FORMULAE AND TABLES

Number of days in month, n_m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
m	1	2	3	4	5	6	7	8	9	10	11	12
n_m =	31	28	31	30	31	30	31	31	30	31	30	31

Assumed number of occupants

if TFA > 13.9: $N = 1 + 1.76 \times [1-\exp(-0.000349 \times (TFA-13.9)^2)] + 0.0013 \times (TFA-13.9)$
if TFA ≤ 13.9: N = 1

N is the assumed number of occupants, TFA is the total floor area of the dwelling.

Domestic hot water usage

(a) Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$
(b) Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)
(c) For each month, multiply $V_{d,average}$ by the factor from Table 1a to obtain the daily volume in the month $V_{d,m}$
(d) The energy content of water used is

$$4.190 \times V_{d,m} \times n_m \times \Delta T_m / 3600 \quad \text{kWh/month}$$

where ΔT_m is the temperature rise for month m from Table 1b.
(e) Distribution loss is 0.15 times energy content calculated in (d).

Table 1a: Monthly factors for hot water use

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	annual
1.10	1.06	1.02	0.98	0.94	0.90	0.90	0.94	0.98	1.02	1.06	1.10	1.00

Table 1b: Temperature rise of hot water drawn off (in K)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	annual
41.2	41.4	40.1	37.6	36.4	33.9	30.4	33.4	33.5	36.3	39.4	39.9	37.0

Table 1c: Thermal capacities for some common constructions

Heat capacity per unit area, κ in kJ/m²K, for a construction element is calculated from:

$$\kappa = 10^{-6} \times \Sigma (d_j \, \rho_j \, c_j)$$

where:

the summation is over all layers in the element, starting at the inside surface and stopping at whichever of these conditions occurs first (which may mean part way through a layer):
- half way through the element;
- an insulation layer;
- total thickness of 100 mm.

d_j is the thickness of a layer (mm)

ρ_j is density (kg/m³)

c_j is heat capacity (J/kg·K)

The elements to be included are walls, floors and roofs (windows and doors have negligible capacity), including all internal and party walls and floors. In the case of internal walls and floors, the capacity is needed for each side of the element.

The table gives some typical values.

Construction	**Capacity** k **(kJ/m²K)**
Ground floors	
Suspended timber, insulation between joists	20
Slab on ground, screed over insulation	110
Suspended concrete floor, carpeted	75
Exposed floors	
Timber exposed floor, insulation between joists	20
External walls - masonry, solid, external insulation	
Solid wall: dense plaster, 200 mm dense block, insulated externally	190
Solid wall: plasterboard on dabs, 200 mm dense block, insulated externally	150
Solid wall: dense plaster, 210 mm brick, insulated externally	135
Solid wall: plasterboard on dabs, 210 mm brick, insulated externally	110
External walls - masonry, solid, internal insulation	
Solid wall: dense plaster, insulation, any outside structure	17
Solid wall: plasterboard on dabs, insulation, any outside structure	9
External walls - cavity masonry walls, full or partial cavity fill	
Cavity wall: dense plaster, dense block, filled cavity, any outside structure	190
Cavity wall: dense plaster, AAC block, filled cavity, any outside structure	70
Cavity wall: plasterboard on dabs, dense block, filled cavity, any outside structure	150
Cavity wall: plasterboard on dabs, AAC block, filled cavity, any outside structure	60
External walls – timber or steel frame	
Timber framed wall (one layer of plasterboard)	9
Timber framed wall (two layers of plasterboard)	18
Steel frame wall (warm frame or hybrid construction)	14
Roofs	
Plasterboard, insulated at ceiling level	9
Plasterboard, insulated slope	9
Plasterboard, insulated flat roof	9
Party walls	
Dense plaster both sides, dense blocks, cavity (E-WM-1 or E-WM-2)*	180
Single plasterboard on dabs on both sides, dense blocks, cavity (E-WM-3 or E-WM-4)*	70
Plaster on dabs and single plasterboard on both sides, dense cellular blocks, cavity (E-WM-5)*	70

Construction	**Capacity** k **(kJ/m²K)**
Plasterboard on dabs mounted on cement render on both sides, AAC blocks, cavity (E-WM-6 or E-WM-7)*	45
Double plasterboard on both sides, twin timber frame with/without sheathing board (E-WT-1 or E-WT-2)*	20
Steel frame (E-WS-1 to E-WS-3)*	20
Party floors (k **from above /** k **from below)**	
Precast concrete planks floor, screed, carpeted (E-FC-1)*	40 / 30
Concrete floor slab, carpeted (E-FC-2)*	80 / 100
Precast concrete plank floor (screed laid on insulation) ,carpeted (E-FC-3)*	40 / 30
Precast concrete plank floor (screed laid on rubber),carpeted (E-FC-4)*	70 / 30
In-situ concrete slab supported by profiled metal deck, carpeted (E-FS-1)*	64 / 90
Timber I-joists, carpeted (E-FT-1)*	30 / 20
Internal partitions	
Plasterboard on timber frame	9
Dense block, dense plaster	100
Dense block, plasterboard on dabs	75
Ceiling/floor between floors in a house (k **from above /** k **from below)**	
Plasterboard ceiling, carpeted chipboard floor	18 / 9

* Reference in the Robust Details for Part E “Resistance to the passage of sound”

Table 1d: Thermal mass parameter

The κ values are used to calculate the TMP variable (Thermal Mass Parameter) is used to characterise the thermal mass of the building. It is:

$$\text{TMP} = \frac{\sum \kappa \times \text{A}}{\text{TFA}}$$

where the summation is over all walls, floors and roofs bounding the dwelling (including party walls and floors/ceilings) together with both sides of all internal walls and floors/ceilings.

Indicative values of TMP are:

Thermal mass	TMP (kJ/m²K)
Low	100
Medium	250
High	450

Table 2: Hot water storage loss factor (kWh/litre/day)

If the manufacturer's declared loss is available, see Table 2b.

In the absence of manufacturer's declared cylinder loss, the loss factor L from Table 2 is multiplied by the cylinder volume in litres, by the volume factor from Table 2a, and by the appropriate temperature factor from Table 2b, to obtain the loss rate. These data apply to cylinders heated by gas, oil and solid fuel boilers and by electric immersion, and to stores within combi boilers not tested to EN 13203-2.

For community heating systems with no cylinder in the dwelling, use loss factor for 50 mm factory insulation and a cylinder size of 110 litres. For community systems using a plate heat exchanger apply the data in the table to the insulation on the heat exchanger.

In the case of a combination boiler:
- *a) the storage loss factor is zero if the efficiency is taken from Table 4b;*
- *b) the loss is to be included for a storage combination boiler if its efficiency is the manufacturer's declared value or is obtained from the Boiler Database (in which case its insulation thickness and volume are also to be provided by the manufacturer or obtained from the Database), using the loss factor for a factory insulated cylinder.*

Insulation thickness, mm	**Cylinder loss factor (L)** kWh/litre/day	
	Factory insulated cylinder thermal store store in combi boiler	**Loose cylinder jacket**
0	0.1425	0.1425
12	0.0394	0.0760
25	0.0240	0.0516
35	0.0191	0.0418
38	0.0181	0.0396
50	0.0152	0.0330
80	0.0115	0.0240
120	0.0094	0.0183
160	0.0084	0.0152

Notes:
1. *Alternatively the heat loss factor, L, may be calculated for insulation thickness of t mm as follows:*
   Cylinder, loose jacket: $L = 0.005 + 1.76/(t + 12.8)$
   Cylinder, factory insulated: $L = 0.005 + 0.55/(t + 4.0)$
2. *The data for factory insulated cylinder apply to all cases other than an electric CPSU where the insulation is applied in the course of manufacture irrespective of the insulation material used, e.g. the water store in a storage combi or a gas CPSU.*
3. *For an electric CPSU, the loss is 0.022 kWh/litre/day.*

Table 2a: Volume factor for cylinders and storage combis

Volume V_c	Volume Factor VF	Volume V_c	Volume Factor VF
40	1.442	180	0.874
60	1.259	200	0.843
80	1.145	220	0.817
100	1.063	240	0.794
120	1.00	260	0.773
140	0.950	280	0.754
160	0.908	300	0.737

Notes:
1. *When using the data in Table 2, the loss is to be multiplied by the volume factor.*
2. *Alternatively, the volume factor can be calculated using the equation* $VF = (120 / V_c)^{1/3}$

Table 2b: Factors to be applied to losses for cylinders, thermal stores and CPSUs and storage combi boilers not tested to EN 13203-2

Type of water storage	Temperature Factor	
	for manufacturer's declared loss	for loss from Table 2
Cylinder, electric immersion	0.60	0.60
Cylinder, indirect	0.60 [a) b)]	0.60 [a) b)]
Storage combi boiler, primary store	n/a	Store volume ≥ 115 litres: 0.82 Store volume < 115 litres: $0.82 + 0.0022 \times (115 - V_c)$
Storage combi boiler, secondary store	n/a	Store volume ≥ 115 litres: 0.60 Store volume < 115 litres: $0.60 + 0.0016 \times (115 - V_c)$
Hot water only thermal store	0.89 [c) d)]	1.08 [c) d)]
Integrated thermal store and gas-fired CPSU	0.89 [c) d)]	1.08 [c) d)]
Electric CPSU: for winter operating temperature T_w (°C)	$1.09 + (T_w - 85)$	1.00
Plate heat exchanger in a community system	1.0	1.0

Notes:
[a)] *Multiply Temperature Factor by 1.3 if a cylinder thermostat is absent.*
[b)] *Multiply Temperature Factor by 0.9 if there is separate time control of domestic hot water (boiler systems and heat pump systems)*
[c)] *Multiply Temperature Factor by 0.81 if the thermal store or CPSU has separate timer for heating the store*
[d)] *Multiply Temperature Factor by 1.1 if the thermal store or CPSU is not in an airing cupboard*

