# Energy Efficiency Standards

– For new and existing dwellings

HOUSING
ENERGY EFFICIENCY

BEST PRACTICE
PROGRAMME

GENERAL INFORMATION LEAFLET 72

# INTRODUCTION

The Housing Energy Efficiency Best Practice programme (HEEBPp) has traditionally promoted energy efficiency standards over and above the minimum regulatory standards. The recent changes to the building regulations, in parts of the UK, mean that many current Best Practice standards, which have been used extensively by many housing organisations, are now close to or are exceeded by the minimum standards of the building regulations. A new set of transparent, easy to interpret standards is therefore required.

## WHAT IS THE AIM OF THIS LEAFLET?

To provide Specifiers, Installers and Purchasers with a set of Energy Efficiency Standards that can be used in the design, construction and refurbishment of dwellings in the UK. This leaflet sets out the reasons why we need them, explains what they are and discusses the potential implications of their application.

## COMMITMENT TO GLOBAL CLIMATE CONTROL

Under the Kyoto Protocol, the UK is obligated to reducing its greenhouse gas emissions, including carbon dioxide ($CO_2$) emissions, to 12.5% below 1990 levels by the year 2012. As the domestic sector accounts for about 28% of total UK $CO_2$ emissions, and mostly uses products and equipment that doesn't meet current standards, scope exists for a set of definitive Energy Efficiency Standards.

## WHY WE NEED ENERGY EFFICIENCY STANDARDS

There are many reasons why houses should be designed, built and refurbished to higher standards. These include:

- Reduced $CO_2$ emissions and fuel bills, benefiting the environment and the householder.
- Minimum regulatory standards represent the poorest permissible standards that are acceptable.
- Response to greater environmental awareness and aspirations amongst consumers in housing
- Insurance that the actual energy performance is not significantly greater than the predicted energy use.

## WHY ARE ENERGY EFFICIENCY STANDARDS USEFUL?

- They can be used by people who wish to design, build or refurbish dwellings to a better standard than the minimum required by the building regulations. Many organisations and individuals want to do better than the minimum standards. A set of authoritative standards is invaluable for these people and can be adopted wholesale or in part. Alternatively they can be used to supplement other documents or specifications.
- They contain a carefully developed and integrated package of measures and represent a good balance of fabric measures, ventilation, heating and hot water systems.
- They are used to inform the Housing Energy Efficiency Best Practice programme (HEEBPp), and third party publications.

## WHAT ARE THEY?

The Energy Efficiency Standards are the result of a recent project funded by the HEEBPp. The project consisted initially of a comprehensive review of existing UK and international standards, to establish an understanding of how standards have been developed, set and promoted in the past. A consultation exercise was then initiated with energy efficiency experts and organisations throughout the UK. The standards were then developed based on the results of this consultation.

The project has resulted in three standards for new housing and one for existing housing. This is in line with the consultation exercise that was undertaken, and reflects the greater range of options in newbuild compared to refurbishment.

## NEW HOUSING STANDARDS

There are three standards for new housing, these are:

| | |
|---|---|
| **Good Practice** | A standard which will ensure that the statutory/regulatory minimum is achieved with specific additional constraints. |
| **Best Practice** | A standard that will involve the adoption of technically proven, cost effective products and techniques that are already established on the market, and able to save energy without incurring undue risks. |
| **Advanced** | A standard for those who specifically wish to address sustainability issues and produce dwellings that are capable of achieving a minimum impact on the environment. |

The Good Practice and Best Practice standards consist of the minimum Carbon Index for different types of commonly used fuels, maximum U-Values for all exposed construction elements and various other basic requirements depending on the Standard being defined. In addition, there are further recommendations for each standard. The results from the consultation exercise suggested that there should be a common scale and strong carbon focus for the standards. For this reason, a Carbon Index has been used which would relate to the fuel being used. This is preferable to the use of a SAP related standard ('The Governments Standard Assessment Procedure for Energy Rating of Dwellings, Ref [1]) which would be based on the energy costs for space and water heating rather than the $CO_2$ emissions. Excessive trading-off has been prevented by the use of limiting U-values, which still allow some design flexibility.

**Carbon Index**

The Carbon Index (CI) is based on the $CO_2$ emissions associated with space and water heating, but adjusted for floor area, so that it is independent of dwelling size. The CI is expressed on a scale of 0 to 10. The higher the number the better the performance.

## GOOD PRACTICE STANDARD

**Basic requirements**

- The dwelling must meet a minimum CI as shown in the following:

| Fuel | Minimum CI |
|---|---|
| Gas / Biomass / CHP / Renewables* / LPG | 8.0 |
| Oil | 6.8 |
| Electric | 6.2 |

**not including 'green' electricity tariffs*

- U-values – The U-values must not be greater than the Elemental U-values of the Building Regulations in the relevant country (see the regulations for England and Wales[2], Scotland[3], Northern Ireland[4]).
- At least 50% of the rooms should be lit by energy efficient lights. When replacing old fittings use fittings specifically for CFLs.

