



SUMMARY OF SAP RATING AND CARBON EMISSIONS

Using SAP 2005 and Technical Handbook 2007, Domestic, Section 6

Example , BRS UK

Find out More details

www.brsuk.co.uk

GLASGOW

New dwelling

Location

Scotland

SAP Rating 75
SAP Band C

Environmental Impact Rating 72
Environmental Impact band C

Target Carbon Dioxide Emission Rate (TER) 26.67 (kg/m²/yr)
Dwelling Carbon Dioxide Emission rate (DER) 26.63 (kg/m²/yr)

Calculation by Raymond McGurk
76 Queen Elizabeth Avenue
Hillington Park
Hillington
G52 4NQ
raymond@brsuk.co.uk

Printed 20.9.2011 File ref.Domestic House Example
Software SAPPER version 8.01.0 SAP 2005 Worksheet 9.81 (B.R.E. approved).
Copyright Reginald James 2006

SAP 2005 input data and results (New dwelling). printed on 20 September 2011 at 15.50

File name:Domestic House Example file saved: 20.09.2011

**Technical Handbook 2007, Domestic, Section 6
Summary of compliance with standard 6.1**

Target Carbon Dioxide Emission Rate (TER) for notional dwelling = 26.67 kg/m²
 Dwelling Carbon Dioxide Emission Rate (DER) for proposed dwelling = 26.63 kg/m²

Result: PASS

Software version: SAPPER version 8.01.0 SAP 2005 Worksheet 9.81
 SAP 2005 rating = C 75

Listing of input data

Project name Example , BRS UK
 Find out More details
 www.brsuk.co.uk
 GLASGOW
 Located in Scotland
 Region West Scotland
 UPRN
 Date of Assessment 28 June 2010
 Dwelling type Detached house
 Assessment type New dwelling
 Year completed 2010

Dimensions	Area m ²	Height m.
Ground floor	110.1	2.4
First floor	54.7	2.4
Living area	48.5 (fraction 0.294)	
Front of dwelling faces	South East	

Windows doors and rooflights

Windows type 1 details from manufacturer's information
 Rooflight details from manufacturer's information

	U-Value	Frame & glazing details
Windows (type 1)	1.6	wood frame, gap(s) g = 0.76 FF = 0.7
Rooflights	1.6	wood DG(air filled)
Solid doors	1.8	0 % glazed,

Openings

<u>Number</u>	<u>Type</u>	<u>Location</u>	<u>Orientation</u>	<u>Width</u>	<u>Height</u>
1	Window(1)	Wall(1)	South East	12.83	1
2	Window(1)	Wall(1)	North West	8.68	1
3	<30% glazed door	Wall(1)	South East	1.95	1
4	Roof window	Roof(2)	South East	7.1	1
5	Roof window	Roof(2)	North West	1.52	1

Orientation	type 1 area	type 2 area	type 3 area	type 4 area
Southeast	12.83	0	0	
Northwest	8.68	0	0	
Rooflights area (other)		8.62		
Solid doors area		1.95		
Solar access factor	Average or unknown 20%-60%			

N.B. If Solar Access Factor 'Very little shading' is specified, the Emission rate calculation will use 'Average overshadowing'.

Fabric heat losses

		Area m ²	U-value W/m ² /K
Floor 1	Ground Floor	110.1	0.2
Wall 1	External Wall	221.84	0.27
Wall 2	Attic vertical	34.55	0.27
Roof 1	Flat ceiling	40.9	0.09
Roof 2	Pitched Roof	76.61	0.19

Thermal bridges: Acredited Construction Details (Scotland) ($y = 0.08$)

Ventilation

Pressure test:	permeability = 10 (no pressure test required (default))
Ventilation	natural with intermittent extract fans
No of chimneys	0
No of flues	0
No of fans and vents	3
Number of sides sheltered	2

Main heating (Manufacturer's details)

Heating type: wet system with rads or underfloor
Heat emitter: underfloor heating, pipes in screed above insulation
Pump in heated space

Boiler type:
Manufacturer:
Model:
Type: condensing combi
Fuel: heating oil (4)
Flue type: unknown
Declared efficiency 88 %
pump in heated space

Keep-hot facility
Keep-hot control

Main heating controls: programmer and at least two room thermostats

Secondary heating

Secondary heating: closed room heater (OF) (633)
Secondary heating fuel: solid fuel - wood logs (20)

Efficiency: 65 %

Water heating

Water heating: from main heating system
Water heating fuel: heating oil (4)
Water heating separately timed yes
Hot water storage combi
Solar Water Heating Instalation no

Electricity tariff
Conservatory no conservatory
Fixed air-conditioning No
Photovoltaics none

Low energy lights 50 % of fixed lighting outlets
Wind turbines None
Terrain:
Assess Zero Carbon Home No

The results of the calculation should not be accepted without first checking the input data.

