestic Building Services Compliance Guide* sets out minimum standards for heating and hot water systems (including community systems), heat pumps, micro CHP, mechanical ventilation, comfort cooling, solar water heating and fixed lighting. The guide defines minimum efficiencies for energy using appliances, minimum controls, and minimum insulation for primary pipework, warm air ducts and hot water storage cylinders. Minimum coefficients of performance (CoPs) are defined for heat pumps. For ventilation equipment, there are design limits expressed in terms of maximum specific fan-power (including standards for intermittent fans) and minimum heat recovery efficiency (if fitted).

75% of fixed internal lighting must be by means of energy efficient lamps (output > 400 lm and efficacy > 45 lm/W).

Fixed external lighting must have controls that switch off the lamps when there is sufficient daylight; if energy efficient lamps are not used then lamps must not exceed 100 W per fitting and there must be controls that switch them off when they are not required.

In practice, building fabric and services with performance significantly better than the design limits will be required, in order to meet the carbon dioxide emissions target.

3. There must not be a high risk of the dwelling overheating in summer.

This is demonstrated by a check included in the SAP 2012 energy rating calculation, which grades the risk of summer overheating by means of a calculated 'threshold temperature' (i.e. the 24-hour mean internal temperature in warm weather). Designs with threshold temperatures above 23.5°C have a high risk of overheating and are deemed not to comply. The threshold temperature calculation ignores any installed comfort cooling or air conditioning, in order to promote designs that do not require such systems. Design features that can be used to reduce the threshold temperature include: the area, orientation and shading of glazed openings; the thermal capacity of the building fabric; and the provision of secure ventilation (especially at night).

4. The dwelling as constructed should include no reasonably avoidable thermal bridges, and the as-built DER, including the tested air permeability, must not exceed the TER.

To minimise thermal bridging, reasonable provision includes:

- Use of approved design details as set out in DCLG *Approved Construction Details*
- Use of construction joint calculations from a person with suitable expertise and experience following the guidance in BRE Report BR 497 *Conventions for calculating linear thermal transmittance and temperature factors.*
- Use of the linear thermal transmittance values in the 'default' column of SAP 2012 Table K1.
- If approved design details are not used and Ψ values are not calculated, a conservative default overall thermal bridging transmittance (y value) of 0.15W/m²K must be included in the DER calculation.

1. Approved Document L1A 2013 edition, section 3.10 states that 'Evidence of suitable expertise and experience for calculating linear thermal transmittance would be to demonstrate that the person has been trained in the software used to carry out the calculation, has applied that model to the example calculations set out in BR 497 and has achieved results that are within the stated tolerances'.

The effect of using linear thermal transmittance values that are poorer than those in SAP 2012 Appendix R is that significant improvements to the rest of the design will need to be made in order to achieve the TER and TFEE. **SAP 2012 has introduced 19 new junctions in Table K1, which need to be accounted for when calculating the linear thermal transmittance value, these will add significantly to the Y- value performances compared to SAP2009**. Of the 42 junctions now in Table K1, 25 do not have an Approved Design Detail Ψ value, which means the Ψ values will need to be calculated if developers do not wish to use the default values.

Three dwellings, or 50% of the dwellings of each type (whichever is less) must be pressure tested to confirm compliance with the design limit and establish the tested air permeability for incorporation in the as-built DER calculation. Tests must be carried out in accordance with the Air Tightness Testing and Measurement Association's Technical Standard L1 *Measuring the Air Permeability of the Building Envelopes of Dwellings* (2010). If the tested air permeability exceeds the design limit of 10 m^3/m^2h @ 50 Pa, or results in the as-built DER and DFEE exceeding the TER or TFEE, then remedial measures must be implemented in all dwellings of that type, the dwelling must be re-tested to confirm compliance, and an additional dwelling of the same type must be tested. For dwellings that are not included in the test sample, the air permeability used in the as-built DER calculation is the test result plus 2 m^3/m^2h.

For developments of not more than two dwellings, the Building Control Body may accept a pressure test certificate for a dwelling of the same type, constructed within the previous twelve months. Alternatively, if no pressure testing is carried out, an air permeability of 15 m^3/m^2h may be used in the calculation of the as-built DER (which still may not exceed the TER).

Building services must be commissioned by suitably qualified persons, and commissioning certificates provided.

5. Owners or occupants of dwellings must be provided with information to enable them to use their homes efficiently.

The information provided should include: operating and maintenance instructions for the building services (heating and hot water systems, and any ventilation or air conditioning systems); copies of the data used to calculate the DER, DFEE, TER and TFEE; and copies of the recommendations reports associated with the Energy Performance Certificate (EPC) for the dwelling.