**Further Recommended Measures**

- Where possible 'A' rated electrical appliances should be supplied.
- A pressure test following the method set out in CIBSE TM 23 'Testing Buildings for Air Leakage', (Ref [5]) should achieve an air permeability rate of less than 4 $m^3/h/m^2$ for houses with heat recovery ventilation systems and less than 7 $m^3/h/m^2$ at 50 Pa for other houses (GIR64 Post Construction Testing, Ref [6]).
- A ventilation system should be installed that gives a continuous, controlled supply of fresh air. This can either be a Passive Stack Ventilation system (PSV) or Assisted Passive Stack Ventilation (aPSV) or a Heat Recovery Ventilation system (HRV).

# BEST PRACTICE STANDARD

### Basic requirements

- The dwelling must meet a minimum CI as shown in the following table.

| Fuel | Minimum CI |
|---|---|
| Gas/Biomass/CHP/Renewables*/LPG | 8.6 |
| Oil | 7.4 |
| Electric | 6.8 |

**not including 'green' electricity tariffs*

- The U-values must not be greater than those set out in the following table:

| Element | Maximum U-value ($W/m^2K$) |
|---|---|
| Roofs | 0.13 |
| Walls, including basement walls | 0.25 |
| Floors, including ground floors and basement floors | 0.20 |
| Windows doors and rooflights (area-weighted average) | 1.80 |

- A pressure test following the method set out in CIBSE TM 23[5] should achieve an air permeability rate of less than 3 $m^3/h/m^2$.
- A ventilation system should be installed that gives a continuous, controlled supply of fresh air. This can either be a Passive Stack Ventilation system (PSV) or Assisted Passive Stack Ventilation (aPSV) or a Heat Recovery Ventilation system (HRV) (note 1 below).
- If a central heating system is used, it should comply with the CHeSS HC4 or HR4 specification (GIL59 'Central Heating Systems Specifications', Ref[7]).
- Other heating systems should have time and temperature controls equivalent to the CHeSS specification (note 2).
- At least 80% of rooms should be lit by dedicated energy efficient lights. When replacing old fittings use fittings specifically for CFLs.
- A ventilated space for clothes drying should be provided inside the house (note 3).
- Where electrical appliances are being supplied, they should be 'A' rated (note 4).

### Further Recommended Measures

- A thermographic survey should be considered as a useful technique for identifying missing insulation.
- Low water use appliances should be used. The WC should use no more than 4 litres. Showers should use less than 8 litres/min. Where specified washing machines should have a water consumption of less than 50 litres per wash; consumption for dishwashers should be less than 16 litres (as specified on the energy label). Care should be taken to avoid excessive 'dead legs'. It is recommended that the maximum length of dead leg should contain no more than 1.5 litres of water. This is equivalent to a 10 m length of 15 mm diameter copper pipe. If mains pressure hot or cold water is used, outlets should be fitted with dynamic flow regulators.

### NOTES (BEST PRACTICE STANDARD)

1 If PSV or aPSV is used, both the supply and exhaust vents should be humidity controlled. If fans are used in the ventilation system, the total fan power should be less than 2W per l/s of extract air. If heat recovery is to be used the efficiency of the heat exchanger should be greater than 70% as measured by BS EN 13141/7/8 (CEN TC 156/WG2/AH7 Component/products for residential ventilation, Ref[8])

2 For non-central heating systems the following requirements should be met.

- Non-electric systems. If gas room heaters are used, their efficiency should not be less than the standard set out in BS EN 613[9] 'Independent gas-fired convector heaters' (soon to be superseded). The heaters should have individual room temperature control. If hot water storage is used, it should a) be insulated to CHeSS HR4[7] and b) have time and temperature control.
- Electric systems. Storage heaters should have automatic charge control. Fan assisted storage heaters are recommended. On-peak heaters should have time and individual room temperature control. Hot water systems should have cylinder heat losses less than 1.33*(0.02 + 0.051*V2/3) as measured by BS 1566, 'Copper indirect cylinders for domestic purposes'[10]. This equates to a heat loss of 2.4 kWh over 24 hours for a 210 litre cylinder, or 1.7 kWh for a 120 litre cylinder. BS 1566 requires these heat loss figures to be marked on cylinders.

3 The clothes drying space should either have an exhaust vent from the whole house heat recovery ventilation system or an exhaust terminal from the PSV system or should be fitted with a room heat recovery ventilator.