SAP 2005 WORKSHEET FOR PROPOSED DWELLING (version 9.81)
CALCULATION OF ENERGY RATINGS
Example , BRS UK New dwelling

SAP calculation by: Raymond McGurk
 76 Queen Elizabeth Avenue
 Hillington Park
 Hillington
 G52 4NQ
 Date of SAP rating: 20.09.2011
 Filename: Domestic House Example
 BEDF revision number: 313
 External Definitions rev. number: 2.1a

1. OVERALL DWELLING DIMENSIONS

	Area	Ave.ht	Volume
Ground floor	110.1	2.4	264.24
First floor	54.7	2.4	131.28
Total floor area	164.8		
Dwelling volume =			395.52

2. VENTILATION RATE

No. of chimneys	0	x	40 =	
No. of open flues	0	x	20 =	
No. of fans or passive vents	3	x	10 =	30.00
No. of flueless gas fires	0	x	40 =	
				m ³ /hr
Infiltration due to chimneys, fans, flues and other	30 / 395.52			AC/hr
Pressure test applies permeability q50	10.0			0.08
Assumed permeability q50	10.0			
Infiltration rate				0.58
No. of sides sheltered	2.0			
Shelter factor	0.85			
adjusted infiltration rate				0.49
effective air change rate for natural with intermittent extract fans				
adjusted infiltration rate is less than 1.0				
so effective air change rate = $0.5 + (0.49 \times 0.49 \times 0.5)$				0.62

3. HEAT LOSSES AND HEAT LOSS PARAMETER

Element	Area	U-value	W/K
Solid doors	1.95	1.8	3.51
Windows 1	21.51	1.5 (1.6)	32.35
Rooflights 1	8.62	1.5 (1.6)	12.96
Floor 1 Ground Floor	110.1	0.2	22.02
Wall 1 External Wall	221.84	0.27	59.90
Wall 2 Attic vertical	34.55	0.27	9.33
Roof 1 Flat ceiling	40.9	0.09	3.68
Roof 2 Pitched Roof	76.61	0.19	14.56
Sum of all exposed elements	516.08		
Thermal bridge calculation using 0.08×516.08			41.286
Fabric heat loss			158.30
Total fabric heat loss, W/K			199.59
Ventilation heat loss			80.90
Heat loss coefficient, W/K			280.48
Heat loss parameter (HLP) W/m ² K			1.70

4. WATER HEATING ENERGY REQUIREMENTS

Hot water energy requirement (Table 1, col(a))		kWh/year
Distribution loss (Table 1 column(b))		2836.13
Water storage volume (litres)		500.49
excluding and dedicated solar storage		
Water storage loss factor (Table 2)	0.54	
Volume factor (Table 2a)		
Temperature factor from Table 2b		
Energy lost from water storage (kWh/year)		
Primary circuit loss (table 3)		
Solar DHW input as Appendix H		

Output from water heater	3936.63
Heat gains from water heating	1259.00

5. INTERNAL GAINS

Lights, appliances, cooking and metabolic (Table 5)	869.93	Watts
Reduction of internal gains due to low energy lighting	- 56.00	
Additional gains from Table 5a		
Central heating pump	10.00	
Oil boiler pump, inside dwelling	10.00	
Water heating	143.80	
Total internal gains	977.90	

6. SOLAR GAINS

Orientation		access factor	area m ²	flux	g	FF	gains (W)
Southeast	type 1	.9 x	12.83	64.0	0.76	0.7	302.73
Northwest	type 1	.9 x	8.68	34.0	0.76	0.7	108.8
Other rooflights		.9 x	8.62	75.0	0.76	0.7	309.54
Total solar gains from windows and rooflights							721.08
Total gains							1699.00
Gains/loss ratio					6.06		
Utilization factor (table 7)					0.95		
Useful gains							1611.98

