

The Building Bye-Laws (Jersey) 2007

TECHNICAL GUIDANCE DOCUMENT
11.2B

PART 11
CONSERVATION OF FUEL AND
POWER
IN EXISTING BUILDINGS OTHER
THAN DWELLINGS

October 2015.

MAIN CHANGES IN THE 2016 EDITION

This technical guidance document, Technical Guidance Document 11.2B: Conservation of fuel and power in existing buildings other than dwellings supports the energy efficiency requirements of the Building Bye-laws. This technical guidance document takes effect..... and applies to applications for building permission submitted on or after that date.

The main changes in this technical guidance document are that:

CHANGES IN THE LEGAL REQUIREMENTS

- 1) The requirements for consequential improvements to existing buildings have been extended to include dwellings where the proposed work consists of an extension.
- 2) Requirements relating to the renovation or replacement of thermal elements amended.
- 3) New bye-law requiring information to be provided to building owner about the building and the fixed building services.

CHANGES IN THE TECHNICAL GUIDANCE

- 4) The main technical changes comprise a general strengthening of energy efficiency standards that are considered reasonable for work on thermal elements, controlled fittings and controlled services in existing buildings.
- 5) Additional guidance is given for historic and traditional buildings which may have an exemption from the energy efficiency requirements or where special considerations apply.
- 6) The guidance for the renovation of a thermal element through the provision of a new layer or through the replacement of an existing layer has been expanded.
- 7) Guidance is provided for swimming pool basins (walls and floor) in existing buildings.

WHAT IS A TECHNICAL GUIDANCE DOCUMENT?

The Minister for Planning and Environment has approved a series of documents that give practical guidance about how to meet the requirements of the Jersey Building Bye-laws. Technical guidance documents give guidance on each of the technical requirements of the Building Bye-laws and on Bye-law 7.

A list of all technical guidance documents that have been approved and issued by the Planning and Environment Minister can be obtained from the States of Jersey website: www.gov.je.

Technical guidance documents set out what, in ordinary circumstances, may be accepted as reasonable provision for compliance with the relevant requirements of the Building Bye-laws to which they refer. If you follow the guidance in a technical guidance document, there will be a presumption of compliance with the requirements covered by the guidance. However, compliance is not guaranteed; for example, 'normal' guidance may not apply if the particular case is unusual in some way.

Note that there may be other ways to comply with the requirements – *there is no obligation to adopt any particular solution contained in a technical guidance document*. If you prefer to meet a relevant requirement in some other way than described in a technical guidance document, you should discuss this with the department.

In addition to guidance, some technical guidance documents include provisions that must be followed exactly, as required by Building Bye-laws or where methods of test or calculation have been prescribed by the Minister.

Each technical guidance document relates only to the particular requirements of the Building bye-laws that the document addresses. However, building work must also comply with any other applicable requirements of the Building Bye-laws.

HOW TO USE THIS TECHNICAL GUIDANCE DOCUMENT

This document uses the following conventions.

- a) **Text against a blue background** is an extract from the Building Bye-laws (Jersey) 2007, as amended. These extracts set out the legal requirements of the bye-laws.
- b) **Key terms, printed in bold blue text** are defined in Appendix A.
- c) When the technical guidance document refers to a named standard or other document, the relevant versions are listed in Appendix B (documents referred to) and Appendix C (standards referred to) respectively. However, if the issuing body has revised or updated the listed version of the standard, you should use the new version as guidance provided that it continues to address the relevant requirements of the Building Bye-laws.

- d) Additional *commentary in italic text* appears after some numbered paragraphs. This commentary is intended to assist understanding of the immediately preceding paragraph or sub-paragraph, or to direct readers to sources of additional information, but is not part of the technical guidance itself.

NOTE: Standards and technical approvals may also address aspects of performance or matters that are not covered by the Building Bye-laws, or they may recommend higher standards than required by the Building Bye-laws.

DRAFT

The following is a high level summary of the Building Bye-laws relevant to most types of building work. Where there is any doubt you should consult the full text of the Building Bye-laws, available at www.gov.je.

BUILDING WORK

Part 1 of the Building Bye-laws defines 'building work'. Building work includes:

- a. the erection or extension of a building
- b. the provision or extension of a controlled service or fitting in or in connection with a building
- c. the material alteration of a building or a controlled service or fitting
- d. the renovation and or replacement of thermal elements.

Bye-law 5 states that building work should be carried out in such a way, that when work is complete:

- a. for new buildings or work on a building that complied with the applicable requirements of the Building Bye-laws: the work and the building comply with the applicable requirements of the Building Bye-laws.
- b. For work on an existing building that did not comply with the applicable requirements of the Building Bye-laws:
 - The work itself must comply with the applicable requirements of the Building Bye-laws; **and**
 - The building must be no more unsatisfactory in relation to the requirements than before the work was carried out.

MATERIAL CHANGE OF USE

Bye-law 2 defines a 'material change of use' in which a building or a part of a building that was previously used for one purpose will be used for another.

The Building Bye-laws set out requirements that must be met before a building can be used for a new purpose. To meet the requirements, the building may need to be upgraded in some way.

MATERIALS AND WORKMANSHIP

In accordance with Bye-law 7, building work must be carried out in a workmanlike manner using adequate and proper materials. Guidance on materials and workmanship is given in the Technical Guidance Document - Bye-Law 7.

ENERGY EFFICIENCY REQUIREMENTS

Part 3A of the Building Bye-laws imposes specific requirements for energy efficiency.

If a building is extended or renovated, the energy efficiency of the existing building or part of it may need to be upgraded.

NOTIFICATION OF WORK

A building permit is normally required to undertake building work and material changes of use and the department needs to be notified at the time the work commences.

A building permit is not required for work:

- a. that will be self-certified by a registered competent person and notified to the Department through an approved competent person scheme
- b. that is exempt from the need to obtain a building permit under Bye-Law 3.

RESPONSIBILITY FOR COMPLIANCE

People who are responsible for building work (for example the agent, designer, builder or installer) must ensure that the work complies with all relevant requirements of the Building Bye-laws. The building owner may also be responsible for ensuring that work complies with the Building Bye-laws. If building work does not comply with the Building Bye-laws, the building owner may be served with an enforcement notice.

	PAGE
Summary	9
SECTION 1: THE REQUIREMENTS	10
Limitation on requirements	12
SECTION 2: GENERAL GUIDANCE	
Types of work covered by this Technical Guidance Document	13
Special considerations	14
Historic and traditional buildings	14
Non-exempt buildings with low energy demand	15
Competent person schemes	17
Materials and workmanship	17
SECTION 3: GUIDANCE RELATING TO BUILDING WORK	
Extensions	18
Option providing more design flexibility	19
Conservatory extensions	21
Material change of use	22
Change of energy status	22
Work on controlled fittings and services	24
Commissioning Of fixed building services	29
SECTION 4: GUIDANCE ON THERMAL ELEMENTS	32
The Provision Of Thermal Elements	33
U-values for new thermal elements	34
Continuity of insulation and airtightness	34
Renovation Of Thermal Elements	35
Retained Thermal Elements	36

SECTION 5: CONSEQUENTIAL IMPROVEMENTS TO ENERGY PERFORMANCE.	39
SECTION 6: PROVIDING INFORMATION	43
APPENDIX A: KEY TERMS	44
APPENDIX B: BUILDINGS THAT ARE EXEMPT FROM THE ENERGY EFFICIENCY REQUIREMENTS.	49
APPENDIX C: DOCUMENTS REFERRED TO	51
APPENDIX D: STANDARDS REFERRED TO	52

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SUMMARY

The technical guidance document is one of four approved documents that give guidance on how to comply with the energy efficiency requirements of the Building Bye-laws:

Technical Guidance Document 11.1A: Conservation of fuel and Power in new dwellings.

Technical Guidance Document 11.1B: Conservation of fuel and Power in existing dwellings.

Technical Guidance Document 11.2A: Conservation of fuel and Power in new buildings other than dwellings.

Technical Guidance Document 11.2B: Conservation of fuel and Power in existing buildings other than dwellings.

The technical guidance documents are supported by the:

Domestic Building Services Compliance Guide

Non-Domestic Building Services Compliance Guide

This technical guidance document contains the following sections:

Section 1 sets out the relevant legal requirements contained in the Building Bye-laws

Section 2 contains general guidance, including the definition of key terms, the types of building work covered by this Technical Guidance Document, the types of building work that are exempt, procedures for notifying work and materials and workmanship.

Section 3 deals with the particular case of work to thermal elements.

Section 4 gives guidance in support of the requirement for consequential improvements for dwellings.

Section 5 describes the information that should be provided to occupiers to help them achieve reasonable standards of energy efficiency in practice.

Appendix A: Key terms and abbreviations.

Appendix B: Buildings that are exempt from the energy efficiency requirements.

Appendix C: Documents referred to.

Appendix D: Standards referred to.

THE REQUIREMENTS

- 1.1 This technical guidance document which takes effect on, deals with the **energy efficiency requirements** in the Building Bye-laws 2007 as amended. The **energy efficiency requirements** are conveyed in Bye-laws 5A, 5B, Part 3A and Part 11 of Schedule 2 to the Building Bye-laws.
- 1.2 The **energy efficiency requirements** relevant to this Technical Guidance Document, which deals with existing buildings other than **dwelling**s, are set out below. Where there is any doubt you should consult the full text of the Bye-laws, available at www.gov.ie

Bye-law 5A - Requirements relating to the renovation or replacement of thermal elements.

