# SAP 2009 Worksheet
## Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

| | | | |
|---|---|---|---|
| Assessor name | Mr Philip French | Assessor number | 687 |
| Client | | Last modified | 29/03/2013 |
| Address | Flat 1, 210 Kingston Road, Teddington, TW11 9JF | | |

### 1. Overall dwelling dimensions

| | | Area (m²) | | Average storey height (m) | | Volume (m³) | |
|---|---|---|---|---|---|---|---|
| Lowest occupied | | 50.00 | (1a) x | 2.70 | (2a) = | 135.00 | (3a) |
| Total floor area | (1a) + (1b) + (1c) + (1d)...(1n) = | 50.00 | (4) | | | | |
| Dwelling volume | | | | | (3a) + (3b) + (3c) + (3d)...(3n) = | 135.00 | (5) |

### 2. Ventilation rate

| | | | m³ per hour | |
|---|---|---|---|---|
| Number of chimneys | | 0 | x 40 = | 0 (6a) |
| Number of open flues | | 0 | x 20 = | 0 (6b) |
| Number of intermittent fans | | 2 | x 10 = | 20 (7a) |
| Number of passive vents | | 0 | x 10 = | 0 (7b) |
| Number of flueless gas fires | | 0 | x 40 = | 0 (7c) |

| | | | | Air changes per hour | |
|---|---|---|---|---|---|
| Infiltration due to chimneys, flues, fans, PSVs | (6a) + (6b) + (7a) + (7b) + (7c) = | 20 | ÷ (5) = | 0.15 | (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | |
|---|---|---|
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | 3.00 | (17) |
| If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) | 0.30 | (18) |

*Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used*

| | | |
|---|---|---|
| Number of sides on which dwelling is sheltered | 1 | (19) |
| Shelter factor | 1 - [0.075 x (19)] = 0.92 | (20) |
| Adjusted infiltration rate | (18) x (20) = 0.28 | (21) |

Infiltration rate modified for monthly wind speed:

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | | |
| (22)m | 5.40 | 5.10 | 5.10 | 4.50 | 4.10 | 3.90 | 3.70 | 3.70 | 4.20 | 4.50 | 4.80 | 5.10 | |
| | | | | | | | | | | | ∑(22)1...12 = | 54.10 | (22) |
| Wind Factor (22a)m = (22)m ÷ 4 | | | | | | | | | | | | | |
| (22a)m | 1.35 | 1.27 | 1.27 | 1.12 | 1.02 | 0.98 | 0.92 | 0.92 | 1.05 | 1.12 | 1.20 | 1.27 | |
| | | | | | | | | | | | ∑(22a)1...12 = | 13.52 | (22a) |
| Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m | | | | | | | | | | | | | |
| (22b)m | 0.37 | 0.35 | 0.35 | 0.31 | 0.28 | 0.27 | 0.26 | 0.26 | 0.29 | 0.31 | 0.33 | 0.35 | |
| | | | | | | | | | | | ∑(22b)1...12 = | 3.73 | (22b) |

Calculate effective air change rate for the applicable case:

| | | |
|---|---|---|
| If mechanical ventilation: air change rate through system | N/A | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a) | N/A | (23b) |

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m ≥ 1, then (24d)m = (22b)m; otherwise (24d)m = 0.5 + [(22b)m2 x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m | 0.57 | 0.56 | 0.56 | 0.55 | 0.54 | 0.54 | 0.53 | 0.53 | 0.54 | 0.55 | 0.55 | 0.56 | (24d) |

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m | 0.57 | 0.56 | 0.56 | 0.55 | 0.54 | 0.54 | 0.53 | 0.53 | 0.54 | 0.55 | 0.55 | 0.56 | (25) |

## 3. Heat losses and heat loss parameter

*The κ-value is the heat capacity per unit area, see Table 1e.*

| Element | Gross Area, m² | Openings, m² | Net area A, m² | | U-value, W/m²K | | A x U, W/K | κ-value, kJ/m².K | A x κ, kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Window* | | | 8.10 | x | 1.15 | = | 9.27 | N/A | N/A | (27) |
| External wall | | | 34.02 | x | 0.16 | = | 5.44 | N/A | N/A | (29a) |
| Party Wall | | | 29.07 | x | 0.00 | = | 0.00 | N/A | N/A | (32) |
| Total area of external elements ∑A, m² | | | 42.12 | (31) | | | | | | |

