Ashmount Consulting Engineers Limited

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Site: Joule Street, Blackley, Manchester | **Made by DJW**
Job: End Terrace House | **Page 1**
Client: | **Client copy**

Building Summary: Dwelling as designed

Applicable document: England & Wales L1 AD 2006 edition provisions

		Orient	Area m² Gross	Area m² Open	U-value	Total heat loss W/K
Wall	1: Front Walls	F	26.10	6.20	0.24	14.20
	2: Back Walls	B	27.90	5.60	0.24	13.28
	3: Right Walls	R	3.10	0.00	0.24	0.74
	4: Left Walls	L	55.10	0.00	0.24	13.22
	5: Wall to Loft above GF Toilet (sx)		1.80	0.00	0.22	0.40
Floor	1: Ground	N/A	38.50	0.00	0.16	6.16
Roof	1: Sloped Ceiling Pitched Roof		33.00	2.60	0.11	7.25
	2: Flat Ceiling Pitched Roof		13.50	0.00	0.11	1.49
						Total: 56.75

Breakdown by element type:		Area		
Wall	User-entered U-value	100.40	0.24	24.10
Wall	User-entered U-value	1.80	0.22	0.40
Floor	User-entered U-value	38.50	0.16	6.16
Roof	User-entered U-value	43.90	0.11	4.83
Rooflight	Enter manufacturer's details/ref here	2.60	1.50	3.90
Window	Enter manufacturer's details/ref here	10.10	1.42	14.34
Door	DG PVC frame 16mm gap low-E glass (en=0.05)	1.70	1.80	3.06

Window U-values include curtain factor adjustment (SAP-2005 §3.2)

Average/maximum U-values: Walls: 0.24/0.25 OK; Floors: 0.16/0.16 OK
Roofs: 0.11/0.11 OK; Openings: 1.55/1.80 OK

Floor area: 108.50m² Living area fraction: 0.17 Internal volume: 257m³

Front faces: W

Storeys: 3 Chimneys: 0 Flues: 0 Fans: 3 Flueless gas heaters: 0 Sheltered sides: 2

Pressurisation test q_{50} design value = 5.00

Natural ventilation with intermittent extract fans

Low energy lighting: 50% of fixed lighting points (30% assumed for DER/TER calculations)

Primary heating system: Gas condensing boiler, automatic ignition, 1998 or later
Baxi Platinum 15 HE: Manufacturer's declared efficiency = 91.3%
Full zone control (delayed start stat+compensator)
Fuel: Mains Gas

Secondary heating system: None

Domestic hot water supply: Primary heating system
210 litre cylinder, 50mm factory-insulated
5.00m² solar panel

SAP 2005 Rating 86 Band B
EI Rating 87 Band B

Target Carbon Dioxide Emission Rate **TER: 20.29**
Dwelling Carbon Dioxide Emission Rate **DER: 14.93 PASS**

DER improvement over TER = 26%

Total CO_2 emissions = 1.51 tonnes/year

These calculations should not be accepted without first checking the input data

Important design features *(L1A Appendix B)*
One or more walls has a U-value of less than 0.28
One or more floors has a U-value of less than 0.20

One or more roofs has a U-value of less than 0.15
One or more doors/windows/rooflights has a U-value of less than 1.8 (1.50)
The design includes a 91.3% efficient Gas condensing boiler, automatic ignition, 1998 or later (Baxi Platinum 15 HE)
The design includes a 5.0m² solar panel
A q50 design value of less than 7.0 (5.0) has been used

SAP Worksheet (Version 9.80)

Calculation of Energy Rating: Dwelling as designed

Overall Dwelling Dimensions

	Area m^2	Avg ht m.	Vol. m^3	
Ground/entrance level:	38.50	2.50	96.25	[1]
First:	35.00	2.60	91.00	[2]
Second:	35.00	2.00	70.00	[3]
Total floor area:	108.50 [5]	Volume:	257.25	[6]

Ventilation Rate	ACH	
Fans and passive vents:	3 x 10/257.25 = 0.12	[9]
Infiltration due to chimneys, flues and fans:	0.12	[10]
Design q_{50} value = 5.00	5.00/20 = 0.25	
Infiltration rate:	0.37	[19]
2 sheltered sides: shelter factor = 0.85		[21]
Adjusted infiltration rate = 0.37 x 0.85	0.31	[22]
Natural ventilation:		
Effective air change rate	0.55	[24]
	0.55	[25]