- 1) Where the renovation of an individual thermal element—
 - a) constitutes a major renovation; or
 - b) amounts to the renovation of more than 50% of the element's surface area;
the renovation must be carried out so as to ensure that the whole of the element complies with paragraph 11.1(a) (i) of Schedule 2, in so far as that is technically, functionally and economically feasible.
- 2) Where the whole or any part of an individual element is proposed to be replaced and the replacement—
 - a) constitutes a major renovation; or
 - b) (in the case of part replacement) amounts to the replacement of more than 50% of the thermal element's surface area;
the whole of the thermal element must be replaced so as to ensure that it complies with paragraph 11.1(a) (i) of Schedule 2, in so far as that is technically, functionally and economically feasible to do so.
- 3) In this bye-law –
'major renovation' means the renovation of a building where more than 25% of the surface area of the building envelope undergoes renovation;

'renovation', in relation to a thermal element, means the provision of a new layer in the thermal element or the replacement of an existing layer, but excludes decorative finishes.

Bye-Law 17C - Consequential improvements to energy performance

- 1) This bye-law applies to –
 - a) an existing building with a total useful floor area (as defined by bye-law 17A(3)) over 1000m² in respect of which building work is proposed if the proposed building work consists or includes—
 - i. an extension of the building; or
 - ii. the initial provision of any fixed building services, or an increase to the installed capacity of any fixed building services, in relation to the building; and
 - b) an existing dwelling where it is proposed to construct an extension to it.
- 2) Subject to paragraph (3), such work, if any, shall be carried out as is necessary to ensure that the building complies with the requirements of Part 11 of Schedule 2.
- 3) Nothing in paragraph (2) requires work to be carried out if it is not technically, functionally or economically feasible.

Bye-Law 17E. - Information about use of fuel and power.

- 1) This bye-law applies where requirement 11.1 applies in relation to building work
- 2) The person carrying out the work must, not later than 5 days after the work has been completed, provide to the owner sufficient information about the building, the fixed building services and their maintenance requirements, for the building to be operated in such a manner as to use no more fuel and power than is reasonable in the circumstances.

Requirement**PART 11 - CONSERVATION OF FUEL AND POWER****11.1 Conservation of energy**

Reasonable provision must be made for the conservation of fuel and power in a building by –

- a) limiting heat gains and heat losses –
 - i. through thermal elements and other parts of the building fabric, and
 - ii. from pipes, ducts and vessels used for space heating, space cooling and hot water services;
- b) providing fixed building services which –
 - i. are energy efficient;
 - ii. have effective controls; and
 - iii. are commissioned by testing and adjusting as necessary to ensure they use no more fuel and power than is reasonable in the circumstances.

LIMITATION ON REQUIREMENTS

- 1.3 In accordance with Bye-law 8, the requirements in Parts 1 to 7, 10 and 12 (except for requirements 3.6, 6.2 and 6.6) of Schedule 2 to the Building Bye-laws do not require anything to be done except for the purpose of securing reasonable standards of health and safety for persons in or about buildings (and any others who may be affected by buildings or matters connected with buildings).
- 1.4 Requirement 3.6 and 6.2 are excluded as they deal directly with prevention of the contamination of water, and requirement 6.6 is excluded as it deals with water efficiency. Parts 8 and 9 (which deal, respectively, with access to and use of buildings, and the resistance to the passage of sound) are excluded from bye-law 8 because they address the welfare and convenience of building users. Part 11 is excluded from bye-law 8 because it addresses the conservation of fuel and power.
- 1.5 In addition, bye-law 5(4) of the Building Bye-laws states that where the work is being carried out in order to comply with Bye-law 5A (requirements relating to **renovation** or replacement of a **thermal element**), Bye-law 5B (requirements relating to a change of a building's energy status) or Bye-law 17C (**consequential improvements** to energy performance), and is not a material alteration, it need comply only with the requirements of Part 11.

TYPES OF WORK COVERED BY THIS TECHNICAL GUIDANCE DOCUMENT

2.1 This Technical Guidance Document is intended to give guidance on what, in ordinary circumstances, may be considered reasonable provision for compliance with the requirements of Bye-laws 5A, 5B, Part 3A and Part 11 of Schedule 2 to the Building Bye-laws, for those carrying out building work to existing buildings other than **dwellings**.

*NOTE: Buildings exclusively containing **rooms for residential purposes** such as nursing homes, student accommodation and similar are not **dwellings**, and in such cases this Technical Guidance Document applies.*

2.2 In particular, this Technical Guidance Document gives guidance on compliance with the **energy efficiency requirements** where the following occurs:

- a) the construction of an extension;
- b) a material change of use, or a change to the building's energy status;
- c) the provision or extension of a **controlled service** or **controlled fitting**;
- d) the replacement or **renovation** of a **thermal element**;
- e) the **major renovation** of a building,
- f) **consequential improvements**

2.3 For certain types of work in relation to an existing building, it may be more appropriate to use the guidance given in the other Technical Guidance Documents approved for the purposes of the Part 11 requirements, or to follow only a limited amount of the guidance in this Technical Guidance Document. The following sub-paragraphs identify some of the circumstances in which this might be appropriate:

- a) For **first fit-out works** in buildings such as shell and core office buildings or business park units, the guidance in Technical Guidance Document 11.2A (new non-domestic buildings) covering first **fit-out** should be followed (but note that the appropriate guidance for any subsequent **fit-out works** is contained in this Technical Guidance Document).
- b) Large extensions (as defined in paragraph 3.2) should be carried out in accordance with the guidance in Technical Guidance Document 11.2A. However, bye-law 17C (**consequential improvements** to energy performance) may apply, in which case the guidance in relation to that bye-law set out in this Technical Guidance Document would be relevant.

- c) Modular and portable buildings: where the work involves the construction of subassemblies that have been obtained from a centrally held stock or from the disassembly or relocation of such buildings at other premises, the guidance in Technical Guidance Document 11.2A should be followed but bye-law 17C (**consequential improvements** to energy performance) may also apply if the work was to extend an existing building. In that context, the guidance in relation to that bye-law as set out in this Technical Guidance Document would be relevant

Note that erecting a separate unit on a site with an existing building is not extending that existing building, but is the creation of a new building, unless the new unit is to be permanently linked to the existing building.

- d) Where the work involves a building that either before the work or after the work is completed contains one or more **dwelling**s, the guidance in Technical Guidance Document 11.1B would apply to each **dwelling**.

*It should be noted that **dwelling**s are defined as self-contained units. **Rooms for residential purposes** are not **dwelling**s, and so this Technical Guidance Document applies to them.*

SPECIAL CONSIDERATIONS

- 2.4 Special considerations apply to certain classes of non-exempt building. These building types are:
- a) historic buildings and buildings used primarily or solely as places of worship; the considerations that apply to such existing buildings are given in paragraphs 2.5 to 2.10;
 - b) buildings with low energy demand; the guidance specific to such buildings is given in paragraphs 2.11 to 2.14;
 - c) modular and portable buildings; for the construction of such buildings with a planned service life of more than 2 years at one or more locations, the guidance in Technical Guidance Document 11.2A should be followed. Any changes to the building fabric or **fixed building services** should comply with this Technical Guidance Document.

HISTORIC AND TRADITIONAL BUILDINGS.

- 2.5 Buildings which are registered on the Ministers register of Buildings and Sites of Architectural, Archaeological and Historic importance, are exempt from the **energy efficiency requirements** in cases where compliance with those requirements would unacceptably alter their character or appearance.
- 2.6 When undertaking work on or in connection with a building described in paragraph 2.5 above, the aim should be to improve energy efficiency as far as is reasonably practical. The work should not

prejudice the character of the host building or increase the risk of long-term deterioration of the building fabric or fittings.

- 2.7 The guidance given by English Heritage should be taken into account in determining appropriate energy performance standards for building work in historic buildings.

NOTE: In addition English Heritage has produced detailed technical guidance on how to implement specific energy efficiency measures. (See list of available guidance documents at http://www.englishheritage.org.uk/professional/advice/advice-by-topic/climate-change/energy_efficiency)

- 2.8 In general, new extensions to historic or traditional buildings should comply with the standards of energy efficiency as set out in this Technical Guidance Document. The only exception would be where there is a particular need to match the external appearance or character of the extension to that of the host building.

- 2.9 Particular issues relating to work in historic buildings that warrant sympathetic treatment and where advice from others could therefore be beneficial include:

- a) restoring the historic character of a building that has been subject to previous inappropriate alteration, e.g. replacement windows, doors and rooflights;
- b) rebuilding a former historic building (e.g. following a fire or filling a gap site in a terrace);
- c) making provisions enabling the fabric of historic buildings to 'breathe' to control moisture and potential long-term decay problems.

- 2.10 In assessing an appropriate balance between historic building conservation and energy efficiency improvements, it would be appropriate to take into account the advice of the Departments' historic buildings officer and building control surveyor.

NON-EXEMPT BUILDINGS WITH LOW ENERGY DEMAND

- 2.11 For the purposes of this Technical Guidance Document, non-exempt buildings with low energy demand are taken to be those buildings or parts thereof where:

- a) **fixed building services** are used to heat or cool only a localised area rather than the entire enclosed volume of the space concerned (e.g. localised radiant heaters at a workstation in a generally unheated space); or
- b) **fixed building services** are used to heat spaces in the building to temperatures substantially lower than those normally provided for

human comfort (e.g. to provide condensation or frost protection in a warehouse).