LIGHTING

Percentage of low energy lamps 50

			area (m ²)	light trans	Frame factor	Shading	totals
SE	type 1	0.9 x	12.83	0.8	0.7	0.83	5.37
NW	type 1	0.9 x	8.68	0.8	0.7	0.83	3.63
Rooflights		0.9 x	8.62	0.8	0.7	1.0	4.34
Total							13.34
Lighting energy kWh/year							1115.00

Glazing Ratio	0.081
Correction 1	0.75
Correction 2	0.9704

Reduction in energy due to LE lights

$$9.3 \times 164.8 \times (1 - 0.75) \times 0.97 = 371.82$$

Annual lighting energy in the house

$$9.3 \times 164.8 \times 0.75 \times 0.75 = 1115.0$$

7. MEAN INTERNAL TEMPERATURE

Mean int.temp of living area	19.31	deg C
Temperature adjustment (Table 4e)	-0.15	
Adjustment for gains (Table 4a or 4d), R = 0.75	0.26	
Adjusted living room temp.	19.42	
Temperature difference between zones (Table 9)	1.52	
Living area fraction	48.5 / 164.8	0.294
Rest-of-house fraction		0.71
Mean internal temperature	18.34	

8. DEGREE DAYS

Temperature rise from gains	5.75
Base temperature	12.60
Degree days (Table 10)	1471.00

9a. ENERGY REQUIREMENTS

Energy requirement (useful)	9903.00	kWh/year
Fraction of heat from secondary system	0.1	
Efficiency of main heating %	88.0	
Adjustment from Table 4c (%)	2.0	
Heat pump adjustment from Table 4c (%)	1.0	
Adjusted efficiency of main system (%)	90.0	
Efficiency of secondary system	65.0	
Space heating fuel (main)	9903.00	
Space heating fuel (secondary)	1524.00	
Water heating:		
Water heating requirement	3936.63	
Efficiency of the water heater	90.0	
Energy required for water heating kWh/year	4374.00	

Electricity for pumps and fans			
Central heating pump		130.0	
Pump for heating oil		100.0	
Total electricity for pumps & fans			230.00
Electricity for lighting (50 % fixed LEL)			1115.00

10a. FUEL COSTS Fuel prices from Table 12

	kWh/yr	p/kWh	£/year
Space heating main	9903.0	2.17	214.90
Space heating secondary	1524.0	2.2	33.52
Water heating costs			
Water heating costs	4374.0	2.17	94.92
Pump/ fan energy cost	230.0	7.12	16.38
Electricity for lighting (Appendix L)	1115.0	7.12	79.42
Additional standing charges			
Total energy cost			439.13

11. SAP RATING (conventional heating)

Energy cost deflator (Table 12)	0.91		
Energy Cost Factor (ECF)	1.76		
SAP value			75.41
SAP rating			75.0
SAP band			C

12a. CARBON DIOXIDE EMISSIONS

	Energy (kWh/year)	Emission factor	Emissions (kg/year)
Main heating	9903.0	0.265	2624.36
Secondary heating	1524.0	0.025	38.09
Water heating	4374.0	0.265	1159.12
Space and water heating			<u>3783.48</u>
Electricity for pumps and fans	230.0	0.422	97.06
Energy for lighting	1115.0	0.422	470.72
Total CO2 emissions			4389.35
Carbon Dioxide Emission Rate (kg/m²/year)			26.6344
EI value			71.97
EI rating			72
EI band			C

13a. PRIMARY ENERGY

	Energy kWh/yr	Primary factor	P.Energy kWh/year
Space heating - main	9903.0	1.19	11784.86
Space heating - sec.	1524.0	1.1	1675.93
Water heating	4374.0	1.19	5205.09
Space and water heating			18666.00
Electricity, pumps and fans	230.0	2.8	644.00
Energy for lighting	1115.0	2.8	3123.00
Primary energy kWh/year			22433.0
Primary energy kWh/m²/year			136.12

SAP 2005 SUMMARY	SAP rating	75	C
	Emissions	EI rating	C
		72	
	Primary Energy	136.12	

SAP 2005 WORKSHEET FOR PROPOSED DWELLING (version 9.81)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE
Domestic Handbook Section 6, 2007 Edition

New dwelling

calculated by program SAPPER version 8.01.0 SAP 2005 Worksheet 9.81. Printed 20.9.2011

Name of Project Example , BRS UK
Find out More details
www.brsuk.co.uk
GLASGOW

Project type New dwelling
 Location Scotland
 Date of calculation 20.09.2011
 SAP calculation by: Raymond McGurk
 76 Queen Elizabeth Avenue
 Hillington Park
 Hillington
 G52 4NQ
 Filename: Domestic House Example