Heat Loss Summary	W/K	
Heat loss through structure (b/f from building summary):	56.75	[33]
Thermal bridges 0.08 x 199.00:	15.92	[34]
Total fabric heat loss:	72.67	[35]
Ventilation heat loss:	0.55 [25] x 0.33 x 257.25 [6] = 46.57	[36]
Specific heat loss:	119.24	[37]
Heat loss parameter:	119.24/108.5 = 1.10	[38]

Water Heating Energy Requirements	kWh/year	
Source: Primary heating system (Gas condensing boiler, automatic ignition, 1998 or later)		
Fuel: Mains Gas		
Energy content of heated water (Table 1a N=3.350):	2207	[39]
Distribution loss (Table 1b):	389	[40]
Cylinder volume = 210 litres		[43]
Cylinder loss factor: 0.0152 (Table 2)		[44]
Volume factor: 0.8298 (Table 2a)		[44a]
Temperature factor: 0.54 (Table 2b)		[44b]
Energy lost from store:	210 x 0.0152 x 0.8298 x 0.54 x 365 = 0	[47]
Primary circuit loss :	360	[48]
Solar input (B/F from Solar gains worksheet):	-1063	[50]
Required output from water heater:	1893	[51]
Heat gains from water heating:	0.25 x 2207 + 0.8 x (389+360) = 1151	[52]

Gains	Watts	
Lighting, appliance & metabolic gains (Table 5 N=3.350):	616	[53]
Reduction due to low energy lighting (50%):	-40	[53a]
Central heating pump: 10.0		
Total additional gains	10	[53b]
Water heating:	1151/8.72 = 131	[54]
Total internal gains:	717	[55]
Total solar gains (B/F from solar-related report):	178	[65]
Total gains	895	[66]
Gains/Loss ratio (GLR) = 895/119.2 [37] = 7.505		[67]
Utilisation factor (Table 7): 0.91		[68]
Useful gains:	895 x 0.91 = 814	[69]

Mean internal temperature		°C	
Living area mean temperature: Table 8 col.1; HLP [38] = 1.10		18.88	[70]
Control adjustment (Table 4e)		-0.15	[71]
Heating system responsiveness (R) = 1.00 (Table 4d)			
Adjustment for gains:	0.2 x R x ((814 [69]/119.2 [37]) - 4.0) =	0.56	[72]
Adjusted living room temperature:		19.29	[73]
Temperature difference between zones : (Table 9 col 3)		1.78	[74]
Living area fraction: 0.17			[75]
Rest-of-house fraction: 0.83			[76]
Mean internal temperature:	19.29 - (1.78 x 0.83) =	17.81	[77]
Degree Days			
Temperature rise from gains:	814 [69]/119.2 [37] =	6.82	[78]
Base temperature:	17.81 - 6.82 =	10.98	[79]
Degree days (Table 10):		1137	[80]
Space heating requirements		kWh/year	
Energy requirement (useful):	0.024 x 1137 x 119.2 [37] =	3253	[81]
Primary system: Gas condensing boiler, automatic ignition, 1998 or later			
Controls: Full zone control			
Fuel: Mains Gas			
User-entered efficiency: 93.3%			[83]
Fuel required:	3253 x 100/93.3 =	3487	[85]
Secondary system: None			
Water heating energy requirement (net): 1893 kW [51]			
Source: Primary heating system			
Efficiency : 93.3% (Manufacturer's declared value)			[86]
Energy required:	1893 [51] x 100/93.3 =	2029	[86a]
Electricity for pumps & fans:		250	[87]
Electricity for lighting (B/F from Solar report)		804	
Fuel Costs		£/year	
Space heating: Primary system:	3487 x 1.63p =	56.84	[88]
Water heating:	2029 x 1.63p =	33.07	[91b]
Pump/fan energy cost:	250 x 7.12p =	17.80	[92]
Lighting energy cost:	804 x 7.12p =	57.21	[93]
Additional standing charges (Table 12): Gas		34.00	[94]
Total heating cost:		198.92	[97]
SAP Rating			
Energy cost deflator (Table 12, footnote 2):		0.91	[98]
Energy cost factor (ECF) £/m^2:	(198.92 x 0.91 - 30)/(108.50 + 45.0) =	0.98	[99]
SAP value = 86.2656			[100]
SAP Rating = 86 Band B			
CO_2 Emissions		kg/year	
Primary heating system (mains gas)	3487 [85] x 0.194 =	676	[101]
Water heating (mains gas)	2029 [86a] x 0.194 =	394	[103]
Total for space and water heating		1070	[107]
Electricity for pumps and fans	250 [87] x 0.422 =	106	[108]
Electricity for lighting, C_L	804 x 0.422 =	339	[109]
New technology: None:			
	Total:	1,515	[112]
Carbon Factor, CF = 1515/(108.50 + 45) = 9.87 EI = 87.00			
EI Rating = 87 Band B			