- 2.12 In such situations, it is not reasonable to expect the entire building envelope to be insulated to the standard expected for more typical buildings. Therefore, if an existing building with low levels of heating is extended or parts of the fabric renovated, the new or renovated **building envelope** should be insulated only to a degree that is reasonable in the particular case. If some general heating is provided (case b above), then it would be reasonable that no part of the opaque fabric had a U-value worse than 0.7 W/m².K. In addition, reasonable provision would be for every fixed building service that is installed to meet the energy efficiency standards set out in the Non-Domestic Building Services Compliance Guide.
- 2.13 If a part of a building with low energy demand is partitioned off and heated normally (e.g. an office area in an unheated warehouse), the separately heated area should be treated as a separate 'building' and the normal procedures for demonstrating compliance should be followed in respect of the enclosure.
- 2.14 If a building with low energy demand subsequently changes such that the space is generally conditioned, then this is likely to involve the initial provision or an increase in the installed capacity of a **fixed building service**. Such activities may fall within Bye-law 17C which would require the **building envelope** to be upgraded and **consequential improvements** to be made (see the guidance in Section 5 of this Technical Guidance Document). Alternatively, if the building shell was designed as a building with low energy demand and the first occupier of the building wanted to install (e.g.) heating, this would be a first **fit-out works**, and Technical Guidance Document 11.2A would apply.

NOTIFICATION OF WORK COVERED BY THE ENERGY EFFICIENCY REQUIREMENTS

- 2.15 In most instances in order to comply with the Building Bye-laws it will be necessary to make an application for a building permit before the work starts.
- 2.16 In certain situations, however, there is no need to obtain a building permit before undertaking the work:
- Where the work is being carried out by a person registered with a relevant competent person self-certification scheme approved by the Minister; (see paragraphs 2.17 to 2.20).
 - In accordance with Bye-law 14, where the work involves the provision, extension or repair of a **controlled service or fitting** the work may start before the application for a building permit has been determined. However, in such cases it will still be necessary for the work to comply with the relevant requirements and for

notice to be given to the Department in advance of commencement of the work.

COMPETENT PERSON SELF-CERTIFICATION SCHEMES

- 2.17 It is not necessary to notify the Department in advance of work which is to be carried out and certified by a person registered with a competent person self-certification scheme approved by the Minister. In order to join such a scheme a person must demonstrate competence to carry out the type of work the scheme covers, and also the ability to comply with all relevant requirements in the Building Bye-laws.
- 2.18 Where work is carried out by a person registered with a competent person scheme, Bye-law 15 requires that the person ordering the work to be given, within 30 days of the completion of the work, a certificate confirming that the work complies fully with all applicable building bye-law requirements. There is also a requirement to give the notice of the work carried out to the Department, again within 30 days of the completion of the work. These certificates and notices are made available through the scheme operator.
- 2.19 The department will normally accept these certificates and notices as evidence of compliance with the requirements of the Building Byelaws, however inspection and enforcement powers remain unaffected, and will be used in response to a complaint that work does not comply.
- 2.20 A list of approved competent person schemes and the types of work for which they are authorised can be found at www.gov.ie

MATERIALS AND WORKMANSHIP

- 2.21 Any building work which is subject to the requirements imposed by schedule 2 to the Building Bye-laws shall be carried out in accordance with Bye-law 7. Guidance on meeting these requirements on materials and workmanship is contained in the Technical Guidance Document published in support of Bye-law 7.

Building Bye-laws are made for specific purposes, primarily the health and safety, welfare and convenience of people and for energy conservation. Standards and other technical specifications may provide relevant guidance to the extent that they relate to these considerations. However, they may also address other aspects of performance or matters which, although they relate to health and safety etc., are not covered by the Building Bye-laws.

When a Technical Guidance Document makes reference to a named standard, the relevant version of the standard to which it refers is the one listed at the end of the publication. However, if this version has been revised or updated by the issuing standards body, the new version should be used as a source of guidance provided it continues to address the relevant requirements of the Bye-laws.

EXTENSIONS

3.1 Under Bye-law 17C, the construction of an extension to a building triggers the requirement for **consequential improvements** in buildings other than **dwellings** with a **total useful floor area** greater than 1000m². In such cases, the guidance in Section 5 should be followed in addition to the following specific guidance.

LARGE EXTENSIONS

3.2 Where the proposed extension has a **total useful floor area** that is both:

- a) greater than 100m², and
- b) greater than 25 per cent of the **total useful floor area** of the existing building, the work should be regarded as a new building and the guidance in Technical Guidance Document 11.2A followed. The requirement for **consequential improvements**, if appropriate, should also be met by following the guidance in Section 5 of this Technical Guidance Document.

OTHER EXTENSIONS – REFERENCE METHOD

FABRIC STANDARDS

3.3 Reasonable provision would be for the proposed extension to incorporate the following:

- a) doors, windows, roof windows, rooflights and smoke vents that meet the standards set out in paragraphs 3.23 to 3.27;
- b) newly constructed **thermal elements** that meet the standards set out in paragraphs 4.1 to 4.7;
- c) existing opaque fabric which becomes a thermal element where previously it was not should be upgraded so that it meets the standards in paragraphs 4.12 to 4.14.

OPENING AREAS

3.4 The area of windows and rooflights in the extension should generally not exceed the values given in Table 2. However, where a greater proportion of glazing is present in the part of the building to which the extension is attached, reasonable provision would be to limit the proportion of glazing in the extension so that it is no greater than the proportion that exists in the part of the building to which it is attached.

BUILDING SERVICES SYSTEMS IN THE EXTENSION

- 3.5 Where **fixed building services** are provided or extended as part of constructing the extension, reasonable provision would be to follow the guidance in paragraphs 3.29 to 3.46.

OPTIONAL APPROACHES WITH MORE DESIGN FLEXIBILITY

- 3.6 The approach set out in paragraphs 3.3 to 3.5 is somewhat prescriptive. The following paragraphs offer more flexible approaches to demonstrating that reasonable provision has been made. These alternative approaches allow some elements of the design to be relaxed through compensating measures elsewhere. When adopting the approach given in paragraphs 3.7 to 3.11 the U-value of any individual element should be no worse than the values given in Table 1.

Table 1 Limiting U-values standards (W/m²K)	
Element	Limiting U Value
Wall	0.70
Floor	0.70
Roof	0.35
Windows, roof windows, rooflights and doors ¹	3.3
Notes	
a) See paragraph 3.25	

AREA-WEIGHTED U-VALUE METHOD

- 3.7 The U-values given in paragraph 3.3 and the opening areas given in paragraph 3.4 may be varied provided that the area-weighted U-value of all the elements in the extension is no greater than that of an extension of the same size and shape that complies with the U-value standards referred to in paragraph 3.3 and the opening area standards in paragraph 3.4. Any **fixed building service** provided or extended as part of constructing the extension should follow the guidance in paragraphs 3.29 to 3.46.

- 3.8 The area-weighted U-value is given by the following expression:

$$\frac{\{(U_1 \times A_1) + (U_2 \times A_2) + (U_3 \times A_3) + \dots\}}{\{(A_1 + A_2 + A_3 + \dots\}}$$

TABLE 2 OPENING AREAS IN THE EXTENSION		
Building type	Windows and personnel doors as % of exposed wall	Rooflights as % of area of roof
Residential buildings where people temporarily or permanently reside	30	20
Places of assembly, offices and shops	40	20
Industrial and storage buildings	15	20
Vehicle access doors and display windows and similar glazing	As required	N/A
Smoke vents	N/A	As required

WHOLE BUILDING CALCULATION METHOD

3.9 Where even greater design flexibility is required, reasonable provision would be to use an approved calculation tool to demonstrate that the calculated energy rate from the building and proposed extension are no greater than for the building plus a notional extension complying with the standards of paragraphs 3.3 to 3.5.

3.10 The specification of the existing building used in conjunction with the notional extension as the basis of setting the target energy rate for the building work shall include all upgrades that will be included in fulfilment of the requirement for **consequential improvements** (see Section 5).

Otherwise all the low-cost measures would have been taken by the compensatory measures, leaving little leeway for overall improvement.

3.11 Where additional upgrades over and above the consequential improvements are proposed in the actual building to compensate for lower performance in the extension, then such upgrades should be implemented to a standard that is no worse than set out in the relevant guidance contained in this Technical Guidance Document. The relevant standards for upgrading retained **thermal elements** are as set out in column (b) of Table 5.

NOTE: Where it is proposed to upgrade, the standards set out in this Technical Guidance Document are cost effective and should be implemented in full. It will be worthwhile implementing them even if the improvement is greater than necessary to achieve compliance. In some cases, therefore, the standard of the extended building may be better than that required by paragraphs 3.1 to 3.10.

CONSERVATORY EXTENSIONS

3.12 Where the extension is a **conservatory**, then reasonable provision would be to provide:

- a) Effective thermal separation between the heated area in the existing building, i.e. the walls, doors, and windows between the building and the **conservatory**, should be insulated and draught proofed to achieve a thermal performance not worse than $2.0\text{W/m}^2\text{K}$.
- b) Independent temperature and on/off controls to any heating system installed within the **conservatory**. Any **fixed building service** installed within the **conservatory** should also conform to the standards set out in paragraphs 3.21 to 3.41.
- c) Glazed elements should meet the standards set out in Table 3 and opaque elements should meet the standards set out in Table 4. However, the limitations on total area of windows, roof windows and doors as set out at paragraph 3.4 above do not apply.

3.13 Removing, and not replacing, any or all of the thermal separation between the building and the **conservatory**, or extending the buildings heating system into the **conservatory**, is building work, and replacing the roof of a **conservatory** with non-translucent material is a material alteration to which the **energy efficiency requirements** apply. In such situations, the **conservatory** should be treated as a conventional extension and reasonable provision would be to demonstrate that the extension meets the guidance set out in paragraphs 3.1 to 3.11 above.

