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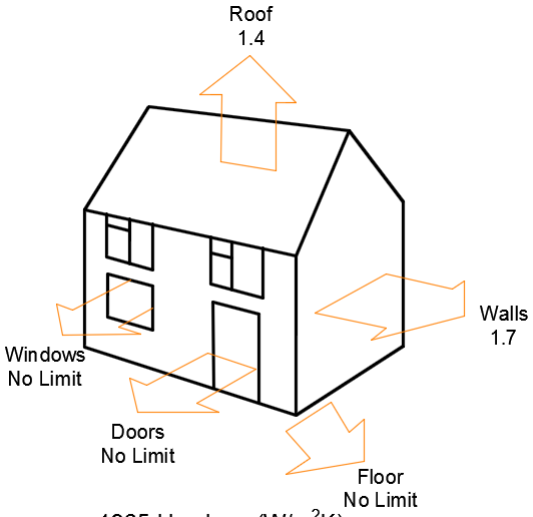
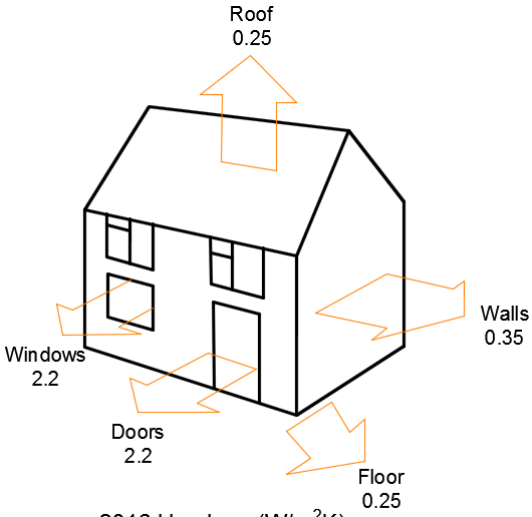
UK U-values



1965 U-values (W/m^{2}K)



2016 U-values (W/m^{2}K)

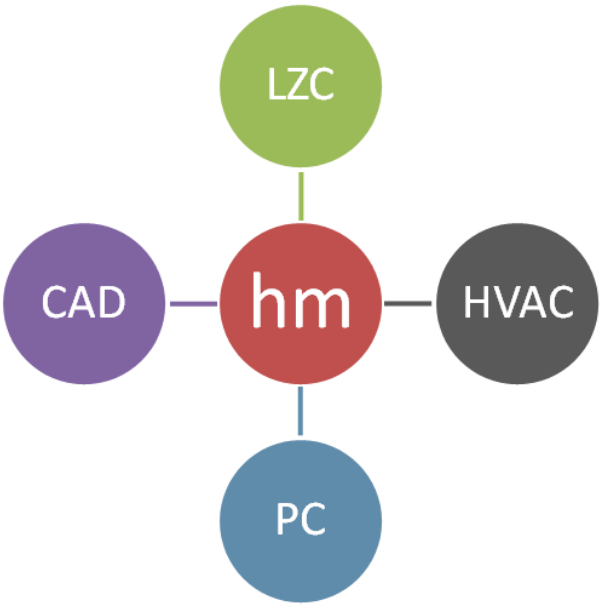
Summary

UK U-value History; a guide to the changes to fabric U-values in the UK. U-values have steadily reduced since 1965. A low U-value (heat transfer coefficient) figure, equals a slower rate of heat loss through a fabric. This guide records changes to u-values required for non-domestic buildings in England and Wales up to 2016.

Updated with U-values only for buildings other than dwellings.

Tags: homemicro.co.uk; u-values; Part L; Building Regulations; UK

The web article relating to this subject can be found here:
http://www.homemicro.co.uk/lzc_insulate.html



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What are U-values?

U-values indicate the rate of heat transfer through a material or structure. The U-value (with units W/m²K) is the rate of heat transfer (through a structure), divided by the difference in temperature across that structure (inside and the outside of a building). The lower the U-value figure, the slower the rate of heat loss, and hence reduced demand on heating or cooling – high insulation levels can contribute to overheating in summer time, but this is another subject.

The rate of heat loss will vary according to the thermal properties of a material. Knowing the thermal conductivity or thermal resistance, as well as the thickness, will permit calculation of the U-value.

As shown in this guide, changes to the Building Regulations (for England and Wales) have pushed for ever lower U-values in a bid to reduce energy consumption and the associated carbon emissions.

Thermal Conductivity & Thermal Resistance

Thermal conductivity (k or lambda value - W/mK) is the capacity of a material to conduct heat assuming there is a temperature gradient across the material. Thermal conductivity is a measure of the rate of conduction therefore the thickness is not relevant.