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Approved Document L1B
Existing Dwellings

Approved Document L1B provides guidance about work to existing dwellings.

Historic buildings

Historic buildings are divided into two categories. Listed buildings, buildings in Conservation Areas and Scheduled Monuments are 'exempt', but only to the extent that compliance would unacceptably alter their character or appearance. Other buildings of architectural or historic interest, including those in National Parks, Areas of Outstanding Natural Beauty and World Heritage Sites, are subject to 'special considerations', and energy efficiency should be improved as far as possible without prejudicing the buildings' character or increasing the risk of deterioration. Local historic buildings officers should be consulted about proposals, and guidance has been published by English Heritage.

Thermal elements

'Thermal elements' are walls, roofs and floors that separate the internal, conditioned spaces from the exterior, or from unheated spaces. Reasonable provision for energy efficiency is required when thermal elements are provided (extensions), replaced, retained (in a material change of use) or renovated. 'Renovation' means adding or replacing a layer of the construction extending to more than 50% of the area of the individual thermal element (not all elements of the same type in the building), or 25% of the area of the building envelope (which is considered a 'major renovation').

Maximum thermal transmittances (U values) apply to the provision or replacement of thermal elements, as follows: walls 0.28 W/m^2K; roofs 0.16 - 0.18 W/m^2K (depending on construction type); and floors 0.22 W/m^2K.

Target 'improved' U values apply to retained thermal elements whose original U values are worse than specified 'threshold' values, but improvements are not expected to involve investments whose simple paybacks exceed 15 years. The threshold U values are 0.70 W/m²K for walls and floors, and 0.35 W/m²K for roofs. The improved U values are: walls with cavity insulation 0.55 W/m²K; other walls 0.30 W/m²K; floors 0.25 W/m²K; roofs 0.16 - 0.18 W/m²K (depending on construction type). For major renovation, Appendix A identifies potential improvement opportunities, standards (target U values) and technical considerations. Improvements are not expected to involve investments whose simple paybacks exceed 15 years.

Controlled fittings

Controlled fittings are windows, roof windows and external doors. Maximum U values or minimum window energy ratings are specified for new and replacement fittings. The standard for windows is an energy rating of C or better or a maximum U value of 1.6 W/m²K. The standard for doors (irrespective of any glazing) is a maximum U value of 1.8 W/m²K.

If a window is enlarged or a new one is created then the total area of windows, roof windows and external doors should not exceed 25% of the floor area of the dwelling, unless compensating measures are included elsewhere in the work.

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Controlled services

Controlled services are heating, hot water, ventilation, comfort cooling, air conditioning, and fixed lighting (internal and external). The *Domestic Building Services Compliance Guide* defines minimum efficiencies for new or replacement heating appliances, minimum controls, and minimum insulation standards for primary pipework, warm air ducts and hot water storage cylinders, as well as commissioning requirements. The efficiency of a replacement heating appliance must meet the appropriate standard in the *Guide* and must not be significantly less than the efficiency of the appliance that it replaces. If a renewable energy generator is replaced, the new system should have an electrical output not less than that of the original installation.

For new or replacement ventilation equipment, there are design limits expressed in terms of maximum specific fan-power (including a standard for intermittent fans) and minimum heat recovery efficiency (if fitted).

Where new fixed internal lighting (in extensions) or replacement lighting (in existing dwellings) is provided, 75% must be by means of energy efficient lamps (output > 400 lm and efficacy > 45 lm/W).

New fixed external lighting must have controls that switch off the lamps when there is sufficient daylight; if energy efficient lamps are not used then lamps must not exceed 100 W per fitting and there must also be controls that switch them off when they are not required.

Extensions

There are three ways in which the compliance of an extension may be demonstrated. Under the **reference method** all the elements of the design must meet the guidance for the provision of new thermal elements, controlled fittings and controlled services. The area of glazed openings in an extension must not exceed 25% of the floor area, plus the area of any openings in the original dwelling that are covered by the extension.

Under the **area-weighted U value method** the thermal properties of exposed walls, roofs and floors, and the thermal properties and areas of glazed openings, may be traded-off against each other, provided that the area weighted average U value of the whole extension envelope is no greater than it would be if the extension complied by the reference method.

Under the **whole dwelling calculation** method SAP 2012 assessments may be used to show that the predicted carbon dioxide emissions of the extended dwelling as proposed are no greater than they would be if the extension complied by the reference method. Improvements to the original dwelling may be traded-off against a lesser standard of performance in the extension, but they must meet the standards for thermal elements, controlled fittings and controlled services, as appropriate.

