

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.

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Client		Last modified	23/05/2019
Address	B5-B-02-08 West Cromwell Road, Kensington, London, W14 8		

### 1. Overall dwelling dimensions

	Area (m <sup>2</sup> )		Average storey height (m)		Volume (m <sup>3</sup> )
Lowest occupied	<input type="text" value="57.00"/> (1a)	x	<input type="text" value="2.55"/> (2a)	=	<input type="text" value="145.35"/> (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = <input type="text" value="57.00"/> (4)				
Dwelling volume	(3a) + (3b) + (3c) + (3d)...(3n) = <input type="text" value="145.35"/> (5)				

### 2. Ventilation rate

			m <sup>3</sup> per hour
Number of chimneys	<input type="text" value="0"/>	x 40 =	<input type="text" value="0"/> (6a)
Number of open flues	<input type="text" value="0"/>	x 20 =	<input type="text" value="0"/> (6b)
Number of intermittent fans	<input type="text" value="2"/>	x 10 =	<input type="text" value="20"/> (7a)
Number of passive vents	<input type="text" value="0"/>	x 10 =	<input type="text" value="0"/> (7b)
Number of flueless gas fires	<input type="text" value="0"/>	x 40 =	<input type="text" value="0"/> (7c)

			Air changes per hour
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = <input type="text" value="20"/>	÷ (5) =	<input type="text" value="0.14"/> (8)

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

Air permeability value, q <sub>50</sub> , expressed in cubic metres per hour per square metre of envelope area	<input type="text" value="5.00"/> (17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	<input type="text" value="0.39"/> (18)
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Number of sides on which the dwelling is sheltered	<input type="text" value="3"/> (19)
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Shelter factor	1 - [0.075 x (19)] = <input type="text" value="0.78"/> (20)
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Infiltration rate incorporating shelter factor	(18) x (20) = <input type="text" value="0.30"/> (21)
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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 U2	<input type="text" value="5.10"/>	<input type="text" value="5.00"/>	<input type="text" value="4.90"/>	<input type="text" value="4.40"/>	<input type="text" value="4.30"/>	<input type="text" value="3.80"/>	<input type="text" value="3.80"/>	<input type="text" value="3.70"/>	<input type="text" value="4.00"/>	<input type="text" value="4.30"/>	<input type="text" value="4.50"/>	<input type="text" value="4.70"/> (22)

Wind factor (22)m ÷ 4	<input type="text" value="1.28"/>	<input type="text" value="1.25"/>	<input type="text" value="1.23"/>	<input type="text" value="1.10"/>	<input type="text" value="1.08"/>	<input type="text" value="0.95"/>	<input type="text" value="0.95"/>	<input type="text" value="0.93"/>	<input type="text" value="1.00"/>	<input type="text" value="1.08"/>	<input type="text" value="1.13"/>	<input type="text" value="1.18"/> (22a)
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	<input type="text" value="0.38"/>	<input type="text" value="0.38"/>	<input type="text" value="0.37"/>	<input type="text" value="0.33"/>	<input type="text" value="0.32"/>	<input type="text" value="0.29"/>	<input type="text" value="0.29"/>	<input type="text" value="0.28"/>	<input type="text" value="0.30"/>	<input type="text" value="0.32"/>	<input type="text" value="0.34"/>	<input type="text" value="0.35"/> (22b)
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	<input type="text" value="N/A"/> (23a)
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If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	<input type="text" value="N/A"/> (23c)
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d) natural ventilation or whole house positive input ventilation from loft

<input type="text" value="0.57"/>	<input type="text" value="0.57"/>	<input type="text" value="0.57"/>	<input type="text" value="0.55"/>	<input type="text" value="0.55"/>	<input type="text" value="0.54"/>	<input type="text" value="0.54"/>	<input type="text" value="0.54"/>	<input type="text" value="0.55"/>	<input type="text" value="0.55"/>	<input type="text" value="0.56"/>	<input type="text" value="0.56"/> (24d)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

<input type="text" value="0.57"/>	<input type="text" value="0.57"/>	<input type="text" value="0.57"/>	<input type="text" value="0.55"/>	<input type="text" value="0.55"/>	<input type="text" value="0.54"/>	<input type="text" value="0.54"/>	<input type="text" value="0.54"/>	<input type="text" value="0.55"/>	<input type="text" value="0.55"/>	<input type="text" value="0.56"/>	<input type="text" value="0.56"/> (25)
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### 3. Heat losses and heat loss parameter