Table 3: Primary circuit losses

System type	kWh/year
Electric immersion heater	0
Boiler or heat pump with uninsulated primary pipework* and no cylinder thermostat	1220
Boiler or heat pump with insulated primary pipework and no cylinder thermostat	610
Boiler or heat pump with uninsulated primary pipework and with cylinder thermostat	610
Boiler or heat pump with insulated primary pipework and with cylinder thermostat	360
Combi boiler	0
CPSU (including electric CPSU)	0
Boiler and thermal store** within a single casing	0
Separate boiler and thermal store connected by no more than 1.5 m of insulated pipework	0
Separate boiler and thermal store connected by: - uninsulated primary pipe work - more than 1.5 m of insulated primary pipe work	 470 280
Community heating	360

Notes:
** "Primary pipework" means the pipes between a boiler and a hot water tank*
*** Thermal stores have a cylinder thermostat*

Table 3a: Additional losses for combi boilers not tested to EN 13203-2

Combi type	kWh/year
Instantaneous, without keep-hot facility*	600 [a)]
Instantaneous, with keep-hot facility controlled by time clock	600
Instantaneous, with keep-hot facility not controlled by time clock	900
Storage combi boiler** store volume $V_c \geq 55$ litres	0
Storage combi boiler** store volume $V_c < 55$ litres	$600 - (V_c - 15) \times 15$ [a)]

[a)] If the annual average hot water usage is less than 100 litres/day, multiply by (daily hot water usage) / 100

Notes:

* *"keep-hot facility" is defined in Appendix D, section D1.16. The facility to keep water hot may have an on/off switch for the user, or it may be controlled by a time switch. If the store is 15 litres or more, the boiler is a storage combination boiler.*

In the case of keep-hot:

1) *If the keep-hot facility is maintained hot solely by burning fuel, use the appropriate loss for combi boiler from Table 3a and proceed with the calculation as normal.*
2) *If the keep-hot facility is maintained by electricity:*
   a) *include appropriate combi loss from Table 3a in box (49);*
   b) *calculate energy required for water heating as $[(51)_m - (49a)_m] \times 100 \div (86)_m$ and enter in box $(86a)_m$.*
   See also Table 4f.
3) *In the case of an electrically powered keep-hot facility where the power rating of the keep-hot heater is obtained from the Boiler Efficiency database, the electric part of the total combi loss should be taken as:*
   LE =8.76 x P (kWh/year) (subject to maximum of the value from Table 3a, 3b or 3c)
   where P is the power rating of the heater in watts
   with the remainder (either 600 – LE or 900 – LE) provided by the fuel.

** *"storage combi boilers" are defined in Appendix D, section D1.10.*

Table 3b: Losses for combi boilers tested to EN 13203-2, schedule 2 only

Combi type	Storage loss $(46a)_m$, kWh/month	Additional loss $(49a)_m$, kWh/month
Instantaneous, with or without keep-hot facility [a]	0	$[(39d)_m \times r] + [F_1 \times n_m]$
Storage combi boiler	$F_1 \times n_m$	$(39d)_m \times r$

These values are obtained from the database record
- rejected energy proportion, r
- loss factor F_1

[a] If the annual average hot water usage is less than 100 litres/day, multiply by (daily hot water usage) / 100

See notes below Table 3a

Table 3c: Losses for combi boilers tested to EN 13203-2, schedule 2 plus schedule 3 or 4

Combi type	Storage loss $(46a)_m$, kWh/month	Additional loss $(49a)_m$, kWh/month
Instantaneous, with or without keep-hot facility [a]	0	$(39d)_m \times [r + \{100.2 - V_{d,m}\} \times F_3$ + $[F_2 \times n_m]$
Storage combi boiler	$F_2 \times n_m$	$(39d)_m \times [r + \{100.2 - V_{d,m}\} \times F_3$

These values are obtained from the database record:
- These values are obtained from the database record
- rejected energy proportion, r
- loss factors F_2 and F_3

[a] If the annual average hot water usage is less than 100 litres/day, multiply by (daily hot water usage) / 100

See notes below Table 3a

Table 4a: Heating systems (space and water)

1. *The table shows space heating efficiency. The same efficiency applies for water heating when hot water is supplied from a boiler system.*
2. *For independent water heaters see section at the end of table.*
3. *'Heating type' refers to the appropriate column in Table 8.*
4. *'Responsiveness (R) is used to calculate mean internal temperature (Table 9b).*
5. *Systems marked "rd" in the right-hand column are part of the reduced data set (see S10 in Appendix S)*
6. *Heating systems, heating controls and fuels are assigned a code number for identification purposes*

	Efficiency %		Heating type	Respon-siveness (R)	Code	Rd SAP
NO HEATING SYSTEM PRESENT						
Refer to Group 0 in Table 4e for control options and temperature adjustments due to control						
Electric heaters (assumed)	100		1	1.0	699	rd
CENTRAL HEATING SYSTEMS WITH RADIATORS OR UNDERFLOOR HEATING						
Gas boilers and oil boilers						
For efficiency, use boiler database (www.boilers.org.uk) if possible, otherwise use efficiency from Table 4b.						
Use Table 4c for efficiency adjustments.						
Use Table 4d for heating type and responsiveness.						
Refer to Group 1 in Table 4e for control options and temperature adjustments due to control.						
Micro-cogeneration (micro-CHP)						
See Appendix N. Performance data to be obtained from boiler database (www.boilers.org.uk).						
Use Table 4c for efficiency adjustments.						
Refer to Group 1 in Table 4e for control options and temperature adjustments due to control.						
Solid fuel boilers						
For efficiency, use boiler database if possible, otherwise use efficiency from this table. Column (A) gives minimum values for HETAS approved appliances, use column (B) for other appliances (see section 9.2.3). For open fires with back boilers and closed roomheaters with boilers the efficiencies are the sum of heat to water and heat to room. See Table 12b for fuel options.						
Refer to Group 1 in Table 4e for control options	(A)	(B)				
Manual feed independent boiler in heated space [a)]	65	60	2	0.75	151	rd
Manual feed independent boiler in unheated space [a)]	60	55	2	0.75	152	
Auto (gravity) feed independent boiler in heated space [a)]	70	65	2	0.75	153	
Auto (gravity) feed independent boiler in unheated space [a)]	65	60	2	0.75	154	rd
Wood chip/pellet independent boiler	65	63	2	0.75	155	
Open fire with back boiler to radiators	63	55	3	0.50	156	rd
Closed roomheater with boiler to radiators	67	65	3	0.50	158	rd
Stove (pellet-fired) with boiler to radiators	65	63	2	0.75	159	
Range cooker boiler (integral oven and boiler)	50	45	3	0.50	160	rd
Range cooker boiler (independent oven and boiler)	60	55	3	0.50	161	
[a)] Heated space means within the boundary of the dwelling as defined in section 1, "Dwelling dimensions"						
Electric boilers						
Refer to Group 1 in Table 4e for control options						
Direct acting electric boiler	100		1	1.0	191	rd
Electric CPSU in heated space [a)] – radiators or underfloor	100		2	0.75	192	rd
Electric dry core storage boiler in heated space [a) b)]	100		2	0.75	193	rd
Electric dry core storage boiler in unheated space [a) b)]	85		2	0.75	194	
Electric water storage boiler in heated space [a) b)]	100		2	0.75	195	rd
Electric water storage boiler in unheated space [a) b)]	85		2	0.75	196	

	Efficiency %	Heating type	Respon-siveness (R)	Code	Rd SAP
[a] Heated space means within the boundary of the dwelling as defined in section 1, "Dwelling dimensions"					
[b] Store within boiler capable of meeting all space heating needs					
Heat pumps (see also warm air systems)					
Refer to Group 2 in Table 4e for control options					
The efficiency values shown apply only for heat pumps that cannot be located in the database					
Ground-to-water heat pump (electric)	320	From Table 4d		201	rd
Ground-to-water heat pump with auxiliary heater (electric)	300	From Table 4d		202	rd
Water-to-water heat pump (electric)	300	From Table 4d		203	rd
Air-to-water heat pump (electric)	250	From Table 4d		204	rd
Gas-fired, ground source	120	From Table 4d		205	
Gas-fired, water source	120	From Table 4d		206	
Gas-fired, air source	110	From Table 4d		207	
COMMUNITY HEATING SCHEMES					
For calculation of SAP rating: efficiency is 100% reduced by the amount in the “efficiency adjustment” column of Table 4c.					
For calculation of CO_2 emissions: if known, use manufacturer's declared efficiency instead of value from this table.					
Refer to Group 3 in Table 4e for control options.					
Check Table 4c for efficiency adjustment due to controls.					
Allow for distribution loss (see Table 12c).					
Community boilers only	75	1	1.0	301	rd
Community CHP and boilers	75	1	1.0	302	rd
Community waste heat from power station and boilers	75 [a]	1	1.0	303	
Community heat pump	300	1	1.0	304	
Community geothermal heat source and boilers	75 [a]	1	1.0	305	
[a] Efficiency of boilers; apply 100% to the heat fraction from waste heat or geothermal					
ELECTRIC STORAGE SYSTEMS					
Refer to Group 4 in Table 4e for control options.					
Off-peak tariffs:					
Old (large volume) storage heaters	100	5	0.0	401	rd
Modern (slimline) storage heaters	100	4	0.25	402	rd
Convector storage heaters	100	4	0.25	403	
Fan storage heaters	100	3	0.5	404	rd
Modern (slimline) storage heaters with Celect-type control	100	3	0.5	405	
Convector storage heaters with Celect-type control	100	3	0.5	406	
Fan storage heaters with Celect-type control	100	2	0.75	407	
Integrated storage+direct-acting heater	100	2	0.75	408	rd
24-hour heating tariff:					
Modern (slimline) storage heaters	100	3	0.5	402	rd
Convector storage heaters	100	3	0.5	403	
Fan storage heaters	100	3	0.5	404	rd
Modern (slimline) storage heaters with Celect-type control	100	2	0.75	405	
Convector storage heaters with Celect-type control	100	2	0.75	406	
Fan storage heaters with Celect-type control	100	2	0.75	407	
ELECTRIC UNDERFLOOR HEATING					
Refer to Group 7 in Table 4e for control options.					
Off-peak tariffs:					
In concrete slab (off-peak only)	100	5	0.0	421	rd