*NOTE: A **conservatory** extension that has less than three quarters of its roof area and less than one half of its external wall area made from translucent material is more likely to be occupied all year round, so for the purposes of the **energy efficiency requirements** is treated as a conventional extension.*

SWIMMING POOL BASINS

3.14 Where a swimming pool is being provided in a building, the U-value of the basin (walls and floor) should not be worse than $0.25\text{W/m}^2\text{K}$ as calculated according to BS EN ISO 13370 – Thermal Performance of Buildings – Heat Transfer via the Ground – Calculation Methods.

NOTE: Design consideration should be taken with regards to compressive creep, insulation boards not being fully supported and the effects of point loading. Care should be taken to avoid thermal bridging particularly around basin wall and floor junctions with foundations.

MATERIAL CHANGE OF USE

3.15 Material changes of use (see Bye-law 2) covered by this document are where, after the change:

- a) the building is used as a hotel or a guest house, where previously it was not;
- b) the building is used as an institution, where previously it was not;
- c) the building is used as a public building, where previously it was not;
- d) the building is not a building described in Classes I to 7 in Schedule 1, where previously it was;
- e) the building contains a room for residential purposes, where previously it did not;
- f) the building, which contains at least one room for residential purposes, contains a greater or lesser number of such rooms than it did previously;
- g) the building is used as a shop where previously it was not; or
- h) the building is used as an office where previously it was not

CHANGE OF ENERGY STATUS

3.16 A change to a building's energy status is defined in Part 1 of the Building Bye-laws as:

A change which results in a building becoming a building to which the **energy efficiency requirements** apply, where previously it was not.

3.17 The requirements relating to a change to energy status are in Bye-law 5B:

Where there is a change in a building's energy status, such work, if any, shall be carried out to ensure that the building complies with the applicable requirements of Part 11 of Schedule 2.

3.18 For the purposes of the bye-laws 'building' means the building as a whole or parts of the building that have been designed or altered to be used separately.

NOTE: For example, this could occur where a previously unheated building, or parts of the building that have been designed or altered to be used separately, were to be heated in future, or where a previously exempt building were no longer within the exempted categories. A material alteration may result in a change in buildings energy status.

3.19 In normal circumstances, reasonable provision where there is a material change of use or a change to the building's energy status would be:

- a) Where **controlled services or fittings** are being provided or extended, to meet the standards set out in paragraphs 3.22 to 3.46. If the area of openings in the newly created building is more than 25 per cent of the total floor area, either the area of openings should be reduced to be not greater than 25 per cent, or the larger area should be compensated for in some other way using the procedure described in paragraph 3.9.
- b) Where the work involves the provision of a **thermal element**, to meet the standards set out in paragraphs 4.1 to 4.7.

For the purposes of Building Bye-laws, provision means both new and replacement elements

- c) Where any **thermal element** is being retained, to upgrade it following the guidance given in paragraphs 4.13 to 4.14. This guidance should also be followed in respect of any existing element that becomes part of the thermal envelope of the building where previously it was not.

As an example, this would include the party wall between units in a terrace of industrial units which originally were unheated, but heating is to be provided to one of the units.

- d) Where an existing window (including roof window or rooflight) or door which separates a conditioned space from an unconditioned space or the external environment has a U-value that is worse than $3.3 \text{ W/m}^2\text{.K}$, to provide replacement units following the guidance in paragraphs 3.23 to 3.28, unless it is a **display window** or **high usage entrance door**. It would be reasonable in these latter cases to make some lesser provision for energy efficiency.

3.20 As well as satisfying the **energy efficiency requirements** in respect of the material change of use or change in energy status, such building work may be one of the triggers for **consequential improvements** - see Bye-law 17C and Section 5.

WORK ON CONTROLLED FITTINGS AND SERVICES

3.21 **Controlled services or fittings** are defined in Part 1 of the Building Bye-laws as follows:

Controlled service or fitting means a service or fitting in relation to which Part 3, 6 or 11 of Schedule 2 imposes a requirement.

CONTROLLED FITTINGS

3.22 In the context of this Technical Guidance Document, the application of the term controlled fitting to a window, roof window, rooflight or door refers to a whole unit, i.e. including the frame. Consequently, replacing the glazing whilst retaining an existing frame is not providing a controlled fitting, and so such work is not controlled and does not have to meet the Part 11 standards, although where practical it would be sensible to do so. Similar arguments apply to a new door in an existing frame.

3.23 Where windows, roof windows, roof-lights or doors are to be provided, reasonable provision in normal cases would be the installation of draught proofed units whose performance is no worse than given in Table 3. In addition, insulated cavity closers should be installed where appropriate. If a window, pedestrian door or roof-light is enlarged or a new one created, then the area of the windows and pedestrian doors and of roof-lights expressed as a percentage of the total floor area of the building should not exceed the relevant value from Table 2, or should be compensated for in some other way. Where the windows or fully glazed external pedestrian doors are unable to meet the requirements of Table 3 because of the need to maintain the external appearance of the façade or the character of the building, such fittings should meet a centre pane U-value of $1.2\text{W/m}^2\text{K}$, where the centre-pane U-value is defined as the U-value determined in the central area of the glazing unit, making no allowance for edge spacers or window frame. As an alternative, single glazing should be supplemented with low-e secondary glazing. In this latter case, the weather stripping should be on the secondary glazing to minimise condensation risk between the primary and secondary glazing. Where enhanced performance requirements (e.g. wind load, safety, security or acoustic attenuation) require thicker glass to be used, reasonable provision would be demonstrated if the window unit with the equivalent standard glazing thickness can be shown to comply.

3.24 U-values of windows, roof-windows, rooflights and doors shall be calculated using the methods and conventions set out in BR 443, and should be based on the whole unit (i.e. in the case of a window, the combined performance of the glazing and frame). The U-value for windows can be taken as that for:

- a) the smaller of the two standard windows defined in BS EN 14351-17; or
- b) the standard configuration referred to in BR 443; or
- c) the specific size and configuration of the actual window.

The U-value of the door can be calculated for:

- a) the standard size as laid out in BS EN 14351-1, or
- b) the specific size and configuration of the actual door.

NOTE: For domestic type construction, SAP 2012 Table 6e gives values for different window configurations that can be used in the absence of test data or calculated values.

TABLE 3 STANDARDS FOR CONTROLLED FITTINGS	
Fitting	Standard
Windows in buildings that are essentially domestic in character ²	A Window Energy Rating ³ of Band C or 1.6 W/m ² .K
All other windows and roof windows and rooflights ^{1,4} .	1.8 W/m ² .K for the whole unit
Curtain Walling	See paragraph 3.28
Pedestrian doors where the door has more than 60% of its external face area glazed	U-value 1.8 W/m ² K
All other pedestrian doors	U-value 1.8 W/m ² K
High usage entrance doors for people	3.5 W/m ² .K
Vehicle access and similar large doors	1.5 W/m ² .K
Roof ventilators (including smoke extract ventilation)	3.5 W/m ² .K
Notes:	
<ol style="list-style-type: none"> 1. Display windows are not required to meet the standard given in this table. 2. For example, student accommodation, care homes and similar uses where the occupancy levels and internal gains are essentially domestic in character. 3. See Guide to the Calculation of Energy Ratings for Windows, Roof Windows & Doors, GGF, 2013 at www.ggf.org.uk 4. For the purposes of checking compliance with this table, the true U-value based on aperture area can be converted to the U-value based on the developed area of the rooflight. Further guidance on evaluating the U-value of out-of-plane rooflights is given in Assessment of thermal performance of out-of-plane rooflights, NARM Technical Document NTD 2 (2010), See http://www.narm.org.uk/uploads/pdfs/NARM-TAOOPR-030311.pdf 	

3.25 The U-values for roof windows and rooflights given in this Technical Guidance Document are based on the particular U-value having been assessed with the roof window or rooflight in the vertical position. If a particular unit has been assessed in a plane other than the vertical, the standards given in this Technical Guidance Document should be

modified by making a U-value adjustment following the guidance given in BR 443.

NOTE: The stated standard for a replacement plastic rooflight as given in Table 3 is 1.8 W/m².K. This is for the unit assessed in the vertical plane. If the performance of a triple-skin rooflight was assessed in the horizontal plane, then, based on the guidance given in BR 443, the standard would be adjusted by 0.3 W/m².K (the value from BR 443 for a horizontal triple-skin rooflight), requiring the rooflight as assessed in the horizontal plane to achieve a standard of 1.8 + 0.3 = 2.1 W/m².K.

3.26 In certain classes of building with high internal gains, a less demanding U-value for glazing may be an appropriate way of reducing overall energy use. If this case can be made, then the average U-value for windows, doors and rooflights can be relaxed from the values given in Table 3, but the value should not exceed 2.7 W/m².K.

3.27 The overall U-value of curtain walling should be no greater than the better of 1.8 W/m².K or a limiting U-value U_{limit} given by:

$$U_{\text{limit}} = 0.8 + \{(1.2 + (\text{FOL} \times 0.5)) \times \text{GF}\}$$

where FOL is the fraction of opening lights and GF is the glazed fraction.

This means that if an area of curtain walling is to be 60 per cent glazed and 40 per cent opaque, with 50 per cent opening lights, the U-value standard should be $0.8 + (1.2 + 0.5 \times 0.5) \times 0.6 = 1.7 \text{ W/m}^2.\text{K}$.

CONTROLLED SERVICES.

3.28 Where the work involves the provision or extension of controlled services, reasonable provision would be demonstrated by following the guidance set out in the Non-Domestic Building Services Compliance Guide. The Guide covers the following services:

- a) heating and hot water systems (including insulation of pipes, ducts and vessels;
- b) mechanical ventilation;
- c) mechanical cooling/air-conditioning;
- d) fixed internal lighting;
- e) renewable energy systems.