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 14.72 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 7.57 (36)

*if details of thermal bridging are not known then (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 22.29 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 25.36 | 25.03 | 25.03 | 24.42 | 24.05 | 23.89 | 23.72 | 23.72 | 24.14 | 24.42 | 24.71 | 25.03 | (38) |

Heat transfer coefficient, W/K (37)m + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m | 47.65 | 47.32 | 47.32 | 46.71 | 46.34 | 46.17 | 46.01 | 46.01 | 46.43 | 46.71 | 47.00 | 47.32 | |

Average = ∑(39)1...12/12 = 46.75 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m | 0.95 | 0.95 | 0.95 | 0.93 | 0.93 | 0.92 | 0.92 | 0.92 | 0.93 | 0.93 | 0.94 | 0.95 | |

Average = ∑(40)1...12/12 = 0.94 (40)

## 4. Water heating energy requirement

kWh/year

Assumed occupancy, N 1.69 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.34 (43)

*Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43) | | | | | | | | | | | | | |
| (44)m | 81.77 | 78.80 | 75.83 | 72.85 | 69.88 | 66.91 | 66.91 | 69.88 | 72.85 | 75.83 | 78.80 | 81.77 | |

∑(44)1...12 = 892.08 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m | 121.56 | 106.32 | 109.71 | 95.65 | 91.78 | 79.19 | 73.39 | 84.21 | 85.22 | 99.31 | 108.41 | 117.72 | |

∑(45)1...12 = 1172.45 (45)

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

*For community heating include distribution loss whether or not hot water tank is present*

Distribution loss 0.15 x (45)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m | 18.23 | 15.95 | 16.46 | 14.35 | 13.77 | 11.88 | 11.01 | 12.63 | 12.78 | 14.90 | 16.26 | 17.66 | (46) |

Water storage loss:

b) If manufacturer's declared cylinder loss factor is not known:

| | | |
|---|---|---|
| Cylinder volume (litres) including any solar storage within same cylinder | 50.00 | (50) |
| *If community heating and no tank in dwelling, enter 110 litres in box (50)* | | |
| *Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)* | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.04 | (51) |
| *If community heating see SAP 2009 section 4.3* | | |
| Volume factor from Table 2a | 1.34 | (52) |
| Temperature factor from Table 2b | 0.70 | (53) |
| Energy lost from water storage, kWh/day (50) x (51) x (52) x (53) | 1.76 | (54) |
| Enter (49) or (54) in (55) | 1.76 | (55) |

Water storage loss calculated for each month = (55) x (41)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m | 54.57 | 49.29 | 54.57 | 52.81 | 54.57 | 52.81 | 54.57 | 54.57 | 52.81 | 54.57 | 52.81 | 54.57 | (56) |

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m | 54.57 | 49.29 | 54.57 | 52.81 | 54.57 | 52.81 | 54.57 | 54.57 | 52.81 | 54.57 | 52.81 | 54.57 | (57) |

Primary circuit loss (annual) from Table 3: 0.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (59) |

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m | 5.21 | 4.53 | 4.83 | 4.49 | 4.45 | 4.12 | 4.26 | 4.45 | 4.49 | 4.83 | 4.86 | 5.21 | (61) |

Total heat required for water heating calculated for each month 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m | 181.34 | 160.14 | 169.11 | 152.95 | 150.80 | 136.13 | 132.22 | 143.23 | 142.52 | 158.71 | 166.08 | 177.50 | (62) |

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |

∑(63)1...12 = 0.00 (63)

Output from water heater for each month, kWh/month (62)m + (63)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m | 181.34 | 160.14 | 169.11 | 152.95 | 150.80 | 136.13 | 132.22 | 143.23 | 142.52 | 158.71 | 166.08 | 177.50 | |

∑(64)1...12 = 1870.73 (64)

*if (64)m < 0 then set to 0*

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m | 85.38 | 75.92 | 81.34 | 75.17 | 75.29 | 69.61 | 69.12 | 72.77 | 71.71 | 77.89 | 79.51 | 84.10 | (65) |