Conservatories

A conservatory is exempt if: it is at ground level; it has floor area less than 30 m²; it is separated from the dwelling by the original external walls, windows and doors (or, if they are replaced, by new ones that meet the standards for replacement thermal elements and controlled fittings); and the dwelling's heating system is not extended into the conservatory. Conservatories that do not meet all of these conditions are not exempt.

Non-exempt conservatories are treated as extensions, except that the maximum area of glazed openings does not apply. In addition the conservatory must be separated from the dwelling by the original external walls, windows and doors (or, if they are replaced, by new ones that meet the standards for replacement thermal elements and controlled fittings); and any fixed heating must have independent on/off and temperature control, and meet the guidance for controlled services.

An attached structure that is not separated from the dwelling to which it is attached is treated as an extension, and the maximum area of glazed openings applies.

Material changes of use

A material change of use (where a dwelling is created by conversion of another type of building) must include reasonable provision for energy efficiency, in accordance with the guidance for thermal elements, controlled fittings and controlled services. Existing windows, external doors and roof windows with U values worse than 3.30 W/m^{2}K should be replaced by new fittings that meet the standards for replacement controlled fittings. Alternatively, SAP 2012 assessments may be used to show that the predicted carbon dioxide emissions for the converted *building* are no greater than they would be if all the *dwellings* in the building complied with the guidance for individual thermal elements, controlled fittings and controlled services.

Change of energy status

A change of energy status occurs if a building becomes one to which Part L of the Building Regulations applies, where previously it did not. For example, a change of energy status would occur if: a previously unheated building has heating installed; a previously exempt building is no longer exempt; or the separation between a dwelling and a conservatory is removed. In these cases the same standards apply as for material changes of use.

Approved Document L2A
New Non-Domestic Buildings

For new buildings other than dwellings, Approved Document L2A sets out five criteria for demonstrating compliance with the new regulations. Criterion 1 is a regulation, and therefore mandatory, whereas the limits on design flexibility in Criterion 2 are statutory guidance.

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1. The Building Carbon Dioxide Emissions Rate (BER) must not exceed the Target Carbon Dioxide Emissions Rate (TER)

The BER (in kg/m^2/yr) must be calculated for the building as proposed by an 'accredited model' using the National Calculation Methodology (NCM), one implementation of which is the Simplified Building Energy Model (SBEM). Some dynamic simulation models (DSMs) that incorporate the NCM may also be used. The assessments must be made by an accredited energy assessor and the results presented to the Building Control Body both on submission of a full plans application and on completion of the project, with the energy performance certificate. The assessor should demonstrate that the model used for the calculations is appropriate and can adequately reflect the design approach taken to the building.

The TER is also calculated using the NCM (SBEM), but for a notional building, of the same size and shape as the one proposed, using a set of reference standards for the building's fabric and fixed services. The target is set to achieve an aggregate 9% improvement, compared with the 2010 standards across the new non-domestic stock. The reference standards have been derived from an analysis of the most cost effective measures to deliver the required reduction in carbon dioxide emissions. This means that the approximate cost of meeting the standard across the building stock will be broadly similar, but that some buildings will deliver more than the 9% improvement and others less. To set the target four notional building types have been defined:

- Buildings that are side-lit through vertical windows (offices, halls of residence etc.) and heated only
- Cogeneration (combined heat and power or combined heat and mechanical energy)
- District heating, especially if some or all of the energy is from renewable sources
- Heat pumps (air, ground or water source)

In practice the target will be derived from a combination of notional specifications for different zones of the building, for example a large distribution warehouse will use the top-lit specification for the main warehouse area and the side-lit specification for the office areas.

Consideration of high-efficiency alternative systems for new buildings

Regulation 25A of the Building Regulations 2010 states that consideration of high-efficiency alternative systems must be given before construction of a new building starts. The systems to be considered include:

- Decentralised energy supply systems based on renewable energy sources
- Cogeneration (combined heat and power or combined heat and mechanical energy)
- District heating, especially if some or all of the energy is from renewable sources
- Heat pumps (air, ground or water source)

The person carrying out the building work must inform the BCB that the analysis has been undertaken, is documented and is available for inspection by the BCB. This must be done no later than the morning of the day before work is due to commence.

The analysis should state whether high-efficiency alternative systems have or have not been included in the design, although there is no requirement that high-efficiency systems have to be used.

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For modular and portable buildings with a designed lifespan of more than two years, if 70% of the fabric was manufactured prior to 6 April 2014, compliance with Criterion 1 can be demonstrated by adjusting the TER by the multiplying factor shown in Table 2 of the Approved Document. Buildings with swimming pool basins should be assessed as if the pool basin was not present, and the area of the pool should be given the same U value as the pool surround.