Element	Gross area, m <sup>2</sup>	Openings m <sup>2</sup>	Net area A, m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	κ-value, kJ/m <sup>2</sup> .K	A x κ, kJ/K						
Window			11.64	x 1.33	= 15.43		(27)						
Door			1.89	x 1.00	= 1.89		(26)						
Ground floor			57.00	x 0.13	= 7.41		(28a)						
External wall			26.63	x 0.18	= 4.79		(29a)						
Party wall			39.64	x 0.00	= 0.00		(32)						
Total area of external elements ΣA, m <sup>2</sup>			97.16				(31)						
Fabric heat loss, W/K = Σ(A x U)						(26)...(30) + (32) =	29.53 (33)						
Heat capacity Cm = Σ(A x κ)						(28)...(30) + (32) + (32a)...(32e) =	N/A (34)						
Thermal mass parameter (TMP) in kJ/m <sup>2</sup> K							250.00 (35)						
Thermal bridges: Σ(L x Ψ) calculated using Appendix K							4.86 (36)						
Total fabric heat loss						(33) + (36) =	34.38 (37)						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	27.50	27.36	27.23	26.60	26.48	25.94	25.94	25.83	26.15	26.48	26.72	26.97	(38)
Heat transfer coefficient, W/K (37)m + (38)m	61.88	61.75	61.61	60.98	60.87	60.32	60.32	60.22	60.53	60.87	61.10	61.35	
	Average = Σ(39)1...12/12 =										60.98	(39)	
Heat loss parameter (HLP), W/m <sup>2</sup> K (39)m ÷ (4)	1.09	1.08	1.08	1.07	1.07	1.06	1.06	1.06	1.06	1.07	1.07	1.08	
	Average = Σ(40)1...12/12 =										1.07	(40)	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

### 4. Water heating energy requirement

Assumed occupancy, N

1.90

(42)

Annual average hot water usage in litres per day  $V_{d,average} = (25 \times N) + 36$

79.22

(43)

JanFebMarAprMayJunJulAugSepOctNovDec

Hot water usage in litres per day for each month  $V_{d,m} = \text{factor from Table 1c} \times (43)$

87.1483.9880.8177.6474.4771.3071.3074.4777.6480.8183.9887.14

$\Sigma(44)1...12 =$

950.67

(44)

Energy content of hot water used =  $4.18 \times V_{d,m} \times n_m \times T_m / 3600$  kWh/month (see Tables 1b, 1c 1d)

129.23113.03116.63101.6897.5784.1978.0289.5390.60105.58115.25125.15

$\Sigma(45)1...12 =$

1246.47

(45)

Distribution loss  $0.15 \times (45)m$

19.3816.9517.5015.2514.6412.6311.7013.4313.5915.8417.2918.77

(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel

4.00

(47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day)

0.28

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage (kWh/day)  $(48) \times (49)$

0.15

(50)

Enter (50) or (54) in (55)

0.15

(55)

Water storage loss calculated for each month  $(55) \times (41)m$

4.674.224.674.524.674.524.674.674.524.674.524.67

(56)

If the vessel contains dedicated solar storage or dedicated WWHRS  $(56)m \times [(47) - V_s] \div (47)$ , else (56)

4.674.224.674.524.674.524.674.674.524.674.524.67

(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
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(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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(61)

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

157.17	138.26	144.57	128.72	125.51	111.23	105.96	117.46	117.63	133.52	142.29	153.09
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(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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(63)

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

157.17	138.26	144.57	128.72	125.51	111.23	105.96	117.46	117.63	133.52	142.29	153.09
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$\Sigma(64)1...12 =$  1575.41

(64)

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

65.32	57.77	61.13	55.44	54.79	49.62	48.29	52.12	51.75	57.46	59.95	63.96
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(65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Metabolic gains (Table 5)

94.78	94.78	94.78	94.78	94.78	94.78	94.78	94.78	94.78	94.78	94.78	94.78
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(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

14.81	13.16	10.70	8.10	6.05	5.11	5.52	7.18	9.64	12.24	14.28	15.22
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(67)

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

165.32	167.04	162.72	153.51	141.89	130.98	123.68	121.97	126.29	135.49	147.11	158.03
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(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

32.48	32.48	32.48	32.48	32.48	32.48	32.48	32.48	32.48	32.48	32.48	32.48
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(69)

Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
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(70)

Losses e.g. evaporation (Table 5)

-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83	-75.83
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(71)

Water heating gains (Table 5)

87.79	85.96	82.16	77.00	73.64	68.92	64.91	70.05	71.88	77.22	83.26	85.97
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(72)

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

322.36	320.59	310.01	293.05	276.03	259.44	248.55	253.63	262.24	279.39	299.09	313.66
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(73)