	Efficiency %	Heating type	Respon-siveness (R)	Code	Rd SAP
Integrated (storage+direct-acting)	100	4	0.25	422	rd
Integrated (storage+direct-acting) with low (off-peak) tariff control	100	3	0.50	423	
Standard or off-peak tariff:					
In screed above insulation	100	2	0.75	424	rd
In timber floor, or immediately below floor covering	100	1	1	425	
WARM AIR SYSTEMS					
Refer to Group 5 in Table 4e for control options.					
Gas-fired warm air with fan-assisted flue					
Ducted, on-off control, pre 1998	70	1	1.0	501	
Ducted, on-off control, 1998 or later	76	1	1.0	502	rd
Ducted, modulating control, pre 1998	72	1	1.0	503	
Ducted, modulating control, 1998 or later	78	1	1.0	504	
Roomheater with in-floor ducts	69	1	1.0	505	
Gas fired warm air with balanced or open flue					
Ducted or stub-ducted, on-off control, pre 1998	70	1	1.0	506	rd
Ducted or stub-ducted, on-off control, 1998 or later	76	1	1.0	507	
Ducted or stub-ducted, modulating control, pre 1998	72	1	1.0	508	
Ducted or stub-ducted, modulating control, 1998 or later	78	1	1.0	509	
Ducted or stub-ducted with flue heat recovery	85	1	1.0	510	rd
Condensing	81	1	1.0	511	rd
Oil-fired warm air					
Ducted output (on/off control)	70	1	1.0	512	rd
Ducted output (modulating control)	72	1	1.0	513	
Stub duct system	70	1	1.0	514	
Electric warm air					
Electricaire system	100	2	0.75	515	rd
Heat pumps					
The efficiency values shown apply only for heat pumps that cannot be located in the database					
Ground-to-air heat pump (electric)	320	1	1.0	521	rd
Ground-to-air heat pump with auxiliary heater (electric)	300	1	1.0	522	rd
Water-to-air heat pump (electric)	300	1	1.0	523	rd
Air-to-air heat pump (electric)	250	1	1.0	524	rd
Gas-fired, ground source	120	1	1.0	525	
Gas-fired, water source	120	1	1.0	526	
Gas-fired, air source	110	1	1.0	527	

ROOM HEATERS

Refer to Group 6 in Table 4e for control options.
If declared efficiency is available (see Appendix E) use instead of value from table.
The normal flue type is indicated as OF (open), BF (balanced) or C (chimney)

Gas (including LPG) room heaters:

Column (A) gives efficiency values for mains gas, column (B) for LPG

	Flue	(A)	(B)	Heating type	Respon-siveness (R)	Code	Rd SAP
Gas fire, open flue, pre-1980 (open fronted)	OF	50	50	1	1.0	601	rd
Gas fire, open flue, pre-1980 (open fronted), with back boiler unit	OF	50	50	1	1.0	602	rd
Gas fire, open flue, 1980 or later (open fronted),	OF	63	64	1	1.0	603	rd

		Efficiency %		Heating type	Respon-siveness (R)	Code	Rd SAP
sitting proud of, and sealed to, fireplace opening							
Gas fire, open flue, 1980 or later (open fronted), sitting proud of, and sealed to, fireplace opening, with back boiler unit	OF	63	64	1	1.0	604	rd
Flush fitting Live Fuel Effect gas fire (open fronted), sealed to fireplace opening	OF	40	41	1	1.0	605	rd
Flush fitting Live Fuel Effect gas fire (open fronted), sealed to fireplace opening, with back boiler unit	OF	40	41	1	1.0	606	rd
Flush fitting Live Fuel Effect gas fire (open fronted), fan assisted, sealed to fireplace opening	OF	45	46	1	1.0	607	rd
Gas fire or wall heater, balanced flue	BF	58	60	1	1.0	609	rd
Gas fire, closed fronted, fan assisted	BF	72	73	1	1.0	610	rd
Condensing gas fire	BF	85	85	1	1.0	611	rd
Decorative Fuel Effect gas fire, open to chimney	C	20	20	1	1.0	612	rd
Flueless gas fire, secondary heating only *(add additional ventilation requirements in box (9a)*	none	90	92	1	1.0	613	rd
Oil room heaters:	**Flue**						
Room heater, pre 2000	OF	55		1	1.0	621	rd
Room heater, pre 2000, with boiler (no radiators)	OF	65		1	1.0	622	rd
Room heater, 2000 or later	OF	60		1	1.0	623	rd
Room heater, 2000 or later with boiler (no radiators)	OF	70		1	1.0	624	rd
Solid fuel room heaters							
Column (A) gives minimum values for HETAS approved appliances, use column (B) for other appliances (see section 9.2.3).							
	Flue	(A)	(B)				
Open fire in grate	C	37	32	3	0.50	631	rd
Open fire with back boiler (no radiators)	C	50	50	3	0.50	632	rd
Closed room heater	OF*	65	60	3	0.50	633	rd
Closed room heater with boiler (no radiators)	OF*	67	65	3	0.50	634	rd
Stove (pellet fired)	OF*	65	63	2	0.75	635	
Stove (pellet fired) with boiler (no radiators)	OF*	65	63	2	0.75	636	
* some wood-burning appliances have a room-sealed flue							
Electric (direct acting) room heaters:							
Panel, convector or radiant heaters*		100		1	1.0	691	rd
Fan heaters		100		1	1.0	692	
Portable electric heaters		100		1	1.0	693	rd
Water- or oil-filled radiators		100		1	1.0	694	
OTHER SPACE HEATING SYSTEMS							
Refer to Group 7 in Table 4e for control options.							
Electric ceiling heating		100		2	0.75	701	rd

Table 4a (continued)

	Efficiency %	Code	Rd SAP
HOT WATER SYSTEMS			
No hot water system present - electric immersion assumed	100	999	rd
From main heating system	efficiency of main system, except:	901	rd
Back boiler (hot water only), gas	65		
Circulator built into a gas warm air system, pre 1998	65		
Circulator built into a gas warm air system, 1998 or later	73		
From secondary system	efficiency of secondary heater, except:	902	rd
Back boiler (hot water only), gas	65		
Electric immersion (on-peak or off-peak)	100	903	rd
Single-point gas water heater (instantaneous at point of use)	70	907	rd
Multi-point gas water heater (instantaneous serving several taps)	65	908	rd
Electric instantaneous at point of use	100	909	rd
Gas boiler/circulator for water heating only*	65	911	
Oil boiler/circulator for water heating only*	70	912	
Solid fuel boiler/circulator for water heating only	55	913	
Range cooker with boiler for water heating only:*			
Gas, single burner with permanent pilot	46	921	
Gas, single burner with automatic ignition	50	922	
Gas, twin burner with permanent pilot pre 1998	60	923	
Gas, twin burner with automatic ignition pre 1998	65	924	
Gas, twin burner with permanent pilot 1998 or later	65	925	
Gas, twin burner with automatic ignition 1998 or later	70	926	
Oil, single burner	60	927	
Oil, twin burner pre 1998	70	928	
Oil, twin burner 1998 or later	75	929	
Solid fuel, integral oven and boiler	45	930	
Solid fuel, independent oven and boiler	55	931	
From hot-water only community scheme - boilers	75	950	
From hot-water only community scheme - CHP	75	951	
From hot-water only community scheme - heat pump	300	952	

* If available use data from the boiler database instead of the values in this table

Table 4b: Seasonal efficiency for gas and oil boilers

1. *This table is to be used only for gas and oil boilers which cannot be located in the database.*
2. *See section 9.2.2 for application of the efficiency values in this table.*
3. *See Appendix B for guidance on boiler classification.*
4. *Apply efficiency adjustments in Table 4c if appropriate.*
5. *See Table 4d for heating type and responsiveness.*
6. *Systems marked "rd" in the right-hand column are part of the reduced data set (see S10 in Appendix S)*

Boiler	Efficiency, %		Code	Rd SAP
	Winter	Summer		
Gas boilers (including LPG) 1998 or later				
Regular non-condensing with automatic ignition	74	64	101	rd
Regular condensing with automatic ignition	84	74	102	rd
Non-condensing combi with automatic ignition	74	65	103	rd
Condensing combi with automatic ignition	84	75	104	rd
Regular non-condensing with permanent pilot light	70	60	105	rd
Regular condensing with permanent pilot light	80	70	106	
Non-condensing combi with permanent pilot light	70	61	107	rd
Condensing combi with permanent pilot light	80	71	108	
Back boiler to radiators	66	56	109	rd
(select gas fire as secondary heater, see section 9.2.5)				
Gas boilers (including LPG) pre-1998, with fan-assisted flue				
Low thermal capacity	73	63	110	
High or unknown thermal capacity	69	59	111	rd
Combi	71	62	112	rd
Condensing combi	84	75	113	rd
Condensing	84	74	114	rd
Gas boilers (including LPG) pre-1998, with balanced or open flue				
Wall mounted	66	56	115	rd
Floor mounted, pre 1979	56	46	116	rd
Floor mounted, 1979 to 1997	66	56	117	rd
Combi	66	57	118	rd
Back boiler to radiators	66	56	119	rd
(select gas fire as secondary heater, see section 9.2.5)				
Combined Primary Storage Units (CPSU) (mains gas and LPG)				
With automatic ignition (non-condensing)	74	72	120	rd
With automatic ignition (condensing)	83	81	121	rd
With permanent pilot (non-condensing)	70	68	122	
With permanent pilot (condensing)	79	77	123	
Oil boilers				
Standard oil boiler pre-1985	66	54	124	
Standard oil boiler 1985 to 1997	71	59	125	rd
Standard oil boiler, 1998 or later	80	68	126	rd
Condensing	84	72	127	rd
Combi, pre-1998	71	62	128	rd
Combi, 1998 or later	77	68	129	rd
Condensing combi	82	73	130	rd
Oil room heater with boiler to radiators, pre 2000	66	54	131	rd
Oil room heater with boiler to radiators, 2000 or later	71	59	132	rd
Range cooker boilers (mains gas and LPG)				
Single burner with permanent pilot	47	37	133	rd
Single burner with automatic ignition	51	41	134	rd
Twin burner with permanent pilot (non-condensing) pre 1998	61	51	135	
Twin burner with automatic ignition (non-condensing) pre 1998	66	56	136	rd