3.29 In general terms, the aim should be to:

- a) provide new **fixed building services** that meet reasonable standards of energy efficiency, which in normal circumstances would be:

- i. an efficiency not less than set out in the Non-Domestic Building Services Compliance Guide. The efficiency claimed for the **fixed building service** should be based on the appropriate test standard as set out in the Guide and the test data should be certified by a notified body. In the absence of such quality-assured data, the department should be provided with information that demonstrates the claimed performance is justified. If a particular technology is not covered in the Guide, reasonable provision would be demonstrated by showing that the proposed technology gives a performance that is no worse than a reference system of the same type whose details are given in the Guide; and
 - ii. an efficiency not less than that of the **controlled service** being replaced.
- b) provide new HVAC systems with appropriate controls to achieve reasonable standards of energy efficiency. In normal circumstances reasonable provision would be to provide the following control features on each system in addition to the system-specific controls detailed in subsequent paragraphs:
- i. the **fixed building services** systems should be sub-divided into separate control zones to correspond to each area of the building that has a significantly different solar exposure, occupancy period, or type of use;
 - ii. each separate control zone should be capable of independent switching and control of set-point;
 - iii. the provision of the service should respond to the requirements of the space it serves. If both heating and cooling are provided, they should be controlled so they do not operate simultaneously;
 - iv. central plant serving the zone-based systems should operate only as and when required. The default condition should be off;
 - v. in addition to these general control requirements, the systems should meet the specific control requirements and general energy efficiency criteria as set out in the Non-Domestic Building Services Compliance Guide.
- c) demonstrate the new service has been effectively commissioned (see paragraphs 3.34 to 3.46);
- d) demonstrate that reasonable provision of energy meters has been made for effective monitoring of the performance of newly installed plant (see paragraphs 3.31 to 3.33);

- e) demonstrate that the relevant information has been recorded in a new log book or incorporated into an update of the existing one as described in Section 6.

3.30 If a renewable energy generator such as a wind turbine or photovoltaic array is being replaced, the new system should have an electrical output that is not less than the original installation.

ENERGY METERS

3.31 The aim for buildings as a whole is to enable building occupiers to assign at least 90 per cent of the estimated annual energy consumption of each fuel to the various end-use categories (heating, lighting, etc.).

3.32 Reasonable provision for energy meters in existing buildings would be to install energy metering systems in the building service systems provided as part of the works in accordance with the recommendations in CIBSE TM 39.

3.33 In addition to this:

- a) meters should be provided to enable the performance of any renewable energy system provided as part of the works to be separately monitored;
- b) in buildings with a **total useful floor area** greater than 1000 m², the metering system should enable automatic meter reading and data collection;
- c) the metering provisions should be designed such as to facilitate the benchmarking of energy performance as set out in TM 46.

COMMISSIONING OF FIXED BUILDING SERVICES

3.34 Bye-law 17G (**Commissioning**) states:

17G Commissioning

- 1) This bye-law applies to a building in relation to which requirement 11.1(b) applies and building work is carried out, but does not apply where the building work consists only of exempt electrical certifiable work (within the meaning of Bye-law 15).
- 2) The person carrying out the building work shall give to the Chief Officer a notice confirming that the relevant fixed building services have been commissioned in accordance with the procedure set out in the relevant technical guidance document.
- 3) The notice shall be given not later than –
 - i. in every case, the date on which the notice required by byelaw 13(6) in relation to the building work is given; and
 - ii. in the case of certifiable building work (within the meaning of bye-law 15), not more than 30 days after completion of the work.
- 4) For the purposes of this bye-law, the relevant technical guidance document is one concerning pressure testing in a building in order to determine heat gains and losses in the building from its pipes, ducts, and vessels, used for space heating, space cooling and hot water services.

3.35 Reasonable provision could be to prepare a **commissioning** plan, identifying the systems that need to be tested and the tests that will be carried out. The notice required by Bye-law 17G (3) should confirm that the **commissioning** plan has been followed and that every system has been inspected in an appropriate sequence and to a reasonable standard and that the test results confirm that performance is reasonably in accordance with the design requirements.

3.36 Not all **fixed building services** will need to be commissioned. With some systems it is not possible as the only controls are 'on' and 'off' switches. Examples of this would be some mechanical extraction systems or single fixed electrical heaters. In other cases **commissioning** would be possible but in the specific circumstances would have no effect on energy use.

NOTE: **Fixed building services** which do not require **commissioning** should be identified in the **commissioning** plan, along with the reason for not requiring **commissioning**.

- 3.37 **Commissioning** must be carried out in such a way as not to prejudice compliance with any applicable health and safety requirements.
- 3.38 In existing buildings other than **dwelling commissioning** is most often carried out by the person who installs the system. Sometimes it may be carried out by a subcontractor or by a specialist firm. It is important that whoever carries it out follows the relevant approved procedure.

NOTE: Energy efficiency in practice can often be enhanced by a sustained period of fine tuning to ensure the systems are operating as intended and controls are configured to the needs of the occupier. The Soft Landings initiative is an example of an appropriate fine tuning process, see <http://www.bsria.co.uk/services/design/soft-landings/>.

- 3.39 Where **commissioning** is carried out, it should be done in accordance with the procedures set out in:
- a) CIBSE **Commissioning** Code M on **commissioning** management; and

*This provides guidance on the overall process and includes a schedule of all the relevant guidance documents relating to the **commissioning** of specific building services systems.*

- b) for leakage testing of ductwork, paragraphs 3.45 and 3.46.
- 3.40 **Commissioning** must be carried out in such a way as not to prejudice compliance with any applicable health and safety requirements.
- 3.41 **Commissioning** is often carried out by the person who installs the system. Sometimes it may be carried out by a subcontractor or even by a specialist firm. It is important that whoever carries it out follows the relevant approved procedure.

NOTICE OF COMPLETION OF COMMISSIONING

- 3.42 Building Bye-law 17G requires a notice be given to confirm that **commissioning** has been carried out.
- 3.43 The notice should include a declaration confirming that:
- a) **commissioning** plan has been followed so that every system has been inspected and commissioned in an appropriate sequence and to a reasonable standard; and
- b) the results of tests confirm that the performance is reasonably in accordance with the actual building design, including written commentaries where excursions are proposed to be accepted.

*NOTE: Such declarations should be signed by someone suitably qualified by relevant training and experience. A way of achieving this would be to employ a member of the **Commissioning** Specialists Association or the **Commissioning** Group of the Building and Engineering Services Association (B&ES) in respect of heating, ventilation and air-conditioning (HVAC) systems, or a member of the Lighting Industry **Commissioning** Scheme in respect of fixed internal or external lighting. The use of the templates in the Model **Commissioning** Plan is a way of documenting the process in an appropriate way.*

- 3.44 Until the Department receives a satisfactory **commissioning** notice, it may not consider it appropriate to give a completion certificate.

AIR LEAKAGE TESTING OF DUCTWORK

- 3.45 Ductwork leakage testing should be carried out on new or refurbished ducting where practicable in accordance with the procedures set out in B&ES DW/143 on systems served by fans with a design flow rate greater than $1\text{m}^3/\text{s}$.

Membership of the B&ES specialist ductwork group or the Association of Ductwork Contractors and Allied Services (ADCAS) could be a way of demonstrating suitable qualifications for this testing work.

- 3.46 If a ductwork system fails to meet the leakage standard, remedial work should be carried out as necessary to achieve satisfactory performance in retests and further ductwork sections should be tested as set out in DW/143.

The Provision Of Thermal Elements

- 4.1 New **thermal elements** must comply with Part 11.1(a)(i) of Schedule 2 to the Building Bye-laws. Work on existing **thermal elements** must comply with Bye-law 5A of the Building Bye-laws which states:

Requirements relating to the renovation or replacement of thermal elements – Bye-law 5A

- 2) Where the renovation of an individual thermal element—
 - a) constitutes a major renovation; or
 - b) amounts to the renovation of more than 50% of the element's surface area;the renovation must be carried out so as to ensure that the whole of the element complies with paragraph 11.1(a) (i) of Schedule 2, in so far as that is technically, functionally and economically feasible.
- 3) Where the whole or any part of an individual element is proposed to be replaced and the replacement—
 - c) constitutes a major renovation; or
 - d) (in the case of part replacement) amounts to the replacement of more than 50% of the thermal element's surface area;the whole of the thermal element must be replaced so as to ensure that it complies with paragraph 11.1(a) (i) of Schedule 2, in so far as that is technically, functionally and economically feasible to do so.
- 4) In this bye-law –
 - 'major renovation' means the renovation of a building where more than 25% of the surface area of the building envelope undergoes renovation;
 - 'renovation', in relation to a thermal element, means the provision of a new layer in the thermal element or the replacement of an existing layer, but excludes decorative finishes.

U-VALUES

- 4.2 U-values shall be calculated using the methods and conventions set out in BR 443.
- 4.3 Reasonable provision for newly constructed **thermal elements** such as those constructed as part of an extension would be to meet the standards set out in Table 4.

- 4.4 Reasonable provision for those **thermal elements** constructed as replacements for existing elements would be to meet the standards set out in Table 4.

*Curtain walling is treated as a **controlled fitting** and guidance is given in paragraph 3.28.*

TABLE 4 STANDARDS FOR NEW THERMAL ELEMENTS	
ELEMENT¹	STANDARD (W/M².K)
Wall	0.28 ²
Pitched roof – insulation at ceiling level	0.16
Pitched roof – insulation at rafter level	0.18
Flat roof or roof with integral insulation	0.18
Floors ³	0.22 ⁴
Swimming pool basin	0.25 ⁵
Notes:	
1) 'Roof ' includes the roof parts of dormer windows, and 'wall' includes the wall parts (cheeks) of dormer windows. 2) A lesser provision may be appropriate where meeting such a standard would result in a reduction of more than 5% in the internal floor area of the room bounded by the wall. 3) The U-value of the floor of an extension can be calculated using the exposed perimeter and floor area of the whole enlarged building. 4) A lesser provision may be appropriate where meeting such a standard would create significant problems in relation to adjoining floor levels. The U-value of the floor of an extension can be calculated using the exposed perimeter and floor area of the whole enlarged dwelling. 5) See paragraph 3.14	

CONTINUITY OF INSULATION AND AIRTIGHTNESS.