1. OVERALL DWELLING DIMENSIONS	Area	Ave.ht	Volume
	m ²	m	m ³
Ground floor	110.1	2.4	264.24
First floor	54.7	2.4	131.28
Total floor area	164.8		
Dwelling volume =			395.52

2. VENTILATION RATE				m ³ /hr
No. of chimneys	0	x	40 =	
No. of flues	0	x	20 =	
No. of fans and passive vents	3	x	10 =	30.00
No. of flueless gas fires	0	x	40 =	
Infiltration				AC / hr
Chimneys, fans, flues and other	30 / 395.52			0.08
Infiltration rate				0.58
No. of sides sheltered	2.0			
Shelter factor	0.85			
adjusted infiltration rate				0.49
effective air change rate for natural with intermittent extract fans				
adjusted infiltration rate is less than 1.0				
so effective air change rate = $0.5 + (0.49 \times 0.49 \times 0.5)$				0.62

3. HEAT LOSSES AND HEAT LOSS PARAMETER	Area	U-value	W/K
Element			
Solid doors	1.95	1.8	3.51
Windows 1	21.51	1.5	32.35
Rooflights	8.62	1.6	12.96
Floor 1 Ground Floor	110.1	0.2	22.02
Wall 1 External Wall	221.84	0.27	59.90
Wall 2 Attic vertical	34.55	0.27	9.33
Roof 1 Flat ceiling	40.9	0.09	3.68
Roof 2 Pitched Roof	76.61	0.19	14.56
Sum of all exposed elements	516.08		
Fabric heat loss			158.30
Thermal bridge calculation using 0.08×516.08			41.286
Total fabric heat loss, W/K			199.59
Ventilation heat loss			80.90
Heat loss coefficient, W/K			280.48
Heat loss parameter (HLP) W/m ² K			1.70

4. WATER HEATING REQUIREMENTS	kWh/year
Hot water energy requirement (Table 1, col(a))	2836.13
Distribution loss (Table 1 column(b))	500.49
Water storage volume (litres)	
excluding and dedicated solar storage	
Water storage loss factor (Table 2)	0.54
Volume factor (Table 2a)	

Temperature factor from Table 2b	
Energy lost from water storage (kWh/year)	
Primary circuit loss (table 3)	
Output from water heater	3936.63
Heat gains from water heating	1259.00

5. INTERNAL GAINS

	Watts
Lights, appliances, cooking and metabolic (Table 5)	869.93
Reduction of internal gains due to low energy lighting	- 55.77
Additional gains from Table 5a	
Central heating pump	10.00
Oil boiler pump, inside dwelling	10.00
Water heating	143.80
Pump for solar water heating	
Total internal gains	977.93

6. SOLAR GAINS

Orientation		access factor	area m ²	flux	g	FF	gains (W)	
Southeast	type 1	.9 x	0.77	12.83	64.0	0.76	0.7	302.73
Northwest	type 1	.9 x	0.77	8.68	34.0	0.76	0.7	108.8
Other rooflights		.9 x	1.0	8.62	75.0	0.76	0.7	309.54
Total solar gains from windows and rooflights								721.075
Total gains								1699.01
Gains/loss ratio				6.06				
Utilization factor (table 7)				0.95				
Useful gains								1611.98

7. MEAN INTERNAL TEMPERATURE

	deg C
Mean int.temp of living area	19.31
Temperature adjustment (Table 4e)-0.15	
Adjustment for gains (Table 4a or 4d), R = 0.75	0.26
Adjusted living room temp.	19.42
Temperature difference between zones (Table 9)	
Living area fraction	48.5 / 164.8
Rest-of-house fraction	0.294
Mean internal temperature	18.34

8. DEGREE DAYS

Temperature rise from gains	5.75
Base temperature	12.60
Degree days (Table 10)	1471.16

9a. ENERGY REQUIREMENTS

	kWh/year
Space heating energy requirement (useful)	9903.00
Fraction of heat from secondary system	0.1
Heating system efficiency %	88.0
Adjustment from Table 4c (%)	2.0
Adjusted efficiency of main system (%)	90.00
Efficiency of secondary system (%)	65.00
Space heating fuel (main) requirement	9903.00
Space heating fuel (sec.) requirement	1524.00
Water heating:	
Water heating requirement	3936.63
Efficiency of water the heater	90.0
Energy required for water heating kWh/year	4374.00
Electricity for pumps and fans:	
Central heating pump	130.00
Pump for heating oil	100.00
Total electricity for pumps & fans	230.00
Energy for lighting	1115.46

