

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 Adrian Fell	Assessor number	3536
Client		Last modified	23/05/2019
Address	B2-A-03-03 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="77.00"/> (1a)	x	<input type="text" value="2.55"/> (2a)	=	<input type="text" value="196.35"/> (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = <input type="text" value="77.00"/> (4)				
Dwelling volume	(3a) + (3b) + (3c) + (3d)...(3n) = <input type="text" value="196.35"/> (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="3"/>	x 10 =	<input type="text" value="30"/> (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="30"/>	÷ (5) =	<input type="text" value="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, 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="0.40"/> (18)
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Number of sides on which the dwelling is sheltered	<input type="text" value="2"/> (19)
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Shelter factor	1 - [0.075 x (19)] = <input type="text" value="0.85"/> (20)
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Infiltration rate incorporating shelter factor	(18) x (20) = <input type="text" value="0.34"/> (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="0.44"/>	<input type="text" value="0.43"/>	<input type="text" value="0.42"/>	<input type="text" value="0.38"/>	<input type="text" value="0.37"/>	<input type="text" value="0.33"/>	<input type="text" value="0.33"/>	<input type="text" value="0.32"/>	<input type="text" value="0.34"/>	<input type="text" value="0.37"/>	<input type="text" value="0.39"/>	<input type="text" value="0.40"/> (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="0.60"/>	<input type="text" value="0.59"/>	<input type="text" value="0.59"/>	<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="0.55"/>	<input type="text" value="0.56"/>	<input type="text" value="0.57"/>	<input type="text" value="0.57"/>	<input type="text" value="0.58"/> (24d)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

<input type="text" value="0.60"/>	<input type="text" value="0.59"/>	<input type="text" value="0.59"/>	<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="0.55"/>	<input type="text" value="0.56"/>	<input type="text" value="0.57"/>	<input type="text" value="0.57"/>	<input type="text" value="0.58"/> (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			19.25	x 1.33	= 25.52		(27)						
Exposed floor			77.00	x 0.13	= 10.01		(28b)						
External wall			38.58	x 0.18	= 6.94		(29a)						
Party wall			44.50	x 0.00	= 0.00		(32)						
Total area of external elements ΣA, m <sup>2</sup>			134.83				(31)						
Fabric heat loss, W/K = Σ(A × U)					(26)...(30) + (32) =	42.48	(33)						
Heat capacity Cm = Σ(A × 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 × Ψ) calculated using Appendix K						6.74	(36)						
Total fabric heat loss					(33) + (36) =	49.22	(37)						
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 × (25)m × (5)	38.57	38.33	38.10	36.99	36.79	35.83	35.83	35.65	36.20	36.79	37.20	37.64	(38)
Heat transfer coefficient, W/K (37)m + (38)m	87.79	87.55	87.31	86.21	86.00	85.04	85.04	84.86	85.41	86.00	86.42	86.86	
	Average = Σ(39)1...12/12 =											86.21	(39)
Heat loss parameter (HLP), W/m <sup>2</sup> K (39)m ÷ (4)	1.14	1.14	1.13	1.12	1.12	1.10	1.10	1.10	1.11	1.12	1.12	1.13	
	Average = Σ(40)1...12/12 =											1.12	(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											2.40	(42)	
Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$											91.28	(43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$													
	100.41	96.76	93.11	89.46	85.81	82.15	82.15	85.81	89.46	93.11	96.76	100.41	
											$\sum(44)1...12 =$	1095.39	(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)													
	148.91	130.23	134.39	117.16	112.42	97.01	89.90	103.16	104.39	121.65	132.80	144.21	
											$\sum(45)1...12 =$	1436.23	(45)
Distribution loss $0.15 \times (45)m$													
	22.34	19.54	20.16	17.57	16.86	14.55	13.48	15.47	15.66	18.25	19.92	21.63	(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 $(55) \times (41)m$													
	4.67	4.22	4.67	4.52	4.67	4.52	4.67	4.67	4.52	4.67	4.52	4.67	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS $(56)m \times [(47) - V_s] \div (47)$ , else (56)													
	4.67	4.22	4.67	4.52	4.67	4.52	4.67	4.67	4.52	4.67	4.52	4.67	(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	(59)
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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	(61)
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Total heat required for water heating calculated for each month  $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

176.84	155.47	162.33	144.20	140.36	124.05	117.83	131.09	131.42	149.59	159.83	172.14	(62)
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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	(63)
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Output from water heater for each month (kWh/month)  $(62)m + (63)m$

176.84	155.47	162.33	144.20	140.36	124.05	117.83	131.09	131.42	149.59	159.83	172.14	
$\Sigma(64)1...12 =$											1765.16	(64)

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

71.86	63.49	67.03	60.59	59.73	53.88	52.24	56.65	56.34	62.80	65.78	70.30	(65)
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## 5. Internal gains