6. Solar gains

	Access factor Table 6d	Area m <sup>2</sup>	Solar flux W/m <sup>2</sup>	g specific data or Table 6b	FF specific data or Table 6c	Gains W
NorthEast	0.77	9.05	11.28	0.63	0.70	31.21
SouthEast	0.77	2.59	36.79	0.63	0.70	29.12

(75)

(77)

Solar gains in watts  $\Sigma(74)m...(82)m$

60.33	113.13	182.32	272.05	346.85	362.87	342.13	283.50	212.95	132.46	74.15	50.41
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(83)

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

382.69	433.72	492.34	565.10	622.87	622.31	590.68	537.13	475.19	411.84	373.24	364.07
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(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
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Utilisation factor for gains for living area n1,m (see Table 9a)

1.00	0.99	0.98	0.93	0.80	0.60	0.45	0.51	0.78	0.96	0.99	1.00
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(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.91	20.06	20.31	20.65	20.89	20.98	21.00	20.99	20.92	20.60	20.20	19.89	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

20.01	20.01	20.02	20.03	20.03	20.04	20.04	20.04	20.03	20.03	20.02	20.02	(88)
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Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.97	0.91	0.74	0.52	0.35	0.41	0.71	0.95	0.99	1.00	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.57	18.78	19.15	19.62	19.92	20.02	20.03	20.03	19.97	19.58	19.00	18.53	(90)
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Living area fraction

Living area ÷ (4) = 0.52 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.27	19.45	19.76	20.15	20.42	20.52	20.54	20.53	20.47	20.11	19.62	19.24	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.27	19.45	19.76	20.15	20.42	20.52	20.54	20.53	20.47	20.11	19.62	19.24	(93)
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## 8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, ηm

0.99	0.99	0.97	0.91	0.77	0.56	0.40	0.46	0.74	0.95	0.99	1.00	(94)
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Useful gains, ηmGm, W (94)m x (84)m

380.55	428.85	478.27	515.02	478.47	349.28	236.35	246.81	353.30	390.00	368.99	362.47	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

926.37	898.39	816.90	686.38	531.03	357.21	237.41	248.96	385.56	578.94	765.23	922.65	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

406.09	315.53	251.94	123.38	39.10	0.00	0.00	0.00	0.00	140.57	285.29	416.77	
										Σ(98)1...5, 10...12 =	1978.67	(98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 34.71 (99)

## 9a. Energy requirements - individual heating systems including micro-CHP

### Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00 (201)

Fraction of space heat from main system(s)

1 - (201) = 1.00 (202)

Fraction of space heat from main system 2

0.00 (202)

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 system 1 (%)

93.50 (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Space heating fuel (main system 1), kWh/month

434.32	337.46	269.45	131.95	41.82	0.00	0.00	0.00	0.00	150.34	305.13	445.75	
										Σ(211)1...5, 10...12 =	2116.22	(211)

### Water heating

Efficiency of water heater

87.24	86.95	86.28	84.70	82.11	79.80	79.80	79.80	79.80	84.95	86.63	87.35	(217)
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Water heating fuel, kWh/month

180.17	159.02	167.56	151.97	152.86	139.39	132.78	147.20	147.41	157.17	164.24	175.26	
										Σ(219a)1...12 =	1875.00	(219)

### Annual totals

Space heating fuel - main system 1		2116.22	
Water heating fuel		1875.00	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		261.59	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4327.81	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2116.22	x	3.48	x 0.01 =	73.64	(240)
Water heating	1875.00	x	3.48	x 0.01 =	65.25	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	261.59	x	13.19	x 0.01 =	34.50	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		303.29	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.25	(257)
SAP value	82.58	
SAP rating (section 13)	83	(258)
SAP band	B	

#### 12a. CO<sub>2</sub> emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO <sub>2</sub> /kWh		Emissions kg CO <sub>2</sub> /year	
Space heating - main system 1	2116.22	x	0.216	=	457.10	(261)
Water heating	1875.00	x	0.216	=	405.00	(264)
Space and water heating			(261) + (262) + (263) + (264) =		862.10	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	261.59	x	0.519	=	135.77	(268)
Total CO <sub>2</sub> , kg/year			(265)...(271) =		1036.79	(272)
Dwelling CO <sub>2</sub> emission rate			(272) ÷ (4) =		18.19	(273)
EI value					86.38	
EI rating (section 14)					86	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2116.22	x	1.22	=	2581.79	(261)
Water heating	1875.00	x	1.22	=	2287.50	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4869.29	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	261.59	x	3.07	=	803.08	(268)
Primary energy kWh/year					5902.63	(272)
Dwelling primary energy rate kWh/m <sup>2</sup> /year					103.55	(273)