4 Where electrical appliances are not supplied, occupants should be given information on the benefits of energy efficient appliances.

# ADVANCED STANDARD

The Advanced standard is based on the 'Zero Heating' Standard, (further detail in GIR 53 'Building a sustainable future'[11]). Fabric U-values are set to a level which reflects what is practicably achievable. Since the $CO_2$ emissions in the Advanced standard are dominated by lights and appliances, the use of the CI, as a measure is inappropriate as it does not take electricity used by these items into account.

**SPECIALIST ADVICE SHOULD BE TAKEN WHEN DESIGNING AND BUILDING TO THIS STANDARD.**

## Basic requirements

- Fabric U-values should not be greater than those set out in the following table.

| Element | Maximum U--value |
|---|---|
| Roofs | 0.08 |
| Walls, including basement walls | 0.15 |
| Floors, including ground floors and basement floors | 0.10 |
| Windows doors and rooflights (area-weighted average) | 1.50 |

- Average daylight factor calculations should show that the minimum values shown in the table below are achieved.

| Room | Minimum average daylight factor (%) |
|---|---|
| Living rooms, dining rooms, studies | 1.5 |
| Kitchen | 2.0 |
| Bedrooms | 1.0 |

## Basic Requirements (Continued)

- A pressure test following the method set out in CIBSE TM 23[5] should achieve an air permeability rate of less than 1 $m^3/h/m^2$.
- A ventilation system should be installed. This can either be a Passive Stack Ventilation system (PSV) or Assisted Passive Stack Ventilation (aPSV) or a Heat Recovery Ventilation system (HRV) (note 1).
- A ventilated space for clothes drying should be provided inside the house (note 2).
- If a central heating system is used, it should comply with the CHeSS HC4 or HR4[7] specification.
- Other heating systems should have time and temperature controls equivalent to the CHeSS specification (note 3).
- Dedicated energy efficient lighting should be used throughout the dwelling. When replacing old fittings use fittings specifically for CFLs.
- Where electrical appliances are being supplied, they should be 'A' rated.
- Low water use appliances should be used. The WC should use not more than 4 litres. Showers should use less than 6 litres/min. Where specified washing machines should have a water consumption of less than 50 litres per wash; consumption for dishwashers should be less than 16 litres (as specified on the energy label). Care should be taken to avoid excessive 'dead legs'. It is recommended that the maximum length of dead leg should contain no more than 1.5 litres of water. This is equivalent to a 10 m length of 15 mm diameter copper pipe. If mains pressure hot or cold water is used, outlets should be fitted with dynamic flow regulators.

## Further Recommended Measures

- A thermographic survey should be considered as a useful technique for identifying missing insulation.
- Consideration should be given to creating:
  - 'net zero $CO_2$' emissions by using renewable energy to balance the emissions from non-renewable fossil fuel use.
  - 'Autonomous' dwellings as in GIR 53[11]. These use on-site renewable energy generation and avoid connections to mains services.

## NOTES (ADVANCED STANDARD)

1 If PSV or aPSV is used, both the supply and exhaust vents should be humidity controlled. If fans are used in the ventilation system, the total fan power should be less than 1W per l/s of extract air. If heat recovery is to be used the efficiency of the heat exchanger should be greater than 85% as measured by BS EN 13141/7/8[8]

2 The clothes drying space should either have an exhaust vent from the whole house heat recovery ventilation system or an exhaust terminal from the PSV system or should be fitted with a room heat recovery ventilator.

3 For non-central heating systems these requirements should be met:

- Non-electric systems. If gas room heaters are used, their efficiency should not be less than the standard set out in BS EN 613[9] 'Independent gas-fired convector heaters' (soon to be superseded). They should have individual room temperature control. If hot water storage is used, it should be insulated to CHeSS HR4[7] and have time and temperature control.
- Electric systems. Storage heaters should have automatic charge control. Fan assisted storage heaters recommended. On-peak heaters should have time/individual room temperature control. Hot water systems should have cylinder heat losses less than 1.33*(0.02 + 0.051*V2/3) as measured by BS 1566[10] – which requires heat loss figures to be marked on cylinders. Over 24 hours it gives a cylinder heat loss of 2.4 kWh (210 litre), or 1.7 kWh (120 litre).

## EXISTING HOUSING

The Standard for existing housing uses established recommendations from the HEEBPp publication GPG 155 'Energy efficient refurbishment of existing housing'[12].