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

120.17	120.17	120.17	120.17	120.17	120.17	120.17	120.17	120.17	120.17	120.17	120.17	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

18.99	16.87	13.72	10.39	7.76	6.55	7.08	9.21	12.36	15.69	18.31	19.52	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

213.06	215.27	209.70	197.84	182.86	168.79	159.39	157.18	162.75	174.61	189.58	203.66	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

35.02	35.02	35.02	35.02	35.02	35.02	35.02	35.02	35.02	35.02	35.02	35.02	(69)
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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	(70)
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Losses e.g. evaporation (Table 5)

-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	-96.14	(71)
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Water heating gains (Table 5)

96.59	94.48	90.10	84.15	80.28	74.84	70.21	76.14	78.25	84.41	91.37	94.49	(72)
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Total internal gains  $(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$

390.69	388.67	375.57	354.42	332.96	312.24	298.74	304.58	315.41	336.76	361.31	379.72	(73)
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## 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	x	11.00	x	11.28	x 0.9	0.63	x	0.70	=	37.93	(75)
NorthWest	0.77	x	8.25	x	11.28	x 0.9	0.63	x	0.70	=	28.45	(81)

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

66.38	135.11	243.43	399.79	537.39	572.92	535.95	427.27	296.63	165.12	83.52	54.21	(83)
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Total gains - internal and solar  $(73)m + (83)m$

457.07	523.78	619.00	754.21	870.36	885.16	834.69	731.85	612.04	501.88	444.84	433.93	(84)
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## 7. Mean internal temperature (heating season)

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

												21.00	(85)
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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	1.00	0.99	0.94	0.80	0.59	0.44	0.52	0.82	0.98	1.00	1.00	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.77	19.91	20.20	20.59	20.87	20.98	21.00	20.99	20.89	20.50	20.07	19.74	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.97	19.97	19.97	19.98	19.99	20.00	20.00	20.00	19.99	19.99	19.98	19.98	(88)
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Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.98	0.92	0.74	0.51	0.35	0.41	0.75	0.97	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)

18.32	18.54	18.95	19.51	19.87	19.98	20.00	20.00	19.91	19.41	18.78	18.30	(90)
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Living area fraction

Living area ÷ (4) = 0.65 (91)

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

19.26	19.43	19.76	20.21	20.52	20.63	20.64	20.64	20.55	20.12	19.61	19.23	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.26	19.43	19.76	20.21	20.52	20.63	20.64	20.64	20.55	20.12	19.61	19.23	(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

1.00	0.99	0.98	0.92	0.77	0.56	0.41	0.49	0.79	0.97	0.99	1.00	(94)
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Useful gains, ηmGm, W (94)m x (84)m

455.64	520.34	606.77	696.57	674.23	499.40	341.71	355.12	483.88	485.38	442.06	432.88	(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]

1312.87	1271.91	1157.57	974.88	758.35	512.48	343.73	359.72	550.52	818.37	1081.38	1305.59	(97)
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Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

637.78	505.05	409.80	200.38	62.59	0.00	0.00	0.00	0.00	247.75	460.31	649.30	
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Σ(98)1...5, 10...12 = 3172.96 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) 41.21 (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

682.12	540.16	438.28	214.31	66.94	0.00	0.00	0.00	0.00	264.97	492.31	694.44	
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Σ(211)1...5, 10...12 = 3393.54 (211)

### Water heating

Efficiency of water heater

87.94	87.73	87.18	85.69	82.82	79.80	79.80	79.80	79.80	86.15	87.48	88.03	(217)
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Water heating fuel, kWh/month

201.09	177.21	186.19	168.28	169.48	155.45	147.66	164.28	164.69	173.64	182.71	195.56	
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Σ(219a)1...12 = 2086.24 (219)

### Annual totals

Space heating fuel - main system 1

3393.54

Water heating fuel			2086.24	
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)			335.44	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =		5890.22	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3393.54	x	3.48	x 0.01 =	118.10	(240)
Water heating	2086.24	x	3.48	x 0.01 =	72.60	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	335.44	x	13.19	x 0.01 =	44.24	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		364.83	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.26	(257)
SAP value	82.48	
SAP rating (section 13)	82	(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	3393.54	x	0.216	=	733.00	(261)
Water heating	2086.24	x	0.216	=	450.63	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1183.63	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	335.44	x	0.519	=	174.09	(268)
Total CO <sub>2</sub> , kg/year			(265)...(271) =		1396.65	(272)
Dwelling CO <sub>2</sub> emission rate			(272) ÷ (4) =		18.14	(273)
EI value					84.66	
EI rating (section 14)					85	(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	3393.54	x	1.22	=	4140.11	(261)
Water heating	2086.24	x	1.22	=	2545.21	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6685.32	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	335.44	x	3.07	=	1029.81	(268)
Primary energy kWh/year					7945.38	(272)
Dwelling primary energy rate kWh/m <sup>2</sup> /year					103.19	(273)