2. Design limits for the building fabric and services must not be exceeded.

For the building fabric, there are maximum U values expressed as area-weighted averages for all the elements of each type. The maximum U values are found in Approved Document C because they are associated with minimising the risk of surface condensation. The assumed design air permeability of the building fabric must not exceed 10 m^3/m^2hr at 50 Pa excess pressure.

For building services, the Non-Domestic Building Services Compliance Guide sets out minimum efficiencies and controls for conventional fixed building services, including space heating, hot water, mechanical ventilation, comfort cooling, interior lighting, low carbon methods of power and heat generation using heat pumps and combined heat and power, and renewable energy systems including wind turbines and solar photovoltaic panels.

Fixed internal lighting must achieve an average efficacy of at least 55 luminaire lumens per circuit Watt in offices, industrial and storage areas (in all building types) and at least 55 lamp lumens per circuit Watt in all other areas. Display lighting must achieve an average efficacy of at least 22 lamp lumens per circuit Watt and have dedicated circuits that can be switched off when people are not inspecting the display.

Energy meters and sub-meters must be installed to account for at least 90% of the use of each fuel, assigned by end-use. 'Low and zero carbon' (LZC) systems should be separately metered. Buildings of more than 1,000 m^2 floor area should have facilities for automatic meter reading and data collection.

In practice building fabric and services with performance significantly better than the design limits will be required, in order to meet the carbon dioxide emissions target.

3. There must not be a high risk of solar overheating

The guidance applies to all buildings, regardless of whether they are designed to use air-conditioning, and has the twin aims of reducing the need for air-conditioning and (where it is installed) ensuring that it is appropriately sized to the cooling load. To demonstrate compliance for occupied spaces or spaces that are mechanically cooled the amount of solar gain for the period April to September should not exceed the solar gains through a reference glazing system as follows:

- For side-lit buildings the reference case is an east facing facade with full width glazing to a height of one metre and a solar energy transmittance value (g-value) of 0.68.
- For top-lit buildings where the average zone is less than 6m high the reference case is a horizontal roof, 10% glazed with rooflights that have a solar energy transmittance value (g-value) of 0.68.
- For top-lit buildings where the average zone is more than 6 m high the reference case is a horizontal roof, 20% glazed with rooflights that have a solar energy transmittance value (g-value) of 0.46.

4. The building as constructed should perform as well as or better than predicted

The building fabric must include no reasonably avoidable thermal bridges, and the 'as built' BER, including the tested air permeability, ductwork leakage rate and commissioned fan performance must not exceed the TER.

To demonstrate compliance with the requirement to reduce the heat losses associated with thermal bridges the builder may use details from a quality-assured accredited construction details scheme; or demonstrate by calculation that the details used provide equivalent or better thermal performance using the calculation procedures in BRE 497, with a process flow sequence (submitted to the Building Control Body) showing how the detail should be constructed; or use unaccredited details, in which case the default values given in BRE's Information Paper IP1/06, increased by a 'workmanship' factor of 50% or 0.04 W/mK (whichever is greater), should be taken in the calculation of the BER. The Building Control Body must be provided with details of the site inspection system that the builder proposes to use to ensure construction quality.

The Building Control Body must also be provided with a report confirming the results of a pressure test to confirm that the air permeability standard has been achieved. Pressure tests must be carried out by suitably qualified persons and in accordance with the Air Tightness Testing and Measurement Association's Technical Standard L2 *Measuring Air Permeability of Building Envelopes* (2010). If the tested air permeability exceeds the design air permeability then the building must be re-tested after remedial work has been carried out. However, the design air permeability may be adjusted provided that it does not exceed the design limit and the as-built BER incorporating the tested air permeability does not exceed the TER. For small buildings of less than 500 m2 floor area, if no pressure testing is carried out, an air permeability of 15 m^3/m^2h @ 50 Pa may be used in the as-built BER calculation (which, nevertheless, may not exceed the TER).

Ductwork must be air-leakage tested in accordance with the Heating Ventilating and Air Conditioning Association's guide DW143, to demonstrate that it achieves the minimum standard assumed in the BER calculation. Ductwork that fails to meet the standard must be subjected to remedial work and re-tested.

To assist the BCB a commissioning plan should be prepared and submitted with the calculation of the TER and BER, setting out the systems installed and the tests that will be carried out. Completed heating, hot water, ventilation and air conditioning systems must be commissioned by competent persons to appropriate standards, and a commissioning notice provided stating that the building services have been commissioned in accordance with the commissioning plan and that the results of the tests are reasonable.