Twin burner with permanent pilot (non-condensing) 1998 or later	66	56	137	
Twin burner with automatic ignition (non-condensing) 1998 or later	71	61	138	
Range cooker boilers (oil)				
Single burner	61	49	139	rd
Twin burner (non-condensing) pre 1998	71	59	140	rd
Twin burner (non-condensing) 1998 or later	76	64	141	

Table 4c: Efficiency adjustments

Heating system	Efficiency adjustment, %			
Gas or oil boiler systems with radiators or underfloor heating: *The adjustments are to be applied to the space and water heating seasonal efficiency for both tested efficiency values and efficiency values from Table 4b.*				
(1) Efficiency adjustment due to lower temperature of distribution system:	**----- Space -----**		**----- DHW -----**	
	Mains gas	**Oil or LPG**	**Mains gas**	**Oil or LPG**
Condensing boiler with load compensator [a)]	0	0	0	0
Condensing boiler with weather compensator [a)]	+3	+1.5	0	0
Condensing boiler with under-floor heating [a) b)]	+3	+2	0	0
Condensing boiler with thermal store [a)]	0	0	0	0
(2) Efficiency adjustment due to control system				
No thermostatic control of room temperature – regular boiler [c)]	-5		-5	
No thermostatic control of room temperature – combi [c)]	-5		0	
No boiler interlock – regular boiler [c)]	-5		-5	
No boiler interlock - combi [c)]	-5		0	
Community heating systems:				
(3) Factor for controls and charging method				
Flat rate charging [d)], no thermostatic control of room temperature	0.90			
Flat rate charging, programmer, no room thermostat	0.90			
Flat rate charging, room thermostat only	0.95			
Flat rate charging, programmer and room thermostat	0.95			
Flat rate charging, TRVs	0.95			
Flat rate charging, programmer and TRVs	0.95			
Charging system linked to use of community heating, room thermostat only	0.95			
Charging system linked to use of community heating, programmer and room thermostat	0.95			
Charging system linked to use of community heating, TRVs	1.0			
Charging system linked to use of community heating, programmer and TRVs	1.0			
Heat pumps:	**Multiply efficiency by:**			
(4) Efficiency adjustment due to temperature of heat supplied	**Space**		**DHW**	
Heat pump with underfloor heating	1.0			
Heat pump with radiators without load or weather compensation [e)]	0.7			
Heat pump with radiators and load or weather compensation [e)]	0.75			
Warm-air heat pump	1.0			
Heat pump supplying all DHW			0.7	
Heat pump supplying 50% DHW (see Appendix G)			1.0	

Notes to Table 4e:

a) *These are mutually exclusive and therefore do not accumulate; if more than one applies, the highest applicable efficiency adjustment is to be used. Also, these efficiency adjustments are not applied if there is a flue gas heat recovery device/system.*

b) *Adjustment is applicable if the boiler supplies only the underfloor heating, and not if it also feeds radiators or supplies hot water.*

c) *These do not accumulate as no thermostatic control or presence of a bypass means that there is no boiler interlock.*

d) *'Flat rate charging' means that households pay for the heat according to a fixed monthly or annual amount, not depending on the amount of heat actually used. If the charges vary within a scheme for other reasons, for example according to dwelling size, it is still classified as flat rate. 'Charging system linked to use of community heating' refers to a system in which the charges are substantially related to the amount of heat used.*

e) *Based on maximum heat distribution temperature of 50°C.*

Table 4d: Heating type and responsiveness for wet systems with heat supplied to radiators or underfloor heating

Heat emitter	Heating type	Responsiveness (R)
Systems with radiators:	1	1.0
Underfloor heating (wet system):		
pipes in insulated timber floor	1	1.0
pipes in screed above insulation	2	0.75
pipes in concrete slab	4	0.25

Table 4e: Heating system controls

1. *Use Table 4a to select appropriate Group in this table.*
2. *'Control' indicates the appropriate column to use in Table 9.*
3. *The 'Temperature adjustment' modifies the living area mean internal temperature obtained from Table 8 and should be entered into box (71) of the worksheet.*
4. *Controls marked "rd" in the right-hand column are part of the reduced data set (see S10 in Appendix S)*

Type of control	Control	Temperature adjustment, °C	Reference to other possible adjustments	Code	rd SAP
GROUP 0: NO HEATING SYSTEM PRESENT					
None	2	+0.3	n/a	2699	rd
GROUP 1: BOILER SYSTEMS WITH RADIATORS OR UNDERFLOOR HEATING					
No time or thermostatic control of room temperature	1	+0.6	Table 4c(2)	2101	rd
Programmer, no room thermostat	1	+0.6	Table 4c(2)	2102	rd
Room thermostat only	1	0	Table 4c(2)	2103	rd
Programmer and room thermostat	1	0	Table 4c(2)	2104	rd
Programmer and at least two room thermostats	2	0	Table 4c(2)	2105	rd
Programmer, room thermostat and TRVs	2	0	Table 4c(2)	2106	rd
TRVs and bypass	2	0	Table 4c(2)	2111	
Programmer, TRVs and bypass	2	0	Table 4c(2)	2107	rd
Programmer, TRVs and flow switch	2	0	Table 4c(2)	2108	
Programmer, TRVs and boiler energy manager	2	0	Table 4c(2)	2109	rd
Time and temperature zone control	3	0	Table 4c(2)	2110	rd
Adjustments for features of control systems:					
(applicable to any control option above and in addition to the adjustments selected above)					
Delayed start thermostat	one of the above	-0.15	n/a		
Load or weather compensation	one of the above	0	Table 4c(1)		
Temperature control of water heating (cylinderstat)	n/a	n/a	Tables 2b and 3		rd
Time control of water heating (separate programming)	n/a	n/a	Table 2b		
Adjustments for features other than controls:					
Temperature adjustment for CPSU or integrated thermal store	n/a	-0.1	n/a		rd
Underfloor heating	n/a	n/a	Table 4c(1)		rd
GROUP 2: HEAT PUMPS WITH RADIATORS OR UNDERFLOOR HEATING					
No time or thermostatic control of room temperature	1	+0.3	Table 4c(4)	2201	rd
Programmer, no room thermostat	1	+0.3	Table 4c(4)	2202	rd
Room thermostat only	1	0	Table 4c(4)	2203	rd
Programmer and room thermostat	1	0	Table 4c(4)	2204	rd
Programmer and at least two room thermostats	2	0	Table 4c(4)	2205	rd
Programmer, TRVs and bypass	2	0	Table 4c(4)	2206	rd
Time and temperature zone control	3	0	Table 4c(4)	2207	rd
Adjustments for features of control systems:					
(applicable to any control option above and in addition to the adjustments selected above)					
Load or weather compensation	one of the above	0	Table 4c(4)		
Temperature control of water heating (cylinderstat)	n/a	n/a	Tables 2b and 3		rd
Time control of water heating (separate programming)	n/a	n/a	Table 2b		

Table 4e continued

Type of control	Control	Temperature adjustment, °C	Reference to other possible adjustments	Code	Rd SAP
Adjustments for features other than controls:					
Temperature adjustment for integrated thermal store	n/a	-0.1	n/a		rd
GROUP 3: COMMUNITY HEATING SCHEMES					
Flat rate charging*, no thermostatic control of room temperature	1	+0.3	Table 4c(3)	2301	rd
Flat rate charging*, programmer, no room thermostat	1	+0.3	Table 4c(3)	2302	rd
Flat rate charging*, room thermostat only	1	0	Table 4c(3)	2303	rd
Flat rate charging*, programmer and room thermostat	1	0	Table 4c(3)	2304	rd
Flat rate charging*, TRVs	2	0	Table 4c(3)	2307	
Flat rate charging*, programmer and TRVs	2	0	Table 4c(3)	2305	rd
Charging system linked to use of community heating, room thermostat only	2	0	Table 4c(3)	2308	
Charging system linked to use of community heating, programmer and room thermostat	2	0	Table 4c(3)	2309	
Charging system linked to use of community heating, TRVs	3	0	Table 4c(3)	2310	
Charging system linked to use of community heating, programmer and TRVs	3	0	Table 4c(3)	2306	rd
* 'Flat rate charging' means that households pay for the heat according to a fixed monthly or annual amount, not depending on the amount of heat actually used. If the charges vary within a scheme for other reasons, for example according to dwelling size, it is still classified as flat rate. Other entries refers to a system in which the charges are substantially related to the amount of heat used.					
GROUP 4: ELECTRIC STORAGE SYSTEMS					
Manual charge control	3	+0.3	n/a	2401	rd
Automatic charge control	3	0	n/a	2402	rd
Celect-type controls	3	0	n/a	2403	
GROUP 5: WARM AIR SYSTEMS (including heat pumps with warm air distribution)					
No thermostatic control of room temperature	1	+0.3	n/a	2501	rd
Programmer, no room thermostat	1	+0.3	n/a	2502	rd
Room thermostat only	1	0	n/a	2503	rd
Programmer and room thermostat	1	0	n/a	2504	rd
Programmer and at least two room thermostats	2	0	n/a	2505	rd
Time and temperature zone control	3	0	n/a	2506	rd
GROUP 6: ROOM HEATER SYSTEMS					
No thermostatic control of room temperature	2	+0.3	n/a	2601	rd
Appliance thermostats	3	0	n/a	2602	rd
Programmer and appliance thermostats	3	0	n/a	2603	rd
Room thermostats only	3	0	n/a	2604	rd
Programmer and room thermostats	3	0	n/a	2605	rd
GROUP 7: OTHER SYSTEMS					
No thermostatic control of room temperature	1	+0.3	n/a	2701	rd
Programmer, no room thermostat	1	+0.3	n/a	2702	rd
Room thermostat only	1	0	n/a	2703	rd
Programmer and room thermostat	1	0	n/a	2704	rd
Temperature zone control	2	0	n/a	2705	rd
Time and temperature zone control	3	0	n/a	2706	rd