- 4.5 The building fabric should be constructed so that there are no reasonably avoidable thermal bridges in the insulation layers caused by gaps within the various elements, at the joints between elements, and at the edges of elements such as those around window and door openings. Reasonable provision should also be made to reduce unwanted air leakage through the new envelope parts. The work should comply with all the requirements of Schedule 2, but particular attention should be paid to Parts 3 and 5.
- 4.6 Significant reductions in thermal performance can occur where the air barrier and the insulation layer are not contiguous and the cavity between them is subject to air movement. To avoid this problem, either the insulation layer should be contiguous with the air barrier at all points in the **building envelope**, or the space between them should be filled with solid material such as in a masonry wall.
- 4.7 A suitable approach to showing the requirement has been achieved would be to submit a report signed by a suitably qualified person confirming that appropriate design details and building techniques have been specified, and that the work has been carried out in ways

that can be expected to achieve reasonable conformity with the specifications. Reasonable provision would be to:

- a) adopt design details published on the Accredited Construction Details website; or
- b) demonstrate that the specified details provide adequate protection against surface condensation using the guidance in IP 1/06 and BR 497

MAJOR RENOVATION

4.8 **Major Renovation** means the **renovation** of a building where more than 25% of the surface area of the **building envelope** undergoes **renovation**. When assessing whether the area proportion constitutes a **major renovation** of a building, the surface area of the whole of the external **building envelope** should be taken into account i.e. external walls, floor, roof, windows, doors, roof windows and roof-lights.

Renovation Of Thermal Elements

4.9 For the purposes of this Technical Guidance Document, **renovation** of a **thermal element** through:

- a) the provision of a new layer means either of the following activities:
 - i. Cladding or rendering the external surface of the **thermal element**; or
 - ii. Dry-lining the internal surface of a **thermal element**.
- b) the replacement of an existing layer means either of the following activities:
 - i. stripping down the element to expose the basic structural components (brick/blockwork, timber/metal frame, joists, rafters, etc.) and then rebuilding to achieve all the necessary performance requirements. As discussed in paragraph 2.9, particular considerations apply to renovating elements of traditional construction; or
 - ii. replacing the water proof membrane on a flat roof.

4.10 Where a **thermal element** is subject to a **renovation** through undertaking an activity listed in paragraph (4.9a or 4.9b), the performance of the whole of the **thermal element** should be improved to achieve or better the relevant U-value set out in column (b) of Table 5, provided the area to be renovated is greater than 50% of the surface of the individual **thermal element** or constitutes a

major renovation where more than 25% of the surface area of the building envelope undergoes **renovation**.

In relation to the **renovation** of individual **thermal elements**, when assessing the proportion of the surface area that is to be renovated, the area of the **thermal element** should be assessed as the area of each individual **thermal element**, not the area of all the elements of that type in the building. The area of each individual **thermal element** should also be interpreted in the context of whether the element is being renovated from inside or outside, e.g. if removing all the plaster finish from the inside of a solid brick wall, the area of the element is the area of external wall in the room. If removing external render, it is the area of the elevation in which that wall sits.

*NOTE: This means that if all the roofing on the flat roof of an extension is being stripped down, the area of the individual element is the 'roof area' of the extension, not the 'total roof area' of the building. Similarly, if the rear wall of a single storey extension is being re-rendered externally, then the rear wall of the extension should be upgraded to the standards of Table 5 column (b), even if the **renovation** affected less than 50% of the total area of the building elevation when viewed from the rear. If plaster is being removed from a bedroom wall, the relevant area is the area of the external wall in the room, not the area of the external elevation which contains that wall section. This is because the marginal cost of dry-lining with insulated plasterboard rather than plain plasterboard is small.*

When a building undergoes a **major renovation** this may represent an opportunity to consider and takes into account the technical, environmental and economic feasibility of installing high efficiency alternative systems.

4.11 If achievement of the relevant U-value set out in column (b) of Table 5 is not technically or functionally feasible or would not achieve a **simple payback** of 15 years or less, the element should be upgraded to the best standard that is technically and functionally feasible and which can be achieved within a **simple payback** of no greater than 15 years. Guidance on this approach is given in Appendix A to Technical Guidance Document 11.1B.

4.12 When renovating **thermal elements**, the work should comply with all the requirements in Schedule 1, but particular attention should be paid to Parts 3 and 5 of the second schedule to the Bye-laws.

Retained Thermal Elements

4.13 Part 11 of Schedule 2 to the Building Bye-Laws applies to thermal elements in the following circumstances:

- a) where an existing **thermal element** is part of a building subject to a material change of use;
- b) where an existing element is to become part of the thermal envelope, where previously it was not;

- c) where an existing element is being upgraded as a **consequential improvement** (Bye-law 17C) in accordance with paragraphs 5.1 to 5.9.

4.14 Reasonable provision would be to upgrade those **thermal elements** whose U-value is worse than the threshold value in column (a) of Table 5 to achieve the U-value given in column (b) of Table 5, provided this is technically, functionally and economically feasible. A reasonable test of economic feasibility is to achieve a **simple payback** of 15 years or less. Where the standard given in column (b) is not technically, functionally or economically feasible, then the element should be upgraded to the best standard that is technically and functionally feasible and which meets a **simple payback** criterion of 15 years or less. Generally, this lesser standard should not be worse than $0.7\text{W/m}^2\cdot\text{K}$.

Examples of where lesser provision than column(b) might apply are where the thickness of the additional insulation might reduce usable floor area by more than 5 per cent or create difficulties with adjoining floor levels, or where the weight of the additional insulation might not be supported by the existing structural frame.

- 4.15 When renovating **thermal elements**, the work should comply with all the requirements in Schedule 2, but particular attention should be paid to Parts 3 and 5.

TABLE 5 UPGRADING RETAINED THERMAL ELEMENTS		
Element¹	a) Threshold U-value $\text{W/m}^2\cdot\text{K}$	b) Improved U-value $\text{W/m}^2\cdot\text{K}$
Wall - cavity insulation	0.70	0.55 ²
Wall - external or internal insulation	0.70	0.30 ³
Floor ^{4,5}	0.70	0.25
Pitched roof - insulation at ceiling level	0.35	0.16
Pitched roof - insulation at rafter level ⁶	0.35	0.18
Flat roof or roof with integral insulation ⁷	0.35	0.18

Notes:

- 1) 'Roof' includes the roof parts of dormer windows and 'wall' includes the wall parts (cheeks) of dormer windows.
- 2) This applies only in the case of a wall suitable for the installation of cavity insulation. Where this is not the case, it should be treated as 'wall - external or internal insulation'
- 3) A lesser provision may be appropriate where meeting such a standard would result in a reduction of more than 5% in the internal floor area of the room bounded by the wall.
- 4) The U-value of the floor of an extension can be calculated using the exposed perimeter and floor area of the whole enlarged building.
- 5) A lesser provision may be appropriate where meeting such a standard would create significant problems in relation to adjoining floor levels.

- 6) A lesser provision may be appropriate where meeting such a standard would create limitations on head room. In such cases, the depth of the insulation plus any required air gap should be at least to the depth of the rafters, and the thermal performance of the chosen insulant should be such as to achieve the best practicable U-value.
- 7) A lesser provision may be appropriate if there are particular problems associated with the load-bearing capacity of the frame or the upstand height.

DRAFT

CONSEQUENTIAL IMPROVEMENTS

- 5.1 Bye-law 17C may require additional work to be undertaken to make an existing building more energy efficient when certain types of building work are proposed.
- 5.2 This requirement arises in existing non-domestic buildings which have with a **total useful floor area** of over 1,000 m² where the proposed work consists of or includes:
- an extension
 - the initial provision of any **fixed building service** (other than renewable energy generator);
 - an increase to the installed capacity of any **fixed building service** (other than a renewable energy generator).
- 5.3 Where Bye-law 17C 1(a) applies, **consequential improvements**, in addition to the proposed building work (the **principal works**), should be made to ensure that the building complies with Part 11, to the extent that such improvements are technically, functionally and economically feasible. Paragraphs 5.4 to 5.11 below set out guidance on what will constitute technically, functionally and economically feasible **consequential improvements** in various circumstances.

*The **principal works** must comply with the **energy efficiency requirements** in the normal way.*

- 5.4 Where improvement works other than the 'trigger activities' listed in bye-law 17C (1) are planned as part of the building work, owners can use these as contributing to the **consequential improvements**. The exception to this is if additional work is being done to the existing building to compensate for a poorer standard of an extension (see paragraphs 3.9 to 3.11).

*For example, if, as well as extending the building, the proposals included total window replacement, then the window replacement work would satisfy the requirement for **consequential improvements**, provided the cost was at least 10 per cent of the cost of the extension.*

- 5.5 Measures such as those listed in Table 6 that achieve a simple payback not exceeding 15 years will be economically feasible unless there are unusual circumstances.

For example, if the remaining life of the building is less than 15 years it would be economic to carry out only improvements with payback periods within that life.

CONSEQUENTIAL IMPROVEMENTS ON EXTENDING A BUILDING

Constructing a new free-standing building on an existing site (e.g. a new out-patients building at an existing hospital site, or a new classroom block at a school) is not an extension. These should be treated as new buildings.