5. The building owner or occupants must be provided with a building log-book

The log book must identify: the installed building services and their controls; the intended method of operation and maintenance; details of the installed energy metering and monitoring systems; and the data used to calculate the TER and BER. In addition, the owner should be provided with the Energy Performance Certificate and the associated recommendations report.

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Approved Document L2B
Existing Non-Domestic Buildings

Approved Document L2B provides guidance about work to existing buildings other than dwellings and the requirements for 'consequential improvements' in energy efficiency of buildings with more than 1,000 m^2 of useful floorspace, when other work is carried out. The Approved Document also provides guidance when a change in energy status occurs, for example when a building (or part) that was previously designed to be unheated becomes heated (e.g. on subsequent fit-out).

Historic buildings

Historic buildings are not exempt from these requirements, but improvements in energy efficiency should not prejudice the character of the building or increase the risk of deterioration; local historic buildings officers should be consulted about proposals.

Thermal elements

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Thermal elements are walls, roofs and floors that separate the internal, conditioned spaces from the exterior, or from adjacent unheated spaces. Reasonable provision for energy efficiency is required when thermal elements are provided (in an extension), replaced, retained (in a material change of use) or renovated. 'Renovation' means adding or replacing a layer of the construction extending to more than 50% of the area of the individual element; 'major renovation' means the renovation of 25% or more of the total building envelope. Maximum U values apply to the provision and replacement of thermal elements. Target 'improved' U values apply to retained thermal elements whose original U values are worse than specified 'threshold' values, but improvements are not expected to involve investments whose simple paybacks exceed 15 years. For renovation similar standards are required as for retained elements; however, where these are not technically viable Approved Document L2B refers to Appendix A of Approved Document L1B, which identifies potential improvement opportunities, standards and considerations. Again, improvements are not expected to involve investments whose simple paybacks exceed 15 years.

Controlled fittings

Controlled fittings are windows, (including curtain walling) roof windows and external doors (including high usage entrance doors and vehicle access doors). Maximum U values (area-weighted averages) are specified for new and replacement fittings in existing buildings. Less demanding U values may be acceptable in buildings with high internal heat gains. A procedure is provided for calculating the overall U-value for curtain walling systems based on the glazing fraction and fraction of opening lights.

Controlled services

Controlled services are heating, hot water, ventilation, air conditioning, internal lighting and renewable energy systems. The **Non-Domestic Building Services Compliance Guide** sets out minimum efficiencies for new or replacement plant, minimum controls, and minimum insulation for pipework, air ducts and hot water storage cylinders, as well as commissioning requirements. The efficiency of replacement plant must meet the standard in the *Guide* and must not be worse than the efficiency of the plant that it replaces. Cooling loads should be reduced, if possible, before cooling plant is provided or replaced.

For new or replacement ventilation equipment, there are design limits expressed in terms of worst acceptable specific fan-power and minimum heat recovery efficiency.

New internal lighting (in extensions) and replacement lighting (in existing buildings) must achieve average efficacy of at least 55 luminaire lumens per circuit Watt in offices, industrial and storage areas (in buildings of any type) or at least 50 lamp lumens per circuit Watt in all other types of space. Display lighting must achieve an average efficacy of at least 22 lm/W and have dedicated circuits that can be switched off when people are not inspecting the display. Emergency lighting and process lighting are not subject to control under Part L.

Where a controlled service is provided, controls should be upgraded, energy meters should be provided and the plant should be commissioned, as required by the *Non-Domestic Building Services Compliance Guide*. As with new buildings a commissioning notice should be provided to the BCB confirming the commissioning has been successfully carried out. The building logbook should be updated, or a new logbook provided.

Extensions

An extension that exceeds 100 m² of floorspace and exceeds 25% of the floor area of the original building is treated as a new building. Other extensions must meet the requirements for the provision of new thermal elements, controlled fittings and services.

There are maximum areas for glazed openings (except for vehicle entrance doors and display windows). The thermal properties of exposed walls, roofs and floors, and the thermal properties and areas of glazed openings may be traded-off against each other, subject to design limits. Approved construction details, or other details with equivalent or better thermal performance as demonstrated by calculation using the methods in BR 497 or BRE IP 1/06, should be used.

An SBEM assessment may be used to show that the carbon dioxide emissions of the extended building are no greater than they would have been if all the elemental standards had been applied to the extension, but required improvements to the original building (e.g. the improved efficiency of a replacement boiler) may not be traded off against a lesser standard of performance in the extension.