Table 4f: Electricity for fans and pumps and electric keep-hot facility

Equipment	kWh/year
Heating system:	
Central heating pump (supplying hot water to radiators or underfloor system)	130 [a)]
Oil boiler [b)] - pump (supplying oil to boiler and flue fan) [c)]	100 [a)]
Gas boiler - flue fan (if fan assisted flue)	45
Gas-fired heat pump - flue fan (if fan assisted flue)	45
Warm air heating system fans [d)]	$0.6 \times V$
Keep-hot facility of a combi boiler:	
Electricity for maintaining keep-hot facility [e) f)] - keep-hot facility, controlled by time clock - keep-hot facility, not controlled by time clock	 600 900
Ventilation system:	
Mechanical extract ventilation [g)]	$SFP \times 1.22 \times V$
Balanced whole house mechanical ventilation fans [g)]	$SFP \times 2.44 \times n_{mech} \times V$
Positive input ventilation (from loft space)	0
Positive input ventilation (from outside) [g)]	$SFP \times 1.22 \times V$
Solar water heating pump:	
Solar water heating pump, electrically powered Solar water heating pump, PV powered	75 0

Notes:

a) *Multiply by a factor of 1.3 if room thermostat is absent.*

b) *Applies to all oil boilers that provide main heating, but not if boiler provides hot water only.*

c) *The same motor operates both the pump and the flue fan.*

d) *If the heating system is a warm air unit and there is balanced whole house mechanical ventilation, the electricity for warm air circulation should not be included in addition to the electricity for mechanical ventilation. However it is included for a warm air system and MEV or PIV from outside. V is the volume of the dwelling in m³.*

e) *See notes to Table 3a for the definition of keep-hot facility.*

f) *In the case of an electrically powered keep-hot facility where the power rating of the keep-hot heater is obtained from the Boiler Efficiency database, the electric part of the total combi loss should be taken as:*

LE =8.76 x P (kWh/year) (subject to maximum of the value from Table 3a, 3b or 3c)
where P is the power rating of the heater in watts

with the remainder (either 600 – LE or 900 – LE) provided by the fuel.

g) *SFP is specific fan power in W/(litre/sec), see paragraph 2.6 and Table 4g, V is volume of the dwelling in m³. n_{mech} is the throughput of the MVHR system, see paragraph 2.6.*

Table 4g: Default specific fan power for mechanical ventilation systems and heat recovery efficiency for MVHR systems

1. *The data in Table 4g are used only where values for the specific product are not available.*
2. *The SFP values apply to both rigid and flexible ducting.*
3. *Values of specific fan power and heat recovery efficiency are to be multiplied by the appropriate in-use factor for default data (Table 4h).*

Type of mechanical ventilation	**SFP, W/(litre/sec)**	**Heat recovery efficiency**
Mechanical extract ventilation (centralised or decentralised), or positive input ventilation from outside	0.8	-
Balanced whole house mechanical ventilation, without heat recovery	2.0	-
Balanced whole house mechanical ventilation, with heat recovery	2.0	66%

Table 4h: In-use factors for mechanical ventilation systems

Type of mechanical ventilation	**In-use factor for Specific fan power**			**In-use factor for Efficiency**	
	Flexible duct	**Rigid duct**	**No duct**	**Uninsulated ducts**	**Insulated ducts** [c]
Mechanical extract ventilation or positive input ventilation from outside, centralised [a]	1.70	1.40	-	-	-
Mechanical extract ventilation or positive input ventilation from outside, decentralised [a]	1.45	1.30	1.15	-	-
Balanced whole house mechanical ventilation, without heat recovery [a]	1.70	1.40	-	-	-
Balanced whole house mechanical ventilation, with heat recovery [a]	1.70	1.40	-	0.70	0.85
Default data from Table 4g (all types) [b]	2.5			0.70	

[a] Use these values for data from the database or from data sheets obtained from www.sap-appendixq.org.uk

[b] Use these values for data from Table 4g.

[c] This column applies when all ductwork is within the insulated envelope of the building even though ductwork is not itself insulated.

Table 5: Internal heat gains (in watts)

Source	(A) Typical gains	(B) Reduced gains
Metabolic	$60 \times N$	$50 \times N$
Lighting	equation (L8) in Appendix L	equation (L8a) in Appendix L
Appliances	equation (L11) in Appendix L	equation (L11a) in Appendix L
Cooking	$35 + 7 \times N$	$23 + 5 \times N$
Water heating	$1000 \times (52)_m \div (n_m \times 24)$	$1000 \times (52)_m \div (n_m \times 24)$
Losses	$-40 \times N$	$-40 \times N$
Pumps and fans	Table 5a	Table 5a

Notes:
1. *N is the assumed number of occupants, based on floor area.*
2. *Losses comprise heat to incoming cold water and evaporation.*
3. *Column (A) applies for the calculation of ratings. Column (B) applies to the calculation of the DER for new dwellings.*

Table 5a: Gains from pumps and fans

Function	Gains (W)
Central heating pump in heated space [a)]	10
Oil boiler pump, inside dwelling [b)]	10
Warm air heating system fans [a) c)]	$0.06 \times V$
Fans for positive input ventilation from outside	$SFP \times 0.12 \times V$
Fans for balanced whole house mechanical ventilation without heat recovery	$SFP \times 0.06 \times V$

Notes:
[a)] *Does not apply to community heating*
[b)] *Only for boiler providing main heating. In addition to central heating pump, but not if oil pump is outside dwelling.*
[c)] *If the heating system is a warm air unit and there is balanced whole house mechanical ventilation, the gains for the warm air system should not be included.*
V is the volume of the dwelling.
Gains are not added in for MVHR systems (because their effect is included in the MVHR efficiency), nor for MEV systems.

Table 6a: Mean global solar irradiation on a horizontal plane (latitude 53.4°N) and solar declination

Solar radiation on the horizontal (W/m²)											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
26	54	94	150	190	201	194	164	116	68	33	21
Solar declination (°)											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
-20.7	-12.8	-1.8	9.8	18.8	23.1	21.2	13.7	2.9	-8.7	-18.4	-23.0

Solar radiation on vertical surfaces for solar gain through windows and roof windows

Solar radiation is obtained from the data in Table 6a as follows.

$Fx(m) = R_{htov}(\theta)\ S_h$ where $R_{htov}(\theta) = A + B\cos(\theta) + C\cos(2\theta)$

$A = 0.702 - 0.0119\,(\phi - \delta) + 0.000204\,(\phi - \delta)^2$
$B = -0.107 + 0.0081\,(\phi - \delta) - 0.000218\,(\phi - \delta)^2$
$C = 0.117 - 0.0098\,(\phi - \delta) + 0.000143\,(\phi - \delta)^2$

and
$Fx_i(m)$ is the vertical solar flux for an element in month m with orientation θ (W/m^2)
$R_{htov}(\theta)$ is the factor for converting from horizontal to vertical solar flux
θ is the orientation of the opening measured eastwards from North (e.g. East = 90^o) (^{o})
ϕ is the latitude of the site (^{o}) = 53.4° or Table 10 for summer calculations
δ is the solar declination for month m (^{o}) (Table 6a)
S_h is the horizontal solar flux (W/m^2) (Table 6a or Table 10)

For roof windows
- if orientated within ±30° of North, the value for a North-facing vertical surface
- otherwise the value for a horizontal surface (i.e. as tabulated)

Angles may need to be converted to radians depending on the software implementation of the cosine function.

Table 6b: Transmittance factors for glazing

Type of glazing	Total solar energy transmittance, $g_\perp$ (for calculation of solar gains in section 6 of the worksheet)	Light transmittance, g_L (for calculation of lighting requirement in Appendix L)
Single glazed	0.85	0.90
Double glazed (air or argon filled)	0.76	
Double glazed (low-E, hard-coat)	0.72	0.80
Double glazed (low-E, soft-coat)	0.63	
Window with secondary glazing	0.76	0.80
Triple glazed (air or argon filled)	0.68	
Triple glazed (low-E, hard-coat)	0.64	0.70
Triple glazed (low-E, soft-coat)	0.57	

Notes:

1. *The values are for normal incidence of solar radiation and they are multiplied by 0.9 (both solar and light transmittance) in calculations.*
2. *When the window U-value is declared by the manufacturer (rather than from Table 6e) the solar transmittance should also be obtained from the manufacturer. In this case, ascertain whether the solar transmittance is related to the glazing only or to the whole window: see section 6.1.*
3. *Light transmittance should always be taken from Table 6b, irrespective of the source of the U-value and solar transmittance.*

Table 6c: Frame factors for windows and glazed doors

Frame type	Frame factor (proportion of opening that is glazed)	
	(A) Typical	(B) Default values
Wood	0.7	0.6
Metal	0.8	0.7
Metal, thermal break	0.8	0.7
PVC-U	0.7	0.6

Notes:

1. *Column (A) applies for the calculation of ratings. Column (B) applies to the calculation of the DER for new dwellings.*
2. *If known, the actual frame factor should be used instead of the data in Table 6c. Frame factors can be assigned per window (or per group of similar windows) or as an average for each façade of the dwelling.*

Table 6d: Solar and light access factors

Overshading	% of sky blocked by obstacles.	Winter solar access factor (for calculation of solar gains for heating)	Summer solar access factor (for calculation of solar gains for cooling and summer temperatures in Appendix P)	Light access factor (for calculation of lighting requirement in Appendix L)
Heavy	> 80%	0.3	0.5	0.5
More than average	>60% - 80%	0.54	0.7	0.67
Average or unknown	20% - 60%	0.77	0.9	0.83
Very little	< 20%	1.0	1.0	1.0

Notes

1. *The overshading category of "very little" is not appropriate for new dwellings.*
2. *A solar access factor of 1.0 and a light access factor of 1.0 should be used for roof windows.*

Table 6e: Default U-values (W/m^{2}K) for windows, doors and roof windows

The values apply to the entire area of the window opening, including both frame and glass, and take account of the proportion of the area occupied by the frame and the heat conducted through it. Unless known otherwise, double and triple glazing should be taken as air-filled without low-E coating. If the U-value of the components of the window (glazed unit and frame) are known, window U-values may alternatively be taken from the tables in Annex F of BS EN ISO 10077-1, using the tables for 20% frame for metal-framed windows and those for 30% frame for wood or PVC-U framed windows.