- 5.6 Where a building is extended, or the habitable area is increased, a way of complying with Bye-law 17C would be to adopt measures such as those in Table 6 to the extent that their value is not less than 10 per cent of the value of the **principal works**. The value of the **principal works** and the value of the **consequential improvements** should be established using prices current at the date the proposals are made known to the Department. They should be made known by way of a report signed by a suitably qualified person that should be included as part of the building application plans.

An example of a suitably qualified person would be a chartered quantity surveyor.

TABLE 6 IMPROVEMENTS THAT IN ORDINARY CIRCUMSTANCES ARE PRACTICAL AND ECONOMICALLY FEASIBLE	
<i>Items 1 to 7 will usually meet the economic feasibility criterion set out in paragraph 5.5. A shorter payback period is given in item 8 because such measures are likely to be more capital intensive or more risky than the others.</i>	
No.	Improvement measure
1	Upgrading heating systems more than 15 years old by the provision of new plant or improved controls
2	Upgrading cooling systems more than 15 years old by the provision of new plant or improved controls
3	Upgrading air-handling systems more than 15 years old by the provision of new plant or improved controls
4	Upgrading general lighting systems that have an average lamp efficacy of less than 40 lamp-lumens per circuit-watt and that serve areas greater than 100 m ² by the provision of new luminaires or improved controls
5	Installing energy metering following the guidance given in CIBSE TM 39
6	Upgrading thermal elements which have U-values worse than those set out in column (a) of Table 5 following the guidance in paragraphs 4.13 and 4.14
7	Replacing existing windows, roof windows or rooflights (but excluding display windows) or doors (but excluding high-usage entrance doors) which have a U-value worse than 3.3 W/m ² .K following the guidance in paragraphs 3.22 to 3.27
8	Increasing the on-site low and zero carbon (LZC) energy-generating systems if the existing on-site systems provide less than 10% of on-site energy demand, provided the increase would achieve a simple payback of 7 years or less
9	Measures specified in the Recommendations Report produced in parallel with a valid Energy Performance Certificate

CONSEQUENTIAL IMPROVEMENTS ON INSTALLING BUILDING SERVICES.

5.7 Where it is proposed to install a **fixed building service** as a first installation, or as an installation which increases the installed capacity per unit area of an existing service, reasonable provision would be to:

- a) firstly improve the fabric of those parts of the building served by the service, where this is economically feasible; and

*This means for example that if heating systems are to be installed for the first time in a building or part thereof, or the installed heating capacity per unit area of an existing system is to be increased, the fabric should be improved. The aim in these cases is to make cost-effective improvements to the performance of the fabric so that the installed capacity (and the initial cost) of the **fixed building services** and their subsequent energy consumption are not excessive.*

- b) additionally, make improvements in line with the guidance in paragraph 5.5. The cost of any improvement made as a result of following the guidance in sub-paragraph (a) above cannot be taken as contributing to the value of the consequential improvements specified in paragraph 5.6.

If only the improvements under a) were made, then the CO₂ emissions from the building might well increase as a result of the higher level of servicing. By also requiring the general improvements in b), an overall improvement should be achieved.

5.8 For the purposes of this Technical guidance Document, the installed capacity of a **fixed building service** is defined as the design output of the distribution system output devices (the terminal units) serving the space in question, divided by the **total useful floor area** of that space.

*This means that if (e.g.) the size of central boiler plant is increased to serve a new extension rather than to increase the heating provision in the existing building, the **consequential improvements** in paragraph 5.6 would be required but those in the following paragraphs would not apply.*

5.9 Reasonable provision for improving the fabric of those parts of the building served by the service in line with paragraph 5.7a above would be to follow the guidance in paragraphs 5.10 and 5.11 to the extent that the work is technically, functionally and economically feasible. The extent of such work is not limited by the 10 per cent threshold. The following paragraphs give guidance on what in normal circumstances would be economically feasible.

5.10 Where the installed capacity per unit area of a heating system is increased:

- a) the thermal elements within the area served which have U-values worse than those set out in column (a) of Table 5 should be upgraded following the guidance in paragraphs 4.13 and 4.14; and
- b) existing windows, roof windows or rooflights (but excluding display windows) or doors (but excluding high-usage entrance doors) within the area served and which have U-values worse than 3.3 W/m².K should be replaced following the guidance in paragraphs 3.23 to 3.27.

5.11 Where the installed capacity per unit area of a cooling system is increased:

- a) thermal elements within heated areas which have U-values worse than those set out in column (a) of Table 5 should be upgraded following the guidance in paragraphs 4.13 and 4.14; and
- b) if the area of windows, roof windows (but excluding display windows) within the area served exceeds 40 per cent of the façade area or the area of rooflights exceeds 20 per cent of the area of the roof and the design solar load exceeds 25 W/m², then the solar control provisions should be upgraded such that at least one of the following four criteria is met:
 - i. the solar gain per unit floor area averaged over the period 0630 to 1630 GMT is not greater than 25 W/m² when the building is subject to solar irradiances for July as given in the table of design irradiances in CIBSE Design Guide A;
 - ii. the design solar load is reduced by at least 20 per cent;
 - iii. the effective g-value is no worse than 0.3;
 - iv. the zone or zones satisfies the criterion 3 check in Technical Guidance Document 11.2A based on calculations by an approved software tool; and

This will reduce the solar gain and hence the space cooling demand. Section 5.1 of TM 37 gives guidance on calculating solar gains, and Sections 4.4 and 4.5 give guidance on the effective g-value.

- c) any general lighting system within the area served by the relevant **fixed building service** which has an average lamp efficacy of less than 45 lamp-lumens per circuit-watt should be upgraded with new luminaires and/or controls following the guidance in the Non-Domestic Building Services Compliance Guide.

This will reduce the lighting load and hence the space cooling demand.

PROVIDING INFORMATION

- 6.1 On completion of the work, in accordance with Bye-law 17E, the owner of the building should be provided with sufficient information about the building, the **fixed building services** and their operating and maintenance requirements so that the building can be operated in such a manner as to use no more fuel and power than is reasonable in the circumstances. This requirement applies only to the work that has actually been carried out – e.g. if the work involves replacing windows, there is no obligation on the contractor to provide details on the operation of the heating system.

BUILDING LOG BOOK

- 6.2 A way of showing compliance with the requirement would be to produce the necessary information following the guidance in CIBSE TM 31 Building log book toolkit, or to add it to an existing log book. If an alternative guidance document is followed in preparing the log book, then the information conveyed and the format of presentation should be equivalent to TM 31.
- 6.3 The information should be presented in templates as or similar to those in TM 31. The information should be provided in summary form, suitable for day-to-day use. It could draw on or refer to information available as part of other documentation, such as the Operation and Maintenance Manuals and the Health and Safety file required by the Social Security Department's approved code of practice 11. (ACoP11)

Further advice is provided in BSRIA BG26/2011 Building Manuals and Building User Guides.

- 6.4 The new or updated log book should provide details of:
- a) any newly provided, renovated or upgraded thermal elements or controlled fittings;
 - b) any newly provided fixed building services, their method of operation and maintenance;
 - c) any newly installed energy meters; and
 - d) any other details that collectively enable the energy consumption of the building and building services constituting the works to be monitored and controlled.

KEY TERMS

The following are key terms used in this document:

Building envelope in relation to a building means the walls, floor, roof, windows, doors, roof windows and roof-lights.

Commissioning means the advancement of a **fixed building service** following installation, replacement or alteration of the whole or part of the system, from the state of static completion to working order by testing and adjusting as necessary to ensure that the system as a whole uses no more fuel and power than is reasonable in the circumstances, without prejudice to the need to comply with health and safety requirements. For each system **commissioning** includes setting-to-work, regulation (that is testing and adjusting repetitively) to achieve the specified performance, the calibration, setting up and testing of the associated automatic control systems, and recording of the system settings and the performance test results that have been accepted as satisfactory.

Consequential improvements means those energy efficiency improvements required by bye-law 17C.

A **Conservatory** is an extension that has not less than three quarters of its roof area and not less than one half of its external wall area made from translucent material, that is adequately thermally separated from the building.

Controlled service or fitting means a service or fitting in relation to which Part 3 (combustion appliances and fuel storage systems) Part 6 (drainage, sanitation, hot water safety and water efficiency), or Part 11 (conservation of fuel and power) of Schedule 2 to the Building Bye-laws imposes a requirement.

Display window means an area of glazing, including glazed doors, intended for the display of products or services on offer within the building, positioned:

- a) at the external perimeter of the building; and
- b) at an access level; and
- c) immediately adjacent to a pedestrian thoroughfare.

There should be no permanent workspace within one glazing height of the perimeter. Glazing more than 3 m above such an access level should not be considered part of a **display window** except:

- a) where the products on display require a greater height of glazing;
- b) in cases where building work involving changes to the façade and glazing requiring planning consent, where planners require a greater

height of glazing, e.g. to fit with surrounding buildings or to match the character of the existing façade.

It is expected that **display windows** will be found in the types of building as detailed in the table below.

BUILDINGS LIKELY TO HAVE DISPLAY WINDOWS	
Shops:	including retail-warehouse, undertakers, showrooms, post offices, hairdressers, shops for sale of cold food for consumption off premises
Financial and professional services	banks, building societies, estate and employment agencies, betting offices
Food and drink	restaurants, pubs, wine bars, shops for sale of hot food for consumption off premises
Assembly and leisure:	cinemas, concert halls, bingo halls, casinos, sports and leisure uses

Display lighting means lighting intended to highlight displays of exhibits or merchandise, or lighting used in spaces for public leisure and entertainment such as dance halls, auditoria, conference halls, restaurants and cinemas.