Conservatories

A conservatory is *exempt* if: it is at ground level; it has floor area less than 30 m²; it is separated from the building by the original external walls, windows and doors (or, if they are replaced, by new ones that meet the standards for replacement thermal elements and controlled fittings); and the building's heating system is not extended into the conservatory. Conservatories that do not meet all of these conditions are not exempt.

A non-exempt conservatory is treated as an extension, but the maximum glazed areas do not apply; it must also be separated from the building by the original external walls, windows and doors (or, if they are replaced, by new ones that meet the standards for replacement thermal elements and controlled fittings); and any fixed heating must have independent on/off and temperature control, and meet the guidance for controlled services. An attached structure that is not separated from the building to which it is attached is treated as an extension, and the maximum glazed areas do apply.

Material changes of use and changes of energy status

A material change of use occurs when a building is converted to one use from a different use. A change of energy status occurs if a building becomes one to which Part L of the Building Regulations applies, where previously it did not. For example, a change of energy status would occur if: a previously unheated building has heating installed; a previously exempt building is no longer exempt; or the separation between a building and a conservatory is removed.

Material changes of use and changes of energy status must include reasonable provision for energy efficiency, in accordance with the requirements for thermal elements, controlled fittings and controlled services. Existing windows, external doors and roof windows with U values worse than 3.30 W/m²K should be replaced by new fittings that meet the requirements for replacement controlled fittings. The total area of openings in the converted building should be limited to 25% of the total floor area, or compensating measures should be applied elsewhere in the design to improve energy efficiency. Alternatively, an SBEM assessment may be used to show that the predicted carbon dioxide emissions of the building as proposed are no greater than they would be if the individual standards for thermal elements, controlled fittings and controlled services were applied to the conversion.

It may also be the case that the building works carried out are one of the triggers for consequential improvements. In this event the energy efficiency of the building as a whole must be improved in line with the guidance described below.

Consequential improvements

Consequential improvements apply only to buildings with total useful floor areas greater than 1,000 m². In these cases improvement of the energy efficiency of the whole building must be made if: the floorspace is increased; or the capacity of any fixed building service is increased; or a new fixed building service is provided where it was not provided before. Consequential improvements might include: upgrading thermal elements in line with the requirements for retained thermal elements; replacement of windows, doors and roof windows that have U values worse than 3.30 W/m²K; replacement of heating, air handling or cooling plant that is more than fifteen years old; upgrading of any lighting system that serves an area of more than 100 m² and has an average efficacy less than 40 lm/W; or increasing the provision of energy from on-site low- or zero-carbon technologies, if it is less than 10%.

Consequential improvements should achieve a simple payback of capital cost (via fuel cost savings) within fifteen years, and the expected capital investment should be at least 10% of the cost of the principal works that trigger the requirement. However, this 10% rule does not apply where a new service is added to a building or its existing capacity is increased: in these cases all of the thermal elements enclosing the newly-treated areas should be improved in accordance with the requirements for retained thermal elements; windows or doors with U values worse than 3.30 W/m²K should be replaced; and (in the case of new or extended cooling systems) the cooling load should be reduced.

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Glossary

α value – the additional thermal transmittance of the envelope of a non-domestic building due to heat loss via non-repeating thermal bridges, in W/m²K (as used in SBEM).

Air permeability – the air leakage rate per unit area of the building fabric measured in m³/m²/hr at 50 Pa excess pressure.

BER – the Building (carbon dioxide) Emissions Rate in kg/m²/yr, as calculated by the National Calculation Methodology (NCM), one implementation of which is the Simplified Building Energy Model (SBEM).

Building Control Body – a local authority or improved inspector licensed to control compliance with the Building Regulations.

Change of energy – status any circumstance in which a building becomes one to which Part L of the Building Regulations applies, where previously it did not.

Consequential improvement – improvement of the energy efficiency of a building (or part of a building) as a consequence of other work being carried out, as required by Building Regulation 17D.

Conservatory – a structure that has at least 75% of its roof and at least 50% of its walls made of translucent material, and is thermally separated from the building to which it is attached.

Controlled fittings – windows, roof windows and external doors (including vehicle doors and highusage entrance doors) in existing buildings.

Controlled services – fixed heating, hot water, ventilation, air conditioning and lighting systems in existing buildings.

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DER – Dwelling (carbon dioxide) emissions rate in kg/m²/yr, as calculated by the Standard Assessment Procedure (SAP) energy rating 2005.

Design air permeability – the assumed air permeability included in the calculation of the DER of an unbuilt dwelling, or the BER of an unbuilt non-domestic building, at the design stage.