*include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating*

## 5. Internal gains (see Table 5 and 5a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metabolic gains (Table 5), Watts | | | | | | | | | | | | | |
| (66)m | 101.41 | 101.41 | 101.41 | 101.41 | 101.41 | 101.41 | 101.41 | 101.41 | 101.41 | 101.41 | 101.41 | 101.41 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| (67)m | 33.14 | 29.43 | 23.94 | 18.12 | 13.55 | 11.44 | 12.36 | 16.06 | 21.56 | 27.37 | 31.95 | 34.06 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| (68)m | 219.75 | 222.03 | 216.29 | 204.05 | 188.61 | 174.10 | 164.40 | 162.12 | 167.87 | 180.10 | 195.54 | 210.06 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| (69)m | 46.83 | 46.83 | 46.83 | 46.83 | 46.83 | 46.83 | 46.83 | 46.83 | 46.83 | 46.83 | 46.83 | 46.83 | (69) |
| Pumps and fans gains (Table 5a) | | | | | | | | | | | | | |
| (70)m | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| (71)m | -67.60 | -67.60 | -67.60 | -67.60 | -67.60 | -67.60 | -67.60 | -67.60 | -67.60 | -67.60 | -67.60 | -67.60 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| (72)m | 114.75 | 112.97 | 109.33 | 104.41 | 101.19 | 96.68 | 92.91 | 97.81 | 99.59 | 104.69 | 110.43 | 113.04 | (72) |

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m | 458.28 | 455.07 | 440.19 | 417.21 | 393.98 | 372.85 | 360.30 | 366.62 | 379.65 | 402.79 | 428.55 | 447.79 | (73) |

## 6. Solar gains

*Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.*

*Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.*

*Details for month of January and annual totals are shown below:*

| | Access factor Table 6d | | Area m² | | Solar flux W/m² | | g Specific data or Table 6b | | FF Specific data or Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | 1.00 | x | 8.10 | x | 37.39 | x 0.9 x | 0.63 | x | 0.70 | = | 120.20 | (77) |

Solar gains in watts, calculated for each month ∑(74)m...(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m | 120.20 | 204.90 | 270.74 | 332.71 | 364.36 | 369.85 | 362.61 | 338.66 | 298.65 | 232.64 | 144.11 | 102.71 | (83) |

Total gains - internal and solar (73)m + (83)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m | 578.47 | 659.97 | 710.93 | 749.92 | 758.34 | 742.70 | 722.91 | 705.28 | 678.30 | 635.43 | 572.66 | 550.50 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains for living area, η1,m (see Table 9a) | | | | | | | | | | | | | |
| (86)m | 0.85 | 0.80 | 0.73 | 0.64 | 0.52 | 0.38 | 0.26 | 0.26 | 0.43 | 0.63 | 0.80 | 0.85 | (86) |
| Mean internal temp of living area T1 (steps 3 to 7 in Table 9c) | | | | | | | | | | | | | |
| (87)m | 19.86 | 20.11 | 20.40 | 20.64 | 20.85 | 20.96 | 20.99 | 20.99 | 20.93 | 20.71 | 20.22 | 19.88 | (87) |
| Temperature during heating periods in the living area from Table 9, Th2(˚C) | | | | | | | | | | | | | |
| (88)m | 20.12 | 20.13 | 20.13 | 20.14 | 20.15 | 20.15 | 20.15 | 20.15 | 20.14 | 20.14 | 20.14 | 20.13 | (88) |
| Utilisation factor for gains for rest of dwelling η2,m (see Table 9a) | | | | | | | | | | | | | |
| (89)m | 0.83 | 0.78 | 0.70 | 0.61 | 0.48 | 0.34 | 0.21 | 0.21 | 0.38 | 0.60 | 0.78 | 0.84 | (89) |
| Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) | | | | | | | | | | | | | |
| (90)m | 19.11 | 19.35 | 19.62 | 19.85 | 20.04 | 20.12 | 20.15 | 20.15 | 20.10 | 19.92 | 19.47 | 19.13 | (90) |