In the case of an insulating material a material that conducts heat slowly is obviously more preferable. It is considered that materials are [suitable] thermal insulants if their conductivity is less than 0.065 W/mK. The thermal conductivity of a typical mineral fibre product is in the range of 0.034 to 0.044 W/mK, whereas a good rigid phenolic insulation thermal conductivity is in the range of 0.021 to 0.024 W/mK. Therefore, for the same thickness, phenolic is a better insulator than mineral fibre.

Thermal resistance (R value - m^2K/W) is the capacity of a product to resist against heat loss. A product with a higher R value will perform better as an insulator. The thermal resistance of a specific product can be found by dividing its thickness by the thermal conductivity or if the R value is given, then the thermal conductivity can be calculated by dividing the material thickness by the R value. *Remember to work in metres not millimetres.*

TIP

To achieve a low U-value:

*Use **low Thermal Conductivity** (k or lambda value - W/mK) value*

*Use **high Thermal Resistance** (R value - m^2K/W) value*

Changes to U-values in England & Wales

There have been many updates to the Building Regulations in England & Wales which have changed the U-value limits for building fabric and the methods by which U-values are applied.

An overview of key changes to the Building Regulations in England & Wales, primarily for buildings other than dwellings (non-domestic buildings), is given below and a summary of U-values from 1965 to 2016 is provided in *Table 1*.

The U-value limits introduced in the Building Regulations **1965** Part F Thermal Insulation (enforced from 1966) were:

- 1.7 W/m²K for walls (0.3 Btu/hour/foot²/°F)
- 1.4 W/m²K for roofs (0.25 Btu/hour/foot²/°F)

These were tightened in the Building Regulations **1976** Part F Thermal Insulation (enforced from 1976) to:

- 1.0 W/m²K for exposed walls, floors and non-solid ground and exposed floors
- 1.7 W/m²K for semi-exposed walls
- 1.8 W/m²K average for walls and windows combined
- 0.6 W/m²K for roofs

The **1985** Building Regulations Part L Conservation of Fuel and Power reduced these limits to:

- 0.6 W/m²K for exposed walls, roofs and ground floors in shops, offices and assembly places
- 0.7 W/m²K for exposed walls, roofs and ground floors industrial and other buildings

These limits were reduced again in the **1990** (with 1992 amendments) Building Regulations Part L Conservation of Fuel and Power:

- 0.45 W/m²K for exposed walls, roofs and ground floors
- plus a requirement that the area of windows should not be more than 35% in shops, offices and assembly and 15% in industrial and storage buildings.

In the **1995** Building Regulations Part L Conservation of Fuel and Power U-values were as the following, and the SAP calculations were introduced for dwellings:

- 0.45 W/m²K for exposed walls, floors and ground floors
- 0.6 W/m²K for semi-exposed walls and floors
- 0.25 W/m²K or roofs
- the limit on window area was raised to 22.5%

The **2002** Building Regulations Part L reduced the U-values and made additional elements of the building fabric subject to control. The approved document was also divided into domestic (ADL1) and non-domestic (ADL2) sections. Although there was in practice considerable flexibility and the ability to 'trade off' reductions in one area for increases in another, the 'target' limits became:

- 0.35 W/m²K for walls
- 0.25 W/m²K for floors
- 0.20 W/m²K or 0.25 W/m²K for pitched roofs (depending on the construction)
- 0.16 W/m²K for flat roofs
- 2.2 W/m²K for metal framed doors and windows
- 2.0 W/m²K for other doors and windows
- the limit on window area was raised again to 25%

In **2006** the Building Regulations Part L approved document was also divided into four: new domestic (ADL1A); existing domestic (ADL1B); new non-domestic (ADL2A) and existing non-domestic (ADL2B) sections. Area-weighted average u-values stipulated with "*upper limiting*" u-value for each element. Air permeability limits introduced for the first time.

Minimum energy performance requirements in the form of target CO_2 emission rates were introduced. This is most commonly demonstrated by using a SBEM (Simplified Building Energy Model), a computer program that enables Building Regulations compliance checks and energy ratings to be carried out for non-domestic buildings, providing an analysis of a building's projected regulated energy consumption.

- 0.35 W/m²K for walls
- 0.25 W/m²K for floors
- 0.20 W/m²K or 0.25 W/m²K for pitched roofs (depending on the construction)
- 0.16 W/m²K for flat roofs
- 2.2 W/m²K for other doors and windows
- Air permeability $10m^3/h.m^2$

Only minor changes were made in the **2010** Building Regulations Part L. U-values stipulated as "*limiting fabric parameter*".