When available, the manufacturer's certified U-values for windows or doors should be used in preference to the data in this table. Adjustments for roof windows as in Notes 1 and 2 to the table should be applied to manufacturer's window U-values unless the manufacturer provides a U-value specifically for a roof window.

These U-values to be reviewed to ensure consistency with EN 14351-1 and ISO 10077-1.

	Type of frame						
	Window with wood or PVC-U frame (use adjustment in Note 1)				**Window with metal frame with 4mm thermal break** (use adjustments in Note 2)		
	6 mm gap	**12 mm gap**	**16 or more mm gap**		**6 mm gap**	**12 mm gap**	**16 or more mm gap**
double-glazed, air filled	3.1	2.8	2.7		3.7	3.4	3.3
double-glazed, air filled (low-E, ε_n = 0.2, hard coat)	2.7	2.3	2.1		3.3	2.8	2.6
double-glazed, air filled (low-E, ε_n = 0.15, hard coat)	2.7	2.2	2.0		3.3	2.7	2.5
double-glazed, air filled (low-E, ε_n = 0.1, soft coat)	2.6	2.1	1.9		3.2	2.6	2.4
double-glazed, air filled (low-E, ε_n = 0.05, soft coat)	2.6	2.0	1.8		3.2	2.5	2.3
double-glazed, argon filled	2.9	2.7	2.6		3.5	3.3	3.2
double-glazed, argon filled (low-E, ε_n = 0.2, hard coat)	2.5	2.1	2.0		3.0	2.6	2.5
double-glazed, argon filled (low-E, ε_n = 0.15, hard coat)	2.4	2.0	1.9		3.0	2.5	2.4
double-glazed, argon filled (low-E, ε_n = 0.1, soft coat)	2.3	1.9	1.8		2.9	2.4	2.3
double-glazed, argon filled (low-E, ε_n = 0.05, soft coat)	2.3	1.8	1.7		2.8	2.2	2.1
triple glazed, air filled	2.4	2.1	2.0		2.9	2.6	2.5
triple-glazed, air filled (low-E, ε_n = 0.2, hard coat)	2.1	1.7	1.6		2.6	2.1	2.0
triple-glazed, air filled (low-E, ε_n = 0.15, hard coat)	2.1	1.7	1.6		2.5	2.1	2.0
triple-glazed, air filled (low-E, ε_n = 0.1, soft coat)	2.0	1.6	1.5		2.5	2.0	1.9
triple-glazed, air filled (low-E, ε_n = 0.05, soft coat)	1.9	1.5	1.4		2.4	1.9	1.8
triple-glazed, argon filled	2.2	2.0	1.9		2.8	2.5	2.4
triple-glazed, argon filled (low-E, ε_n = 0.2, hard coat)	1.9	1.6	1.5		2.3	2.0	1.9
triple-glazed, argon filled (low-E, ε_n = 0.15, hard coat)	1.8	1.5	1.4		2.3	1.9	1.8
triple-glazed, argon filled (low-E, ε_n = 0.1, soft coat)	1.8	1.5	1.4		2.2	1.9	1.8

triple-glazed, argon filled (low-E, $\varepsilon_n = 0.05$, soft coat)	1.7	1.4	1.3		2.2	1.8	1.7
Windows and doors, single-glazed	4.8				5.7		
Window with secondary glazing	2.4						
Solid wooden door to outside	3.0						
Solid wooden door to unheated corridor	1.4						

Notes:

1. *For roof windows with wooden or PVC-U frames apply the following adjustments to U-values:*

Wood or PVC-U frame	*U-value adjustment for roof window, W/m²K*
Single glazed	*+0.3*
Double glazed	*+0.2*
Triple glazed	*+0.2*

2. *For windows or roof windows with metal frames apply the following adjustments to U-values:*

Metal frames	*Adjustment to U-value, W/m²K*	
	Window	*Roof window*
Metal, no thermal break	*+0.3*	*+0.7*
Metal, thermal break 4 mm	*0*	*+0.3*
Metal, thermal break 8 mm	*-0.1*	*+0.2*
Metal, thermal break 12 mm	*-0.2*	*+0.1*
Metal, thermal break 20 mm	*-0.3*	*0.0*
Metal, thermal break 32 mm	*-0.4*	*-0.1*

3. *For doors which are half-glazed (approximately) the U-value of the door is the average of the appropriate window U-value and that of the non-glazed part of the door (e.g. solid wooden door [U-value of 3.0 W/m²K] half-glazed with double glazing [low-E, hard coat, argon filled, 6 mm gap, U-value of 2.5 W/m²K] has a resultant U-value of 0.5(3.0+2.5) = 2.75 W/m²K).*

Table 7: Wind speed (in m/s)

Jan	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1

Table 8: Mean external temperature (°C)

Jan	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
4.5	5.0	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7.0	4.9

Calculation of mean internal temperature

Calculation of mean internal temperature is based on the heating patterns defined in Table 9.

Table 9: Heating periods and heating temperatures

Living area		Elsewhere		
Temperature T_{h1} (°C)	**Hours of heating off t_{off}**	**Heating control (Table 4e)**	**Temperature T_{h2} °C**	**Hours of heating off t_{off}**
21	Weekday: 7 and 8 [a] Weekend: 0 and 8 [b]	1	21 – 0.5 HLP	Weekday: 7 and 8 [a] Weekend: 0 and 8 [b]
		2	21 – HLP + 0.085 HLP²	Weekday: 7 and 8 [a] Weekend: 0 and 8 [b]
		3	21 – HLP + 0.085 HLP²	All days: 9 and 8 [c]

[a] heating 0700-0900 and 1600-2300
[b] heating 0700-2300
[c] heating 0700-0900 and 1800-2300

If HLP > 6.0 use HLP = 6.0 for calculation of T_{h2}

During heating periods the temperature is as given in Table 9 and at other times it falls towards the temperature that would apply without heating (T_{sc} as defined in Table 9b). The calculation is done separately for the living area and for elsewhere and the two values combined in proportion to the respective floor areas.

Table 9a: Utilisation factor for heating

H = heat transfer coefficient, $(37)_m$

G = total gains, $(66)_m$

T_i = internal temperature

T_e = external temperature, $(7)_m$

TMP = Thermal Mass Parameter, (33g), in kJ/m²K (= C_m for building / total floor area)

HLP = Heat Loss Parameter, $(38)_m$, in W/m²K

τ = time constant

η = utilisation factor

τ = TMP / (3.6 × HLP)

$a = 1 + \tau / 15$

$L = H (T_i - T_e)$

$\gamma = G / L$

if $\gamma > 0$ and $g \neq 1$: $\eta = \dfrac{1-\gamma^a}{1-\gamma^{a+1}}$

if $g = 1$: $\eta = \dfrac{a}{a+1}$

if $g \leq 0$: $\eta = 1$

Table 9b: Temperature reduction when heating is off

τ = time constant (from Table 9a) t_{off} = number of hours that heating is off T_h = temperature during heating period (Table 9) T_{sc} = internal temperature without heating R = responsiveness of heating system (Table 4a or Table 4d)
$t_c = 4 + 0.25\ \tau$ $T_{sc} = (1 - R) \times (T_h - 2.0) + R\ (Te + \eta\ G / H)$ if $t_{off} \leq t_c$ $\quad u = 0.5\ t_{off}^2 \times (T_h - T_{sc}) / (24 \times t_c)$ if $t_{off} > t_c$. $\quad u = (T_h - T_{sc}) \times (t_{off} - 0.5\ t_c) / 24$

Table 9c: Heating requirement

The following is done using data for the applicable month.

Living area

1. Set T_i to the temperature for the living area during heating periods (Table 9)
2. Calculate the utilisation factor (Table 9a)
3. Calculate the temperature reduction (Table 9b) for each off period (Table 9), u_1 and u_2, for weekdays
4. $T_{weekday} = T_h - (u_1 + u_2)$
5. Calculate the temperature reduction (Table 9b) for each off period (Table 9), u_1 and u_2, for weekends
6. $T_{weekend} = T_h - (u_1 + u_2)$
7. Mean temperature (living area) $T_1 = (5\ T_{weekday} + 2\ T_{weekend}) / 7$

Rest of dwelling

8. Set T_i to the temperature for elsewhere during heating periods (Table 9)
9. Repeat steps 2 to 7 above to obtain the mean temperature (rest of dwelling), T_2
10. Mean internal temperature = $f_{LA} \times T_1 + (1 - f_{LA}) \times T_2$
    f_{LA} is the living area fraction, (74)
11. Apply adjustment to the mean internal temperature from Table 4e, where appropriate
12. Set T_i to the mean internal temperature obtained at step 11 and re-calculate the utilisation factor
13. Heat requirement for month in kWh is $Q_{heat} = 0.024 \times (L_m - \eta_m G_m) \times n_m$
    n_m is the number of days in the month

Set Q_{heat} to 0 if negative.

Include the heating requirement for each month from October to May (disregarding June to September).