Design limits – the worst acceptable U values and air permeability of the building fabric, the worst acceptable efficiencies of space and water heating appliances, the worst acceptable specific fan power and heat recovery efficiencies of ventilation systems, and the minimum provision and/or efficacy of fixed internal and external lighting systems, in new buildings.

DFEE – Dwelling fabric energy efficiency in kWh/m²/yr, calculated from the annual heating and cooling energy use of the dwelling, divided by the total floor area.

Display lighting – lighting that is intended to highlight exhibits or displays of merchandise, or used in places of public entertainment.

Display window – an area of glazing intended for the display of products or services at the external perimeter of a building and adjacent to (and extending not more than 3 m above) a pedestrian thoroughfare.

Dwelling – a self-contained unit of residential accommodation designed to accommodate a single household.

Dwelling type – a set of dwellings of the same built form in which the same construction methods are used for each of the main elements, irrespective of small variations in floor area.

Effective heat generating seasonal efficiency – the sum of the Heating Efficiency Credits and the Heat Generator Seasonal Efficiency.

Emergency escape lighting – lighting that provides illumination for the safety of people leaving an area or attempting to terminate a dangerous process before leaving an area.

Fit out work – work to complete the internal partitioning and building services within the external envelope (shell) of a building to meet the specific needs of incoming occupants.

Fixed building services – any part of or any controls associated with fixed systems for heating, hot water, air conditioning, mechanical ventilation or internal or external lighting (excluding emergency escape lighting and specialist process lighting).

Heat generator – a device for converting fuel and/or electricity into heat.

Heat generator efficiency – the ratio of useful heat output to energy input in the fuel (based on gross calorific value) or electricity delivered to the heat generator.

Heat generator seasonal efficiency – the estimated seasonal ratio of heat input to heat output from the heat generator, which depends on the Heat Generator Efficiency and the operating mode over the heating season.

Heating efficiency credits – credits applied to the Heat Generator Seasonal Efficiencies of heating and hot water systems to account for measures such as improved control.

High usage entrance door – an external door (equipped with closers) at a building entrance (with a lobby) that is expected to experience a large traffic volume, and where robustness and/or powered operation is the primary performance requirement.

Historic building – a building that is officially 'listed' as of special architectural or historic interest, or which is located in a Conservation Area, a National Park, an Area of Outstanding Natural Beauty or a World Heritage Site.

Material change of use – the conversion of a building into a dwelling or dwellings, or the addition of a dwelling to a building that already contains dwellings; or the conversion of a building to a hotel, boarding house, institution or public building, where previously it was not.

Minimum controls package – a package of controls specific to each technology that represents the minimum provision for controls to reduce carbon dioxide emissions associated with space heating, water heating or cooling.

National Calculation Methodology (NCM) – the UK national methodology, under the EPBD, for calculation of the energy performance of buildings; one implementation of the NCM is SBEM.

Principal works – works to an existing building that give rise to a requirement for consequential improvement of the energy efficiency of the building.

Ψ value – the linear thermal conductivity of a construction detail, in W/mK.

Renovation (of a thermal element) – provision of a new layer, or replacement of an existing layer, in the construction of a thermal element of an existing building.

Room for residential purposes – a room or a suite of rooms that is not a dwelling and that is used by one or more persons to live and sleep, (including rooms in hostels, hotels, boarding houses, halls of residence and residential homes) and which is separated from the rest of the building by a lockable door but not designed to be occupied by a single household.

SAP – the Standard Assessment Procedure for the energy rating of dwellings (i.e. The National Calculation Methodology for domestic buildings in England, Wales and Northern Ireland).

SBEM – the Simplified Building Energy Model (i.e. The National Calculation Methodology for nondomestic buildings).

Seasonal efficiency – the estimated ratio of the heat input (based on the gross calorific value of the fuel) to the heat output of a heat generating appliance, (e.g. a boiler) over the heating season.

Simple payback – the amount of time taken to recover an initial investment in improved energy efficiency through fuel cost savings (excluding VAT).

Space heating system – the complete system that is installed to provide heating to a space, including the heating appliance or plant and the heat distribution and emission mechanism.

Specialist process lighting – lighting that is intended to illuminate specialist tasks within a space, rather than the space itself.

TER – the Target (carbon dioxide) Emissions Rate in kg/m^{2}yr, as calculated by SAP (for dwellings) or by SBEM (for all other buildings).

TFEE – Target fabric energy efficiency in kWh/m^2/yr, calculated from the annual heating and cooling energy use of the notional dwelling, divided by the total floor area and multiplied by 1.15.