- 0.35 W/m²K for walls
- 0.25 W/m²K for floors
- 0.25 W/m²K for roofs
- 2.2 W/m²K for doors and windows
- 1.5 W/m²K for vehicle door
- 1.5 W/m²K for high-usage entrance doors
- Air permeability $10m^3/h.m^2$

The **2013** and **2016** revisions to Part L of the Building Regulations made no amendment to the U-values stated in 2010 version. In **2014** separate editions of the Part L of the Building Regulations specifically for use in **Wales** came into force.

U-values Illustrated

A range of the changes to U-values from 1965 to 2016 are illustrated below:

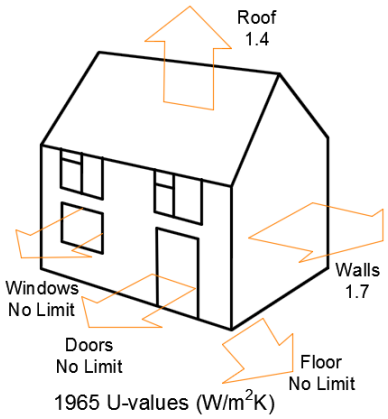

Figure 1 - 1965 U-values

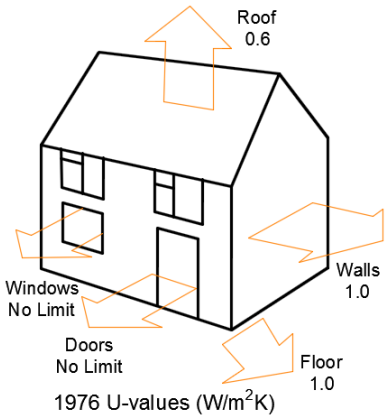

Figure 2 - 1976 U-values

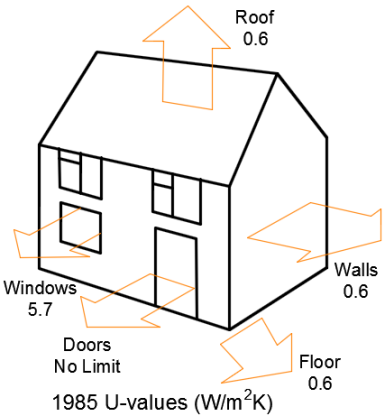

Figure 3 - 1985 U-values

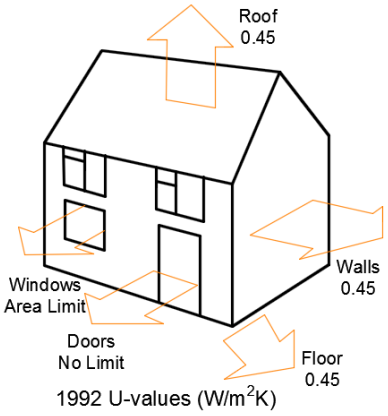

Figure 4 - 1992 U-values

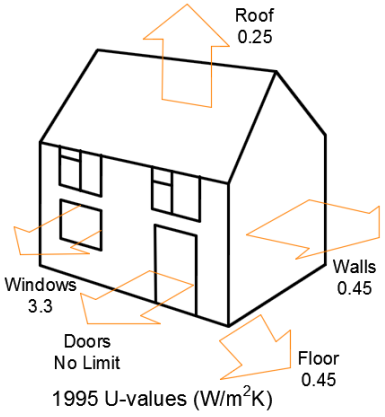

Figure 5 - 1995 U-values

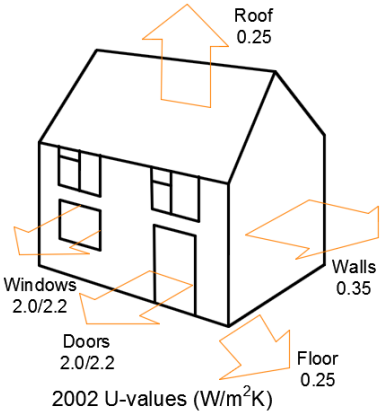

Figure 6 - 1976 U-values

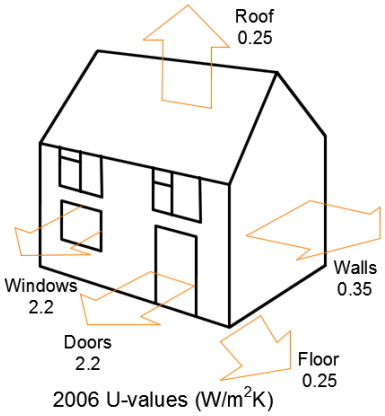

Figure 7 - 2006 U-values

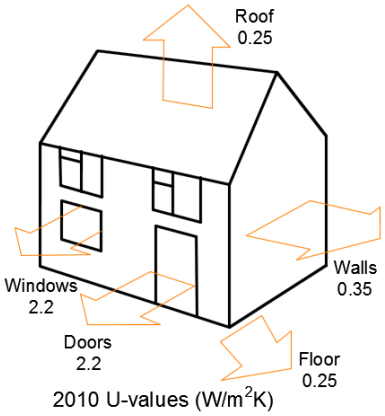

Figure 8 - 2010 U-values

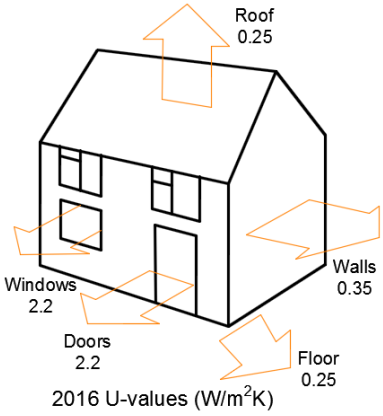

Figure 9 - 2016 U-values

U-values 1965 to 2016 Summary

The changes to U-values stipulated in the Building Regulations in England & Wales from 1965 to 2016, for buildings other than dwellings (non-domestic buildings), is provided in *Table 1*.

Table 1 - History of changes to U-value limits in the UK (England & Wales)

YEAR	1965	1976	1985[1]	1992	1995	2002[2]	2006[3]	2010[4] 2013 & 2016
FABRIC	U-Value W/m^2.K							
Walls	1.7	1.0	0.6/0.7	0.45	0.45	0.35	0.35	0.35
Floors		1.0	0.6/0.7	0.45	0.45	0.25	0.25	0.25
Pitched Roof	1.4	0.6	0.6/0.7	0.45	0.25	0.25	0.25	0.25
Flat Roof		0.6	0.6/0.7	0.45	0.25	0.16	0.25	0.25
Windows metal			5.7			2.2	2.2	2.2
Windows all other			5.7		3.3[6]	2.0	2.2	2.2
Window Area			35/15%[7]	35/15%[7]	40/15%[8]	25%		
Pedestrian Door					3.3	2.2/2.0	2.2	2.2
Vehicle Doors					0.7	0.7	1.5	1.5
Entrance Doors							6.0	3.5
Air Permeability[5]							10	10

Notes

1. First values stated for shops, offices and assembly and second values for industrial and other buildings.
2. The 2002 approved document was split into two parts L1 and L2.
3. The 2006 approved document was split into four parts L1A, L1B, L2A and L2B. The 2006 values are area-weighted average limiting standards (Part L2A). SBEM calculation required.