Calculation of cooling requirements

Table 10: Mean global solar irradiation on a horizontal plane and mean external temperature in summer

Region	Representative latitude (°N)	Solar radiation on the horizontal (W/m²)			Mean external temperature (°C)		
		Jun	Jul	Aug	Jun	Jul	Aug
Thames	51.5	214	204	177	15.4	17.8	17.8
South East England	51.0	225	213	186	15.2	17.6	17.8
Southern England	50.8	225	213	190	15.2	17.4	17.6
South West England	50.6	218	208	186	14.7	16.8	17.0
Severn	51.5	218	208	184	15.2	17.4	17.3
Midlands	52.7	204	194	168	14.9	17.2	17.1
West Pennines	53.4	196	186	159	14.5	16.6	16.5
North West England / South West Scotland	54.8	192	187	156	13.5	15.5	15.4
Borders	55.5	186	178	149	13.4	15.5	15.4
North East England	54.5	188	183	154	14.0	16.2	16.1
East Pennines	53.4	201	194	164	14.6	16.9	16.9
East Anglia	52.3	212	203	173	15.0	17.5	17.6
Wales	52.5	209	198	172	14.3	16.4	16.3
West Scotland	55.8	186	183	154	13.1	14.9	14.8
East Scotland	56.4	187	177	146	13.2	15.2	15.0
North East Scotland	57.2	187	170	142	12.8	14.9	14.7
Highland	57.5	181	163	140	12.5	14.5	14.4
Western Isles	58.0	189	175	147	11.7	13.7	13.7
Orkney	59.0	199	178	141	11.2	13.3	13.6
Shetland	60.2	183	163	138	10.6	12.7	13.0
Northern Ireland	54.7	188	175	152	13.4	15.4	15.2

(See map on next page)

Convert data in Table 10 to the radiation on vertical surfaces using the procedure below Table 6a.


Regions
1 Thames
2 South East England
3 Southern England
4 South West England
5 Severn
6 Midlands
7 West Pennines
8 NW England / SW Scotland
9 Borders
10 North East England
11 East Pennines
12 East Anglia
13 Wales
14 West Scotland
15 East Scotland
16 North East Scotland
17 Highland
18 Western Isles
19 Orkney
20 Shetland
21 Northern Ireland
Shetland
20
Lerwick
19
Orkney
18
Western Isles
Wick
Inverness
17
16
Aberdeen
15
Dundee
14
Edinburgh
Glasgow
Berwick upon Tweed
Ayr
9
Newcastle upon Tyne
Londonderry
Stranraer
Carlisle
21
Belfast
8
Middlesborough
10
York
Blackpool
Leeds
Hull
7
Manchester
Sheffield
11
Anglesey
Liverpool
Lincoln
Chester
Derby
Caernarfon
Nottingham
Norwich
6
Shrewsbury
Leicester
Birmingham
13
12
Cambridge
Northampton
Aberystwyth
Hereford
Colchester
Luton
Cheltenham
Oxford
1
London
Swansea
Swindon
Cardiff
Reading
Canterbury
Bristol
5
2
Dover
Salisbury
Brighton
Portsmouth
Bournemouth
4
3
Exeter
Plymouth
Isles of Scilly

Table 10a: Utilisation factor for cooling

H = heat transfer coefficient, $(37)_m$
G = total gains, $(66)_m$
T_i = internal temperature = 25°C
T_e = external temperature, for the region and month concerned from Table 10
TMP = Thermal Mass Parameter, (33g), in kJ/m²K (= C_m for building / total floor area)
HLP = Heat Loss Parameter, $(38)_m$, in W/m²K
τ = time constant
η = utilisation factor
τ = TMP / (3.6 × HLP)
$a = 1 + \tau / 15$
$L = H (T_i - T_e)$
$\gamma = G / L$
if $\gamma > 0$ and $g \neq 1$: $\eta = \frac{1-\gamma^{-a}}{1-\gamma^{-(a+1)}}$
if $g = 1$: $\eta = \frac{a}{a+1}$
if $g \leq 0$: $\eta = 1$

Table 10b: Cooling requirement

1. Cooling requirement for continuous cooling of whole house for month in kWh is
   $0.024 \times (G_m - \eta_m L_m) \times n_m$
   n_m is the number of days in the month
2. Multiply by the fraction of the total floor area that is cooled, f_{cool}.
3. Multiply by an intermittency factor, $f_{intermittent}$ where
   $f_{intermittent} = 1 - 3.0 \times 0.75 \times \gamma \times 15 / \tau$ (based on procedure in ISO 13790 for 6 hours/day operation)
   subject to $f_{intermittent} \geq 0.25$ and $f_{intermittent} \leq 1.0$
4. The cooling requirement for the part of the dwelling that is cooled allowing for standard hours of operation is:
   $Q_{cool} = 0.024 \times (G_m - \eta_m L_m) \times n_m \times f_{cool} \times f_{intermittent}$
   Set Q_{cool} to zero if negative.
5. Divide by the System Energy Efficiency Ratio (SEER), see Table 10c.

Include the cooling requirements for each month from June to August (disregarding September to May). The fuel cost, CO_2 emission factor and primary emission factor are those for electricity in Table 12.

Table 10c: Energy Efficiency Ratio (EER) and System Energy Efficiency Ratio (SEER)

Energy label class	Default EER	
	Split and Multi-split systems	Packaged systems
A	3.2	3.0
B	3.0	2.8
C	2.8	2.6
D	2.6	2.4
E	2.4	2.2
F	2.2	2.0
G	2.0	1.8

The energy label class is that applied to the product in terms of the Energy Information (Household Air Conditioners) (No. 2) Regulations 2005 (SI 2005 No. 1726). If unknown class G is assumed.

Alternatively the EER measured in accordance with BS EN14511:2004 Parts 1-4 *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling* by an independent accredited laboratory at conditions T1 'moderate', may be used.

The SEER is:

for systems with on/off control — SEER = 1.25 × EER
for systems with variable speed compressors — SEER = 1.35 × EER

Note: If the air conditioner is reversible so as to provide heating it should be assessed as a heat pump in heating mode (Appendix G).

Table 11: Fraction of heat supplied by secondary heating systems

Main heating system	Secondary system	Fraction from secondary
All gas, oil and solid fuel systems	all secondary systems	0.10
Micro-cogeneration	all secondary systems	see Appendix N
Heat pump	all secondary systems	0.10
Electric storage heaters (not integrated)	all secondary systems	
- not fan-assisted		0.15
- fan-assisted		0.10
Integrated storage/direct-acting electric systems		0.10
Electric CPSU		see Appendix F
Electric room heaters		0.20
Other electric systems		0.10
Community heating	all secondary systems	0.10

Notes:

1. *See also Appendix A.*
2. *If an off-peak tariff is present, an electric secondary heater uses the on-peak tariff.*

Table 12: Fuel prices, additional standing charges, emission factors and primary energy factors

Fuel	Additional standing charge, £[a]	Unit price p/kWh	Emissions kg CO_2 per kWh	Primary energy factor	Fuel code
Gas:					
mains gas or LNG	98	2.82	0.206	1.15	1
bulk LPG	67	5.24	0.251	1.10	2
bottled LPG		7.37	0.251	1.10	3
LPG subject to Special Condition 18 [b]	98	2.82	0.251	1.10	9
Oil:					
heating oil		4.01	0.284	1.19	4
biodiesel from any biomass source [c]		5.33	0.098	1.19	71
biodiesel from used cooking oil only [d]		5.33	0.019	1.19	72
rape seed oil		5.33	0.058	1.19	73
appliances able to use mineral oil or liquid biofuel		4.01	0.284	1.19	74
B30K [e]		4.40	0.205	1.19	75
Solid fuel: [f]					
house coal		2.55	0.382	1.07	11
anthracite		2.50	0.365	1.07	15
manufactured smokeless fuel		3.28	0.402	1.30	12
wood logs		2.94	0.018	1.10	20
wood pellets (in bags for secondary heating)		5.46	0.037	1.10	22
wood pellets (bulk supply for main heating)		4.94	0.037	1.10	23
wood chips		2.14	0.015	1.10	21
dual fuel appliance (mineral and wood)		2.77	0.243	1.10	10
Electricity:					
standard tariff		10.61	0.591	2.5	30
7-hour tariff (on-peak) [g]		11.59	0.591	2.5	32
7-hour tariff (off-peak) [g]	31	4.43	0.591	2.5	31
10-hour tariff (on-peak) [g]		11.79	0.591	2.5	34
10-hour tariff (off-peak) [g]	32	6.52	0.591	2.5	33
24-hour heating tariff	83	6.21	0.591	2.5	35
electricity sold to grid		8.49 [h]			36
electricity displaced from grid			0.591[h]	2.5[h]	37
electricity, unspecified tariff [i]					39
Community heating schemes: [j]	98 [k]				
heat from boilers – mains gas		3.44	0.206	1.15	51
heat from boilers – LPG		3.44	0.251	1.10	52
heat from boilers – oil		3.44	0.291[l]	1.19	53
heat from boilers – coal		3.44	0.391[m]	1.07	54
heat from heat pump		3.44	0.591	2.5	41
heat from boilers – waste combustion		3.44	0.047	1.10	42
heat from boilers – biomass		3.44	0.019[n]	1.10	43
heat from boilers – biogas (landfill or sewage gas)		3.44	0.024	1.10	44
waste heat from power stations		2.41	0.058[o]	1.15	45
geothermal heat source		2.41	0.041	1.17	46
heat from CHP		2.41	as above[p]	as above[p]	as above[p]
electricity generated by CHP			0.591[h]	2.5[h]	49
electricity for pumping in distribution network			0.591	2.5	50

Energy Cost Deflator[q] = 0.51

Note to Table 12:

(a) The standing charge given for electricity is extra amount for the off-peak tariffs, over and above the amount for the standard domestic tariff, as it is assumed that the dwelling has a supply of electricity for reasons other than

space and water heating. The standing charge for off-peak electricity is added to space and water heating costs where either main heating or hot water uses off-peak electricity. The standing charge for gas is added to space and water heating costs where gas is used for space heating (main or secondary) or for water heating.