Thermal bridge - an area of reduced insulation within the construction of a wall, roof or floor, at the junction of a wall with another wall or a roof or a floor, or around an opening such as a window, roof window or external door.

Thermal element – a wall, floor or roof of an existing building that separates the internal conditioned space from the external environment or from an unheated space.

Total useful floor area – the total floor area of all enclosed spaces in a building measured to the internal faces of the external walls.

y value – the additional thermal transmittance of the whole envelope of a domestic building due to heat loss through all the non-repeating thermal bridges, in W/m^{2}K (as used in SAP).

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Appendix A
SAP 2102 Appendix R, Table R1

Table R1 : Reference values for England

Element or system	Value
Climate data	UK average
Size and shape	Same as actual dwelling
Opening areas (windows, roof windows and doors)	Same as actual dwelling up to a maximum for total area of openings of 25% of total floor area. If the total area of openings in the actual dwelling exceeds 25% of the total floor area, reduce to 25% as follows: 1. Include all opaque and semi-glazed doors with the same areas as the actual dwelling (excluding any doors not in exposed elements, e.g. entrance door to a flat from a heated corridor). 2. Reduce area of all windows and roof windows by a factor equal to [25% of total floor area less area of doors included in 1)] divided by [total area of windows and roof windows in actual dwelling].
External walls including semi exposed walls	U = 0.18 W/m²K
Party walls	U = 0 W/m²K
Floors	U = 0.13 W/m²K
Roofs	U = 0.13 W/m²K
Opaque door (<30%glazed area)	U = 1.0 W/m²K
Semi-glazed door (30%- 60% glazed area)	U = 1.2 W/m²K
Windows and glazed doors with > 60% glazed area	U = 1.4 W/m²K Frame factor = 0.7 Solar energy transmittance = 0.63 Light transmittance = 0.80 Orientation same as actual dwelling Overshading same as actual dwelling
Roof windows	U = 1.4 W/m²K (Adjustment factor of +0.3 W/m²K applied to roof window as described below Table 6e; resultant U value = 1.7 W/m²K) Other parameters as for windows
Curtain wall	Curtain walling to be treated as standard glazing and opaque wall with the same areas as the actual dwelling. When the total opening area exceeds 25% of floor area the glazed area to be reduced to 25% as for opening areas above. U-value of opaque wall = 0.18 W/m²K U-value of glazing = 1.5 W/m²K (which includes an allowance of 0.1 for thermal bridging within the curtain wall)
Thermal mass	Medium (250 kJ/m²K)
Living area	Same as actual dwelling
Number of sheltered sides	Same as actual dwelling

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Allowance for thermal bridging	1. If the thermal bridging in the actual dwelling has been specified by using the default y-value of 0.15 W/m²K, the thermal bridging is defined by y = 0.05 W/m²K. 2. Otherwise the thermal bridging allowance is calculated using the lengths of junctions in the actual dwelling and the psi values in Table R2. Note. Where the area of openings is > 25% of the total floor area the lengths of junctions in the notional dwellings remain the same as the lengths in the actual dwelling, even though window area is reduced as described for 'Opening areas' above.
Ventilation system	Natural ventilation with intermittent extract fans
Air permeability	5 m³/h·m² at 50 Pa
Chimneys	None
Open flues	None
Extract fans / passive vents	2 extract fans for total floor area up to 70 m², 3 for total floor area > 70 m² and up to 100 m², 4 for total floor area > 100 m²
Main heating fuel (space and water)	Mains gas
Heating system	Boiler and radiators Central heating pump in heated space
Boiler	If gas or oil combi boiler in actual dwelling combi boiler Otherwise regular boiler Efficiency, SEDBUK(2009) = 89.5% Room-sealed, fan-assisted flue Modulating burner control No hot water test for combi boiler
Heating system controls	1. For a single storey dwelling in which the living area is greater than 70% of total floor area, programmer and room thermostat; 2. For any other dwelling, time and temperature zone control. And in all cases: Boiler interlock Weather compensation providing +3% boiler efficiency adjustment
Hot water system	Heated by boiler (regular or combi as above) Separate time control for space and water heating
Hot water cylinder	If cylinder specified in actual dwelling: volume of cylinder in actual dwelling If combi boiler: no cylinder Otherwise: 150 litres If cylinder, declared loss factor = 0.85 x (0.2 + 0.051 V2/3) kWh/day, where V is the volume of the cylinder in litres
Primary water heating losses	Fully insulated primary pipework Cylinder temperature controlled by thermostat Cylinder in heated space
Water use limited to 125 litres per person per day	Yes
Secondary space heating	None
Low energy light fittings	100% of fixed outlets
Air conditioning	None

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Technical Support

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