4. The 2010/2013/2016 values are limiting fabric parameters (Part L2A). SBEM calculation required. New alternative requirements introduced in Wales 2014.
5. Air permeability units m^3/(h.m^2) @ 50Pa.
6. Value varies according to materials used and average U-value to be achieved within the maximum window percentage area limit.
7. Window area allowance 35% for places of assembly, offices and shops and 15% for industrial and storage buildings.
8. Window area allowance 40% for places of assembly, offices and shops and 15% for industrial and storage buildings.

Notional Building

As a note of caution, the Part L Simplified Building Energy Model (SBEM) uses a notional building with set U-values that ensure compliance. These values differ from the limiting fabric values stated in Part L 2013 – refer to Table 5 in the approved document.

The SBEM calculates the Target Emission Rate (TER) based on the performance of a notional building. The notional building is the same size, shape and has the same activity and zoning arrangements as the actual building. The calculation uses a standard set of data from Table 1 of the National Calculation Methodology (NCM) 2013 database, this data includes U-values which differ from the limiting fabric values stated in Part L. A comparison of these values for 2016 is provided in *Table 2*.

Table 2 - Notional building vs. [2016] Part L U-values

CONSTRUCTION	NOTIONAL BUILDING	2016 LIMITING	IMPROVEMENT %
Wall	0.26	0.35	26
Roof	0.18	0.25	28
Exposed/ground floor	0.22	0.25	12
Window	1.6	2.2	27
Roof Window/rooflight	1.8	2.2	18
Vehicle Door	1.5	1.5	0
Entrance Door	2.2	3.5	37
Air permeability $m^3/(h.m^2)$ @ 50Pa	3	10	70
Typical target air permeability is 5, but even then, the improvement is 40%.			

USEFUL RESOURCES

Knowledge base from NBS: https://www.thenbs.com/knowledge/what-is-a-u-value-heat-loss-thermal-mass-and-online-calculators-explained

Unit convertor at Translatorcafe.com: http://www.translatorscafe.com/cafe/EN/units-converter/heat-transfer-coefficient/1-9/watt%2Fmeter%C2%B2%2FK-Btu_(th)%2Fhour%2Ffoot%C2%B2%2F%C2%B0F/

Designing Buildings Wiki article on U-values: *http://www.designingbuildings.co.uk/wiki/U-values*

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