Living area fraction fLA 24.00 ÷ (4) = 0.48 (91)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2 | | | | | | | | | | | | | |
| (92)m | 19.47 | 19.71 | 20.00 | 20.23 | 20.43 | 20.52 | 20.55 | 20.55 | 20.50 | 20.30 | 19.83 | 19.49 | (92) |
| Apply adjustment to the mean internal temperature from Table 4e, where appropriate | | | | | | | | | | | | | |
| (93)m | 19.47 | 19.71 | 20.00 | 20.23 | 20.43 | 20.52 | 20.55 | 20.55 | 20.50 | 20.30 | 19.83 | 19.49 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a) | | | | | | | | | | | | | |
| Utilisation factor for gains, ηm | | | | | | | | | | | | | |
| (94)m | 0.82 | 0.77 | 0.70 | 0.62 | 0.49 | 0.36 | 0.23 | 0.24 | 0.41 | 0.60 | 0.77 | 0.82 | (94) |
| Useful gains, ηmGm, W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m | 473.57 | 506.12 | 495.46 | 461.32 | 373.30 | 264.72 | 166.46 | 166.33 | 274.79 | 383.43 | 439.30 | 453.99 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m | 4.50 | 5.00 | 6.80 | 8.70 | 11.70 | 14.60 | 16.90 | 16.90 | 14.30 | 10.80 | 7.00 | 4.90 | (96) |
| Heat loss rate for mean internal temperature, Lm, W | | | | | | | | | | | | | |
| (97)m | 713.55 | 696.22 | 624.37 | 538.51 | 404.51 | 273.45 | 168.05 | 168.03 | 287.96 | 443.75 | 603.08 | 690.35 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m | 178.55 | 127.75 | 95.91 | 55.57 | 23.22 | 0.00 | 0.00 | 0.00 | 0.00 | 44.87 | 117.92 | 175.85 | |

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 819.64 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 16.39 (99)

## 9a. Energy Requirements - Individual heating systems including micro-CHP

**Space heating:**

| | | |
|---|---|---|
| Fraction of space heating from secondary/supplementary system (Table 11) | 0.00 | (201) |
| Fraction of space heating from main system(s) 1 - (201) | 1.00 | (202) |
| Fraction of main heating from main system 2 | 0.00 | (203) |
| Fraction of total space heat from main system 1 (202) x [1 - (203)] | 1.00 | (204) |
| Fraction of total space heat from main system 2 (202) x (203) | 0.00 | (205) |
| Efficiency of main space heating system 1 (%) | 90.80 | (206) |

*(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement, kWh/month (as calculated above) | | | | | | | | | | | | |
| (98)m | 178.55 | 127.75 | 95.91 | 55.57 | 23.22 | 0.00 | 0.00 | 0.00 | 0.00 | 44.87 | 117.92 | 175.85 |
| Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206) | | | | | | | | | | | | |
| (211)m | 196.64 | 140.69 | 105.62 | 61.20 | 25.58 | 0.00 | 0.00 | 0.00 | 0.00 | 49.42 | 129.87 | 193.67 |

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 902.69 (211)

**Water heating:**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater, kWh/month (calculated above) | | | | | | | | | | | | |
| (64)m | 181.34 | 160.14 | 169.11 | 152.95 | 150.80 | 136.13 | 132.22 | 143.23 | 142.52 | 158.71 | 166.08 | 177.50 |

∑(64)1...12 = 1870.73 (64)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Efficiency of water heater per month | | | | | | | | | | | | |
| (217)m | 85.97 | 85.50 | 84.77 | 83.94 | 82.81 | 81.70 | 81.70 | 81.70 | 81.70 | 83.55 | 85.25 | 85.99 |
| Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m | | | | | | | | | | | | |
| (219)m | 210.92 | 187.29 | 199.48 | 182.21 | 182.11 | 166.62 | 161.83 | 175.32 | 174.44 | 189.97 | 194.82 | 206.43 |