Primary energy	Energy	Primary	P.Energy

	kWh/Yr	Factor	kWh/yr	
Space heating	3487	1.15	4010	[101]
Secondary heating	0	1.15	0	[102]
Water heating	2029	1.15	2333	[103]
Electricity for pumps and fans	250	2.80	700	[108]
Electricity for lighting	804	2.80	2250	[109]
New Technology: Energy saved	0	0.00	0	[110]
New Technology: Energy used	0	0.00	0	[111]
Primary energy kWh/year			**9,293**	[112]
Primary energy kWh/year/m^2			**85.7**	[113]

SAP Worksheet (Version 9.80)

Dwelling Carbon Dioxide Emission Rate (DER) Calculation: Dwelling as designed

Overall Dwelling Dimensions

	Area m^2	Avg ht m.	Vol. m^3	
Ground/entrance level:	38.50	2.50	96.25	[1]
First:	35.00	2.60	91.00	[2]
Second:	35.00	2.00	70.00	[3]
Total floor area:	108.50 [5]	Volume:	257.25	[6]

Ventilation Rate	ACH	
Fans and passive vents:	3 x 10/257.25 = 0.12	[9]
Infiltration due to chimneys, flues and fans:	0.12	[10]
Design q_{50} value = 5.00	5.00/20 = 0.25	
Infiltration rate:	0.37	[19]
2 sheltered sides: shelter factor = 0.85		[21]
Adjusted infiltration rate = 0.37 x 0.85	0.31	[22]
Natural ventilation:		
Effective air change rate	0.55	[24]
	0.55	[25]

Heat Loss Summary	W/K	
Heat loss through structure (b/f from building summary):	56.75	[33]
Thermal bridges 0.08 x 199.00:	15.92	[34]
Total fabric heat loss:	72.67	[35]
Ventilation heat loss:	0.55 [25] x 0.33 x 257.25 [6] = 46.57	[36]
Specific heat loss:	119.24	[37]
Heat loss parameter:	119.24/108.5 = 1.10	[38]

Water Heating Energy Requirements	kWh/year	
Source: Primary heating system (Gas condensing boiler, automatic ignition, 1998 or later)		
Fuel: Mains Gas		
Energy content of heated water (Table 1a N=3.350):	2207	[39]
Distribution loss (Table 1b):	389	[40]
Cylinder volume = 210 litres		[43]
Cylinder loss factor: 0.0152 (Table 2)		[44]
Volume factor: 0.8298 (Table 2a)		[44a]
Temperature factor: 0.54 (Table 2b)		[44b]
Energy lost from store:	210 x 0.0152 x 0.8298 x 0.54 x 365 = 0	[47]
Primary circuit loss :	360	[48]
Solar input (B/F from Solar gains worksheet):	-1063	[50]
Required output from water heater:	1893	[51]
Heat gains from water heating:	0.25 x 2207 + 0.8 x (389+360) = 1151	[52]

Gains	Watts	
Lighting, appliance & metabolic gains (Table 5 N=3.350):	616	[53]
Reduction due to low energy lighting (30% assumed):	-24	[53a]
Central heating pump: 10.0		
Total additional gains	10	[53b]
Water heating:	1151/8.72 = 131	[54]
Total internal gains:	733	[55]
Total solar gains (B/F from solar-related report):	178	[65]
Total gains	911	[66]
Gains/Loss ratio (GLR) = 911/119.2 [37] = 7.640		[67]
Utilisation factor (Table 7): 0.91		[68]
Useful gains:	911 x 0.91 = 825	[69]