Dwelling includes a **dwelling**-house and a flat and means a self-contained unit designed to accommodate a single household. Buildings exclusively containing **rooms for residential purposes** such as nursing homes, student accommodation and similar are not **dwelling**s, and in such cases, this Technical Guidance Document 11.2B applies to work in such buildings.

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

Energy efficiency requirements means the requirements of Bye-laws 5A, 5B, Part 3A and Part 11 of Schedule 2 to, the Building Bye-laws.

Fit-out work means that work needed to complete the partitioning and building services within the external fabric of the building (the shell) to meet the specific needs of incoming occupiers.

Fit-out work can be carried out in whole or in parts:

- a) in the same project and time frame as the construction of the building shell; or
- b) at some time after the shell has been completed.

Fixed building service means –

- a) a fixed internal or external lighting system (other than an emergency escape lighting system or a specialist process lighting system); or
- b) a fixed system for heating, providing hot water, providing air conditioning or providing mechanical ventilation; or
- c) any combination of systems of the kinds referred to in paragraph (a) or (b)

Major renovation means the **renovation** of a building where more than 25% of the surface area of the **building envelope** undergoes **renovation**.

High-usage entrance door means a door to an entrance primarily for the use of people that is expected to experience large volumes of traffic, and where robustness and/or powered operation is the main performance requirement. To qualify as a **high-usage entrance door**, the door should be equipped with automatic closers and, except where operational requirements preclude it, be protected by a lobby.

Principal works means the work necessary to achieve the client's purposes in extending the building and/or increasing the installed capacity of any **fixed building services**. The value of the **principal works** is the basis for determining a reasonable provision of **consequential improvements**.

Room for residential purposes means a room, or suite of rooms –

- a) that is not a dwelling house or flat; and
- b) that is used by one or more persons to live and sleep in, and includes rooms in hotels, hostels, guest houses, halls of residence and residential homes but does not include rooms in hospitals, or similar establishments, used for patient accommodation.

Renovation in relation to a **thermal element** means the provision of a new layer in the **thermal element** or the replacement of an existing layer, but excludes decorative finishes, and 'renovate' shall be construed accordingly.

Simple payback means the amount of time it will take to recover the initial investment through energy savings, and is calculated by dividing the marginal additional cost of implementing an energy efficiency measure by the value of the annual energy savings achieved by that measure taking no account of GST. When making this calculation the following guidance should be used:

- a) the marginal additional cost is the additional cost (materials and labour) of incorporating (e.g.) additional insulation, not the whole cost of the work;
- b) the cost of implementing the measure should be based on prices current at the date the proposals are made known to the Department and be confirmed in a report signed by a suitably qualified person;
- c) the annual energy savings should be estimated using the UK Governments' Simplified Building Energy Model (SBEM);
- d) for the purposes of this Technical Guidance Document, the energy prices that are current at the time of the application to the Department should be used when evaluating the annual energy savings. Current energy prices can be obtained from www.jerseyfuelwatch.com.

Thermal element is defined as:

A wall, floor or roof (but does not include windows, doors, roof windows or roof-lights) which separates a thermally conditioned part of the building ('the conditioned space') from:

- a) the external environment (including the ground); or
- b) in the case of floors and walls, another part of the building which is:
 - i. unconditioned;
 - ii. an extension falling within class 6 in Schedule 1; or
 - iii. where this clause applies, conditioned to a different temperature, and includes all parts of the element between the surface bounding the conditioned space and the external environment or other part of the building. Paragraph (b)(iii) only applies to a building which is not a dwelling, where the other part of the building is used for a purpose which is not similar or identical to the purpose for which the conditioned space is used.

Note that this definition encompasses the walls and floor of a swimming pool basin where this is part of an existing **dwelling**.

Total useful floor area is the total area of all enclosed spaces measured to the internal face of the external walls, that is to say it is the gross floor area as measured in accordance with the guidance issued to surveyors by the RICS. In this convention:

- a) the area of sloping surfaces such as staircases, galleries, raked auditoria, and tiered terraces should be taken as their area on plan; and
- b) areas that are not enclosed such as open floors, covered ways and balconies are excluded.

This equates to the gross floor area as measured in accordance with the guidance issued to surveyors by the RICS.

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BUILDINGS THAT ARE EXEMPT FROM THE ENERGY EFFICIENCY REQUIREMENTS

- 1) Building work in existing buildings which are roofed constructions having walls and use energy to condition the indoor climate will need to comply with the **energy efficiency requirements** of the Building Bye-laws, unless they are exempt as set out Bye-law 17A.
- 2) The following classes of buildings or parts of new buildings other than **dwelling**s are exempt under Bye-law 17A:
 - a) buildings which are used primarily or solely as places of worship;
 - b) temporary buildings with a planned time of use of two years or less, industrial sites, workshops and non-residential agricultural buildings with low energy demand;
 - c) stand-alone buildings other than **dwelling**s with a **total useful floor area** of less than 50m²;
 - d) Buildings which are registered on the Ministers register of Buildings and Sites of Architectural, Archaeological and Historic importance, and compliance with the **energy efficiency requirements** would unacceptably alter their character or appearance.
- 3) The following paragraphs give guidance on those exemptions that relate to buildings that are not **dwelling**s.
 - a) **Places of worship:** For the purposes of the **energy efficiency requirements**, places of worship are those buildings or parts of a building that are used for formal public worship, plus adjoining spaces whose function is directly linked to that use (for example, a vestry in a church). Traditional, religious or cultural constraints often make it impossible for buildings or parts of buildings that are used for public worship to comply with the **energy efficiency requirements**. Parts of the building that are designed to be used separately, such as offices, catering facilities, day centres, meeting halls and accommodation, are not exempt from the **energy efficiency requirements**.
 - b) **Temporary buildings:** For the purpose of the **energy efficiency requirements**, a temporary building with a planned time of use of two years or less is exempt. Portable or modular buildings, whether on one or more sites, which have a planned service life longer than two years, are not exempt.
 - c) **Industrial sites, workshops and non-residential agricultural buildings with low energy demand:** In relation to this category of exempt building, the low energy demand only relates to the energy used by fixed heating or cooling systems, NOT to energy

required for or created by process needs. The following are examples of buildings in the above categories that have low energy demand:

- i. buildings or parts of buildings where the space is not generally heated or cooled other than by process heat;
- ii. buildings or parts of buildings that only require heating or cooling for short periods each year, such as during critical periods in the production cycle (e.g. plant germination, egg hatching) or during very severe weather conditions.

Industrial sites, workshops and non-residential agricultural buildings are exempt only if they meet the low energy demand criterion. In other cases, such buildings must comply with **energy efficiency requirements**. Other buildings which have a low energy demand but do not fall into one of the above categories are not exempt.

DOCUMENTS REFERRED TO**BRE****www.bre.co.uk**

BR 443 Conventions for U-value calculations, 2006.

(Downloadable from www.bre.co.uk/uvalues.)

Information Paper IP1/06 Assessing the effects of thermal bridging at junctions and around openings in the external elements of buildings, 2006. ISBN 978 1 86081 904 9

BRE Reoport BR 497 Conventions for Calculating Linear Thermal Transmittance and Temperature Factors [2007 and 2010 amendments and conventions]. ISBN 978 1 86081 986 5.

Department for Energy and Climate Change (DECC)**www.decc.gov.uk**

The Government's Standard Assessment Procedure for energy rating of dwellings, SAP 2012. (Available at www.bre.co.uk/sap2012)

Current Energy Prices (www.jerseyfuelwatch.com)

English Heritage**www.english-heritage.org.uk**

Energy Efficiency and Historic Buildings, English Heritage, 2011.

Glass and Glazing Federation (GGF)**www.ggf.org.uk**

Guide to the Calculation of Energy Ratings for Windows, Roof Windows & Doors, GGF, 2013.

Heating and Ventilating Contractors Association**www.hvca.org.uk**

DW/143 A practical guide to ductwork leakage testing, HVCA 2000. ISBN 978 0 90378 330 9.

National Association of Rooflight Manufacturers (NARM)**www.narm.org.uk**

NARM Technical Document NTD 2, 2010

CIBSE**www.cibse.org.uk**

TM31 Building Log Book Toolkit CIBSE 2006. ISBN 978 1 90328 771 2.

TM37 Design for Improved Solar Shading Control 2006. ISBN 978 1 90328 757 6.

TM39 Building Energy Metering CIBSE 2009. ISBN 978 1 90684 611 4.

TM46 Energy Benchmarks CIBSE 2008.

CINSE Commissioning Code M: Commissioning Management CIBSE 2003. ISBN 978 1 10328 733 0.

Legislation

The Building Bye-laws (Jersey) 2007, as amended.

Department for Business, Innovation and Skills**www.bis.gov.uk**

Technical Standards and Regulations Directive 98/34/EC. (Available at www.bis.gov.uk/policies/innovation/infrastructure/Standardisation/techstandards-directive).

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Department for Communities and Local Government

Non Domestic Building Services Compliance Guide, DCLG, 2013. (Available to download from www.gov.je)

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Health and Safety Executive (HSE)**www.hse.gov.uk**

L24 Workplace Health, Safety and Welfare: Workplace (Health, Safety and Welfare) Regulations 1992, Approved Code of Practice and Guidance, The Health and Safety Commission, 1992 ISBN 978 0 71760 413 5.

STANDARDS REFERRED TO

BS EN ISO 13370 Thermal performance of buildings – Heat transfer via the ground – Calculation methods [2007 incorporating corrigendum March 2009].

BS EN 14351-1 Windows and doors – Product standard, performance characteristics. Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics [2006 (+AMD 1:2010)].

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