Total per year (kWh/year) = ∑(219)1...12 = 2231.44 (219)

| **Annual Totals Summary:** | **kWh/year** | **kWh/year** | |
|---|---|---|---|
| **Space heating fuel used, main system 1** | | 902.69 | (211) |
| **Water heating fuel used** | | 2231.44 | (219) |
| **Electricity for pumps, fans and electric keep-hot (Table 4f):** | | | |
| mechanical ventilation fans - balanced, extract or positive input from outside | 0.00 | | (230a) |
| warm air heating system fans | 0.00 | | (230b) |
| central heating pump | 130.00 | | (230c) |
| oil boiler pump | 0.00 | | (230d) |
| boiler flue fan | 45.00 | | (230e) |
| maintaining electric keep-hot facility for gas combi boiler | 0.00 | | (230f) |
| pump for solar water heating | 0.00 | | (230g) |
| Total electricity for the above | ∑(230a)...(230g) | 175.00 | (231) |
| **Electricity for lighting (calculated in Appendix L):** | | 234.08 | (232) |
| **Energy saving/generation technologies (Appendices M, N and Q):** | | | |
| Electricity generated by PVs (Appendix M) (negative quantity) | | -2309.44 | (233) |

## 10a. Fuel costs - Individual heating systems including micro-CHP

| | **Fuel kWh/year** | | **Fuel price (Table 12)** | | **Fuel cost £/year** | |
|---|---|---|---|---|---|---|
| Space heating - main system 1 | 902.69 | x | 3.10 | x 0.01 = | 27.98 | (240) |
| Water heating cost (other fuel) | 2231.44 | x | 3.10 | x 0.01 = | 69.17 | (247) |
| Pumps, fans and electric keep-hot | 175.00 | x | 11.46 | x 0.01 = | 20.06 | (249) |
| Energy for lighting | 234.08 | x | 11.46 | x 0.01 = | 26.83 | (250) |
| Additional standing charges (Table 12) | | | | | 106.00 | (251) |
| **Energy saving/generation technologies (Appendices M, N and Q):** | | | | | | |
| PV savings (negative quantity) | -2309.44 | x | 11.46 | x 0.01 = | -264.66 | (252) |

| | | | |
|---|---|---|---|
| Total energy cost | (240)...(242) + (245)...(254) | -14.62 | (255) |

## 11a. SAP rating - Individual heating systems including micro-CHP

| | | | |
|---|---|---|---|
| Energy cost deflator (Table 12) | | 0.47 | (256) |
| Energy cost factor (ECF) | [(255) x (256)] ÷ [(4) + 45.0] = | -0.07 | (257) |
| SAP value | | 101.01 | |
| SAP rating | | 101 | (258) |
| SAP band | | A | |

## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | | Emissions Factor | | Emissions (kgCO2/year) | |
|---|---|---|---|---|---|---|
| Space heating - main system 1 | 902.69 | x | 0.198 | = | 178.73 | (261) |
| Water heating | 2231.44 | x | 0.198 | = | 441.83 | (264) |
| Space and water heating | | | (261) + (262) + (263) + (264) = | | 620.56 | (265) |
| Pumps, fans and electric keep-hot | 175.00 | x | 0.517 | = | 90.48 | (267) |
| Lighting | 234.08 | x | 0.517 | = | 121.02 | (268) |
| **Energy saving/generation technologies:** | | | | | | |
| PV emission savings (negative quantity) | -2309.44 | x | 0.529 | = | -1221.69 | (269) |
| Total carbon dioxide emissions | | | ∑(261)...(271) = | | -389.64 | (272) |
| Dwelling carbon dioxide emissions rate | | | (272) ÷ (4) = | | -7.79 | (273) |
| EI value | | | | | 105.50 | |
| EI rating (see section 14) | | | | | 105 | (274) |
| EI band | | | | | A | |

## 13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | | Primary Energy Factor | | Primary Energy | |
|---|---|---|---|---|---|---|
| Space heating - main system 1 | 902.69 | x | 1.02 | = | 920.74 | (261*) |
| Water heating | 2231.44 | x | 1.02 | = | 2276.07 | (264*) |
| Space and water heating | | | (261*) + (262*) + (263*) + (264*) = | | 3196.81 | (265*) |
| Pumps, fans and electric keep-hot | 175.00 | x | 2.92 | = | 511.00 | (267*) |
| Lighting | 234.08 | x | 2.92 | = | 683.51 | (268*) |
| **Energy saving/generation technologies:** | | | | | | |
| PV primary energy savings (negative quantity) | -2309.44 | x | 2.92 | = | -6743.56 | (269*) |
| Total primary energy kWh/year | | | ∑(261*)...(271*) = | | -2352.24 | (272*) |
| Primary energy kWh/m2/year | | | (272*) ÷ (4) = | | -47.04 | (273*) |

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