Mean internal temperature			°C	
Living area mean temperature: Table 8 col.1; HLP [38] = 1.10			18.88	[70]
Control adjustment (Table 4e)			-0.15	[71]
Heating system responsiveness (R) = 1.00 (Table 4d)				
Adjustment for gains:		0.2 x R x ((825 [69]/119.2 [37]) - 4.0) =	0.58	[72]
Adjusted living room temperature:			19.31	[73]
Temperature difference between zones : (Table 9 col 3)			1.78	[74]
Living area fraction:	0.17			[75]
Rest-of-house fraction:	0.83			[76]
Mean internal temperature:		19.31 - (1.78 x 0.83) =	17.83	[77]
Degree Days				
Temperature rise from gains:		825 [69]/119.2 [37] =	6.92	[78]
Base temperature:		17.83 - 6.92 =	10.91	[79]
Degree days (Table 10):			1123	[80]
Space heating requirements			kWh/year	
Energy requirement (useful):		0.024 x 1123 x 119.2 [37] =	3213	[81]
Heat from secondary system: 10% (Table 11)				[82]
Primary system:	Gas condensing boiler, automatic ignition, 1998 or later Controls: Full zone control Fuel: Mains Gas User-entered efficiency: 93.3%			[83]
	Fuel required:	3213 x 0.90 x 100/93.3 =	3100	[85]
Secondary system:	None (electric heaters assumed) Fuel: Electricity (standard tariff) Efficiency: 100% (Table 4a)			[84]
	Fuel required:	3213 x 0.10 x 100/100 =	321	[85a]
Water heating energy requirement (net): 1893 kW [51]				
Source: Primary heating system				
Efficiency : 93.3% (Manufacturer's declared value)				[86]
Energy required:		1893 [51] x 100/93.3 =	2029	[86a]
Electricity for pumps & fans:			250	[87]
Electricity for lighting (B/F from Solar report)			911	
CO_2 Emissions				kg/year
Primary heating system (mains gas)		3100 [85] x 0.194 =	601	[101]
Secondary heating system (electricity)		321 [85a] x 0.422 =	136	[102]
Water heating (mains gas)		2029 [86a] x 0.194 =	394	[103]
Total for space and water heating			1131	[107]
Electricity for pumps and fans		250 [87] x 0.422 =	106	[108]
Electricity for lighting, C_L		911 x 0.422 =	384	[109]
New technology: None:				
		Total:	1,620	[112]
Dwelling Carbon Dioxide Emission Rate (DER) = 14.93			(1,620/108.50)	

SAP Worksheet (Version 9.80)

Target Carbon Dioxide Emission Rate (TER) Calculation

	Area	U-Value	Heat Loss W/K
Walls (net)	86.88	0.35	30.41
DG wood frame window 16mm gap low-E glass (en=0.2)	25.27	1.852 (2.0)	46.81
Solid wood door	1.85	2.0	3.70
Floors	38.50	0.25	9.63
Roofs	46.50	0.16	7.44
Total heat loss (C/F to [33]			97.98

Overall Dwelling Dimensions

	Area m^2	Avg ht m.	Vol. m^3	
Ground/entrance level:	38.50	2.50	96.25	[1]
First:	35.00	2.60	91.00	[2]
Second:	35.00	2.00	70.00	[3]
Total floor area:	108.50 [5]	Volume:	257.25	[6]

Ventilation Rate	ACH	
Fans and passive vents:	3 x 10/257.25 = 0.12	[9]
Infiltration due to chimneys, flues and fans:	0.12	[10]
Default q_{50} value = 10.00	10.00/20 = 0.50	
Infiltration rate:	0.62	[19]
2 sheltered sides: shelter factor = 0.85		[21]
Adjusted infiltration rate = 0.62 x 0.85	0.52	[22]
Natural ventilation:		
Effective air change rate	0.64	[24]
	0.64	[25]

Heat Loss Summary	W/K	
Heat loss through structure (from above):	97.98	[33]
Thermal bridges 0.11 x 199.00:	21.89	[34]
Total fabric heat loss:	119.87	[35]
Ventilation heat loss:	0.64 [25] x 0.33 x 257.25 [6] = 54.11	[36]
Specific heat loss:	173.97	[37]
Heat loss parameter:	173.97/108.5 = 1.60	[38]