(b) www.ofgem.gov.uk/networks/gasdistr/otherwork/Documents1/7940-Independentnetworksopenletter.pdf

(c) Fuel verified as wholly derived from biomass sources

(d) Fuel verified as wholly derived from used cooking oil

(e) For appliances that specifically use a 70:30 blend of kerosene:biodiesel from cooking oil and relates to a fuel specification being developed by OFTEC

(f) The specific fuel should be assumed for those appliances that can only burn the particular fuel (including Exempted Appliances within Smoke Control Areas).
Where a main heating appliance is classed as dual fuel (i.e mineral and wood), the data for dual fuel should be used, except where the dwelling is in a Smoke Control Area, when the data for solid mineral fuel should be used.
Wood should be specified as fuel for a main heating system only if there is adequate provision (at least 1.5 m³) for storage of the fuel.
Outside Smoke Control Areas an open fire should be considered as dual fuel, and a closed room heater without boiler if capable of burning wood as burning wood logs.

(g) With certain appliances using an off-peak tariff, some of the consumption is at the off-peak rate and some at the on-peak rate. The on-peak percentages to be used are given in Table 12a, the remainder being provided at the off-peak rate.

(h) Deducted from costs, emissions or primary energy

(i) This code is used to define the fuel for any electric system. Other codes for electricity are to provide cost data, depending on the applicable electricity tariff.

(j) Cost is per unit of heat supplied, emission and primary factors are per unit of fuel used

(k) Include half this value if the community scheme is for DHW only

(l) Based on the mix of petroleum products used to generated heat in the UK (predominantly gas oil).

(m) Value for non-domestic coal

(n) Based on the mix of biomass sources used to generate heat in the UK.

(o) Takes account of the reduction in electricity generation that occurs where heat is produced at a high enough temperature to provide community heating.

(p) Use factor for community heat from boilers according to fuel used.

(q) An energy cost deflator term is applied before the rating is calculated. It will vary with the weighted average price of heating fuels in future so that the SAP rating is not affected by the general rate of fuel price inflation. However, individual SAP ratings are affected by relative changes in the price of particular heating fuels.

Table 12a: On-peak fractions for systems using 7-hour and 10-hour tariffs

This table is used for electric space and water heating systems which take electricity at both off-peak and on-peak rates. Use an electricity price for the main heating system weighted between the on-peak and off-peak unit price using the fraction from the table. Secondary heating with fraction according to Table 11 is applied as well.

System	Tariff	Fraction at on-peak rate	
		Space heating	Water heating
Integrated (storage+direct-acting) systems (storage heaters and underfloor heating)	7-hour	0.20	-
Direct-acting electric boiler [(a)]	7-hour 10-hour	0.90 0.60	- -
Electric CPSU	10-hour	Fraction from Appendix F	Fraction from Appendix F
Underfloor heating (in screed above insulation, in timber floor or immediately below floor covering)	7-hour 10-hour	0.90 0.60	- -
Ground/water source heat pump:			
water heating with off-peak immersion	7-hour or 10-hour	-	0.17
water heating without immersion heater	7-hour or 10-hour	-	0.70
space heating with on-peak auxiliary	7-hour	0.80	-
do.	10-hour	0.60	-
space heating without auxiliary	7-hour	0.70	-
do.	10-hour	0.60	-
Air source heat pump:			
space heating	7-hour	0.90	-
do.	10-hour	0.60	-
water heating with off-peak immersion	7-hour or 10-hour	-	0.17
water heating without immersion heater	7-hour or 10-hour	-	0.70
Other direct-acting electric heating (including electric secondary heating)	7-hour 10-hour	1.00 0.80	- -
Immersion water heater	7-hour or 10-hour	-	Fraction from Table 13

Note

(a) An electric boiler can provide space heating only, with a separate cylinder and immersion heater for DHW, or the DHW cylinder can be within the boiler casing. The calculation is the same for both cases.

Other electricity uses	Tariff	Fraction at on-peak rate
Fans for mechanical ventilation systems	7-hour 10-hour	0.71 0.58
All other	7-hour 10-hour	0.90 0.80

Table 12b: Solid Fuels

The table shows the fuels that can normally be used on the different types of solid fuel appliance. It should be regarded as only indicative: it is always necessary to follow the appliance manufacturer's instructions. See also section 10.3.3 and note (g) to Table 12 as regards fuel selection for SAP calculations.

	Possible fuels	
Appliance	**Within Smoke Control Area**	**Outside Smoke Control Area**
Auto (gravity) feed boiler	Anthracite grains and beans	Anthracite grains and beans
Manual feed boiler	Anthracite nuts Authorised Smokeless	Anthracite nuts Smokeless Wood logs
Wood chip boiler	Wood chips if Exempted Appliance	Wood chips
Wood pellet boiler	Wood pellets if Exempted Appliance	Wood pellets
Open fire (with or without back boiler)	Authorised Smokeless	House coal Smokeless Wood logs
Closed room heater (with or without boiler)	Anthracite nuts Authorised Smokeless Wood logs if Exempted Appliance	House coal Anthracite nuts Smokeless Wood logs
Pellet-fired stove	Wood pellets if Exempted Appliance	Wood pellets
Range cooker boiler	Anthracite	Anthracite Wood logs

Table 12c: Distribution loss factor for group and community heating schemes

Heat distribution system	Factor
Mains piping system installed in 1990 or earlier, not pre-insulated medium or high temperature distribution (120-140ºC), full flow system	1.20
Pre-insulated mains piping system installed in 1990 or earlier, low temperature distribution (100ºC or below), full flow system.	1.10
Modern higher temperature system (up to 120ºC), using pre-insulated mains installed in 1991 or later, variable flow system.	1.10
Modern pre-insulated piping system operating at 100ºC or below, full control system installed in 1991 or later, variable flow system	1.05

Note: A full flow system is one in which the hot water is pumped through the distribution pipe work at a fixed rate irrespective of the heat demand (usually there is a bypass arrangement to control the heat delivered to heat emitters). A variable flow system is one in which the hot water pumped through the distribution pipe work varies according to the demand for heat.

[The final version of SAP 2009 may include higher factors for schemes with low linear heat density: see C3 in Appendix C.]

Table 13: On-peak fraction for electric DHW heating

Dwelling total floor area, m^2	Cylinder size, litres						
	7-hour tariff				10-hour tariff		
	110	160	210	245	110	160	210
40 or less	0.12 (0.56)	0.07 (0.18)	0.02	0	0.06 (0.15)	0	0
60	0.14 (0.58)	0.09 (0.21)	0.03	0	0.08 (0.19)	0	0
80	0.17 (0.60)	0.10.(0.24)	0.04	0	0.10 (0.22)	0	0
100	0.19 (0.62)	0.12 (0.27)	0.05	0	0.11 (0.25)	0.00 (0.02)	0
120	0.21 (0.63)	0.14 (0.30)	0.06	0	0.13 (0.28)	0.01 (0.05)	0
140	0.24 (0.65)	0.15 (0.33)	0.06	0.01	0.14 (0.30)	0.02 (0.09)	0
160	0.26 (0.66)	0.16 (0.35)	0.07	0.01	0.16 (0.33)	0.02 (0.12)	0
180	0.27 (0.68)	0.18 (0.37)	0.08	0.02	0.17 (0.35)	0.02 (0.15)	0
200	0.29 (0.69)	0.19 (0.40)	0.09	0.02	0.18 (0.38)	0.03 (0.18)	0
220	0.31 (0.70)	0.20 (0.42)	0.10	0.02	0.19 (0.40)	0.03 (0.21)	0
240	0.32 (0.71)	0.21 (0.43)	0.11	0.03	0.20 (0.41)	0.04 (0.23)	0
260	0.33 0.(72)	0.22 (0.45)	0.11	0.03	0.21 (0.43)	0.04 (0.25)	0
280	0.35 (0.73)	0.23 (0.47)	0.11	0.03	0.22 (0.45)	0.04 (0.27)	0
300	0.36 (0.74)	0.24 (0.48)	0.12	0.03	0.23 (0.46)	0.05 (0.29)	0
320	0.37 (0.75)	0.24 (0.49)	0.12	0.04	0.23 (0.47)	0.05 (0.30)	0
340	0.38 (0.75)	0.25 (0.50)	0.13	0.04	0.24 (0.48)	0.05 (0.32)	0
360	0.38 (0.76)	0.26 (0.51)	0.13	0.04	0.24 (0.49)	0.05 (0.33)	0
380	0.39 (0.76)	0.26 (0.52)	0.13	0.04	0.25 (0.50)	0.05 (0.34)	0
400	0.39 (0.76)	0.26 (0.52)	0.13	0.04	0.25 (0.51)	0.05 (0.35)	0
420 or more	0.39 (0.77)	0.26 (0.52)	0.13	0.04	0.25 (0.51)	0.06 (0.35)	0

Notes:

1) *Table 13 shows fractions of electricity required at on-peak rates for cylinders with dual immersion heaters, and in brackets for cylinders with single immersion heaters, for tariffs providing at least 7 hours of heating per day at the off-peak rate and for tariffs providing at least 10 hours of heating per day at the off-peak rate.*

2) *Alternatively, the fraction may be calculated (for V between 110 and 245 litres) from the following equations:*
   tariffs providing at least 7 hours of heating per day at the off-peak rate
   Dual immersion: $[(6.8 - 0.024V)N + 14 - 0.07V]/100$
   Single immersion: $[(14530 - 762N)/V - 80 + 10N]/100$

   tariffs providing at least 10 hours of heating per day at the off-peak rate
   Dual immersion: $[(6.8 - 0.036V)N + 14 - 0.105V]/100$
   Single immersion: $[(14530 - 762N)/(1.5V) - 80 + 10N]/100$

   where V is the cylinder volume and N is as defined below Table 1. (If these formulae give a value less than zero, set the on-peak fraction to zero; if greater than one, set to one.)

3) *Do not use this table to obtain the on-peak fraction for an electric CPSU. Calculate the on-peak fraction using the procedure described in Appendix F.*

4) *Do not use this table for the on-peak fraction for domestic hot water heated by a heat pump. Use on-peak fraction given in Table 12a.*

Table 14 : Rating bands

The rating is assigned to a rating band according to the following table. It applies to both the SAP rating and the Environmental Impact rating.

Rating	Band
1 to 20	G
21 to 38	F
39 to 54	E
55 to 68	D
69 to 80	C
81 to 91	B
92 or more	A