- Walls: †
  - cavity: cavity wall insulation
  - solid: insulated dry lining to achieve a U-value of 0.45 W/m$^2$K
- External wall insulation to achieve a U-value of 0.35 W/m$^2$K †
- Pitched roofs: 250 mm insulation to achieve a U-value of 0.16 W/m$^2$K †
- Ground floor: insulation to achieve a U-value of 0.20-0.25 W/m$^2$K †
- Windows: double or triple-glazed windows to achieve a U-value of 2.0 W/m$^2$K †
- All doors and windows should be draughtstripped
- Gas central heating (where available): CHeSS HR4 or HC4[7]
- Primary hot water pipework to be fully insulated
- Controlled ventilation to prevent condensation
- Where electrical appliances are being supplied, they should be 'A' rated
- Lighting: Compact fluorescent lamps should be fitted in high usage areas such as living rooms, study bedrooms, halls, landings and for communal and security lighting. New fittings designed specifically for CFLs should be used when old fittings are replaced.

It is impossible to prescribe a single package of measures that would be applicable to all existing dwellings, however it is important to understand that the energy-efficiency of an existing dwelling can be improved without waiting for a full refurbishment package to be undertaken.

Invariably it will be more cost-effective to implement a combination of the measures listed above, in preference to installing them separately.

The most suitable and cost-effective insulation options depend, to a large degree, on the opportunities arising from the proposed general improvements and the form of construction. Ideally, insulation and draughtstripping should be upgraded before boilers and heating systems are replaced. The reduced heating demand will enable the heating plant to be selected accordingly, so cutting capital cost and improving the energy efficiency.

For further information on energy efficiency refurbishment, See GPG 155[12].

### Q WHAT ARE THE COST IMPLICATIONS OF USING THE STANDARDS?

As part of the recent HEEBPp project on which the standards are based, a study was carried out to assess the likely impact on building costs. As a datum, the cost of a typical 85 m$^2$ three bedroom semi-detached house was then calculated in order to meet the 2002 Building Regulations. Following on from this, the costs of changing to the 'Good Practice', 'Best Practice' and 'Advanced' standards were assessed for both masonry and timber frame constructions.

The study found that:

- The 'Good Practice' standards can be introduced for minimal extra capital expenditure of less than 1% over the standard set by the datum (ie the standard set by the building regulations).
- The 'Best Practice' standard can be introduced for approximately 6% above the datum for traditional masonry build, and 8% for timber frame.
- The 'Advanced' standard can be introduced for approximately 11% above the datum for traditional masonary build, and 20% for timber frame.

**† Requirements for Scotland**

Dwellings with inefficient heating systems, solid fuel or electric heating will require more stringent U-values to be achieved. Interpretation of the Technical Standards can vary between different local building control departments. U-values which are worse than the minimum presented in Part J may not be acceptable unless a relaxation of the standards is sought. The local authority building control department should be consulted if there is any doubt.

## REFERENCES AND FURTHER INFORMATION


[1] The Government's Standard Assessment Procedure for Energy Rating of Dwellings, 2001 Edition

[2] The Building Regulations 2000. Approved Document L1, Conservation of Fuel and Power in Dwellings, 2002 Edition, The Stationery Office, London

[3] The Building Standards (Scotland) Regulations 1990, 6th amendment, Technical standards to Part J, Conservation of fuel and power

[4] The Building Regulations (Northern Ireland) 1994. Technical booklet F, Conservation of fuel and power (December 1998). To be updated

[5] CIBSE TM23 Testing Buildings for Air Leakage (www.cibse.org)

[6] General Information Report 64: Post-construction testing, August 2000

[7] General Information Leaflet 59: Central Heating System Specifications (CHeSS) July 2002

[8] BS EN 13141/7/8 (CEN TC 156/WG2/AH7) Component/products for residential ventilation. (To be published)

[9] BS EN 613 Independent gas-fired convector heaters

[10] BS 1566 Copper Indirect Cylinders for Domestic Purposes (www.bsonline.techindex.co.uk)

[11] General Information Report 53: Building a Sustainable Future, October 1998

[12] Good Practice Guide 155: Energy-efficient refurbishment of existing housing


The following Housing Energy Efficiency Best Practice programme publications may be ordered from the programme website at www.housingenergy.org.uk or ring 01923 664258.

### New Build

- General Information Report 64: Post-construction testing, August 2000
- General Information Report 53: Building a Sustainable Future, October 1998
- Good Practice Guide 194: Building your own Energy Efficient House, October 1997
- Good Practice Guide 192: Designing Energy Efficient Multi-Residential Buildings, March 1997

### Heating and Hot water systems

- General Information Leaflet 59: Central Heating System Specifications (CHeSS) July 2002
- Good Practice Guide 302: Controls for domestic heating and hot water, September 2001

### Refurbishment

- Good Practice Guide 155: Energy-efficient refurbishment of existing housing, September 2001
- General Information Report 64: Post-construction testing, August 2000


**Energy Efficiency Best Practice in Housing**

Tel: 0845 120 7799
www.est.org.uk/bestpractice

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