Water Heating Energy Requirements	kWh/year	
Source: Primary heating system (Gas boiler, automatic ignition, 1998 or later)		
Fuel: Mains Gas		
Energy content of heated water (Table 1a N=3.350):	2207	[39]
Distribution loss (Table 1b):	389	[40]
Cylinder volume = 150 litres		[43]
Cylinder loss factor: 0.0191 (Table 2)		[44]
Volume factor: 0.9283 (Table 2a)		[44a]
Temperature factor: 0.54 (Table 2b)		[44b]
Energy lost from store:	150 x 0.0191 x 0.9283 x 0.54 x 365 = 524	[47]
Primary circuit loss :	610	[48]
Solar input:	0	[50]
Required output from water heater:	3730	[51]
Heat gains from water heating:	0.25 x 2207 + 0.8 x (389+524+610) = 1771	[52]

Gains	Watts	
Lighting, appliance & metabolic gains (Table 5 N=3.350):	616	[53]
Reduction due to low energy lighting (30% assumed):	-22	[53a]
Central heating pump: 10.0		
Total additional gains	10	[53b]
Water heating:	1771/8.72 = 202	[54]
Total internal gains:	806	[55]

Total solar gains (B/F from solar-related report):		424	[65]
Total gains		1,230	[66]
Gains/Loss ratio (GLR) = 1230/174.0 [37] = 7.068			[67]
Utilisation factor (Table 7): 0.92			[68]
Useful gains:	1230 x 0.92 =	1,133	[69]
Mean internal temperature		°C	
Living area mean temperature: Table 8 col.1; HLP [38] = 1.60		18.87	[70]
Control adjustment (Table 4e)		0.00	[71]
Heating system responsiveness (R) = 1.00 (Table 4d)			
Adjustment for gains:	0.2 x R x ((1133 [69]/174.0 [37]) - 4.0) =	0.50	[72]
Adjusted living room temperature:		19.38	[73]
Temperature difference between zones : (Table 9 col 2)		1.51	[74]
Living area fraction: 0.17			[75]
Rest-of-house fraction: 0.83			[76]
Mean internal temperature:	19.38 - (1.51 x 0.83) =	18.12	[77]
Degree Days			
Temperature rise from gains:	1133 [69]/174.0 [37] =	6.51	[78]
Base temperature:	18.12 - 6.51 =	11.61	[79]
Degree days (Table 10):		1262	[80]
Space heating requirements		kWh/year	
Energy requirement (useful):	0.024 x 1262 x 174.0 [37] =	5270	[81]
Heat from secondary system: 10% (Table 11)			[82]
Primary system: Gas boiler, automatic ignition, 1998 or later			
Controls: Programmer + roomstat + TRV's			
Fuel: Mains Gas			
Notional efficiency: 78%			[83]
Fuel required:	5270 x 0.90 x 100/78 =	6081	[85]
Secondary system: Portable electric heaters			
Fuel: Electricity (standard tariff)			
Efficiency: 100% (Table 4a)			[84]
Fuel required:	5270 x 0.10 x 100/100 =	527	[85a]
Water heating energy requirement (net): 3730 kW [51]			
Source: Primary heating system			
Efficiency : 78% (Manufacturer's declared value)			[86]
Energy required:	3730 [51] x 100/78 =	4783	[86a]
Electricity for pumps & fans:		175	[87]
Electricity for lighting (B/F from Solar report)		823	
CO_2 Emissions			kg/year
Primary heating system (mains gas)	6081 [85] x 0.194 =	1,180	[101]
Secondary heating system (electricity)	527 [85a] x 0.422 =	222	[102]
Water heating (mains gas)	4783 [86a] x 0.194 =	928	[103]
Total for space and water heating		2330	[107]
Electricity for pumps and fans	175 [87] x 0.422 =	74	[108]
Electricity for lighting, C_L	823 x 0.422 =	347	[109]
New technology: None			
	Total:	2,751	[112]

C_H = (2330 + 74)/108.50 = 22.15 C_L = 347/108.50 = 3.20

Fuel: Mains Gas : Fuel Factor = 1.00 Improvement Factor = 0.20

Target CO_2 Emission Rate (TER) = (C_H x Fuel Factor + C_L) x (1 - imp factor)
= (22.15 x 1.00 + 3.20) x (1 - 0.20) = **20.29**