12a CARBON DIOXIDE EMISSIONS (conventional and community heating without CHP)

	Energy (kWh/year)	Emission factor	Emissions (kg/year)
Space heating - main	9903.0	0.265	2624.37
Space heating - sec.	1524.0	0.025	38.09
Water heating	4374.0	0.265	1159.12
Space and water heating			3821.57
Electricity for pumps and fans	230.0	0.422	97.06
Energy for lighting	1115.46	0.422	470.72
Total CO2 emissions			4389.36
Dwelling Carbon Dioxide Emission Rate (DER) (kg/m²)	4389.36 / 164.8		26.63

SAP 2005 WORKSHEET FOR NOTIONAL DWELLING (Version 9.8 October 2005)**CALCULATION OF TARGET EMISSIONS****Domestic Handbook Section 6, 2007 Edition**

calculated using SAPPER version 8.01.0 SAP 2005 Worksheet 9.81 Printed 20.9.2011

Name of Project Example , BRS UK
Find out More details
www.brsuk.co.uk
GLASGOW

New dwelling

Location Scotland
 Date of SAP rating 20.09.2011
 Location Scotland

1. OVERALL DIMENSIONS

	area (m ²)	height (m)	volume (m ³)
ground floor	110.1	2.4	264.24
first floor	54.7	2.4	131.28
total floor area	164.8		
dwelling volume			395.52

2. VENTILATION RATE

no. of fans and vents	4	x	10 =	m ³ /hr 40.00
infiltration				AC/hr
chimneys, fans, flues and other	40 / 395.52			0.15
Permeability q50 =	10			0.652
number of sides sheltered	2			
shelter factor				0.85
adjusted infiltration rate				0.55
effective air change rate for ventilation method: natural with intermittent extract fans				
adjusted infiltration rate is less than 1.0				
so effective air change rate = $0.5 + (0.55 \times 0.55 \times 0.5)$				0.653

3. HEAT LOSSES AND HEAT LOSS PARAMETER

Element	area	U-value	A x U
Doors	1.85	1.7	3.145
Windows	39.35	1.59 (1.7)	62.636
Floors	110.1	0.2	22.02
Walls	238.65	0.25	59.663
Roof	126.13	0.16	20.181
Sum of all exposed elements			516.08
Fabric heat loss			167.64
Thermal bridges (0.08 x area of exposed elements)	0.08	516.08	41.286
Total fabric heat loss, W/K			208.93
Ventilation heat loss			85.29
Heat loss coefficient, W/K			294.22
Heat loss parameter (HLP), W/m ² /K			1.79

4. WATER HEATING REQUIREMENTS

Hot water energy requirement		kWh/year
Distribution loss		2836.13
Water storage volume(L) excluding any solar storage	150.0	500.49
Water storage loss factor(from Table 2)	0.0152	
Volume factor (Table 2a)	0.9283	
Temperature factor from Table 2b	0.54	
Energy lost from water storage (kWh/year)		417.00
Primary circuit loss from Table 3		360.00
Output from water heater		4113.00
Heat gains from water heating		1731.00

5. INTERNAL GAINS

Lights appliances cooking and metabolic (Table 5)		Watts
Reduction in gains due to low energy lighting	-	869.93
Central heating pump		55.18
Water heating		20.00
Total internal gains		197.58
		1032.34

6. SOLAR GAINS

Orientation			access factor	area m ²	flux	g	FF	gains (W)
East	type 1	.9 x	0.77	39.31	48.0	0.72	0.7	659.7
Total solar gains from windows								659.70
Total gains								1692.05
Gains/loss ratio								5.75
Utilization factor (table 7)								0.96
Useful gains								1618.10

7. INTERNAL TEMPERATURE

Mean int.temp of living area, Table 8								deg C
Temperature adjustment from Table 4e								18.86
Adjustment for gains R = 0.75								0.30
Adjusted living room temperature.								19.16
Temperature difference between zones (Table 9)								1.54
Living room fraction (0 - 1)						0.294		
Rest-of-house fraction						0.71		
Mean internal temperature								18.08

8. DEGREE DAYS

Temperature rise from gains								5.00
Base temperature								13.00
Degree days								1467.38

9. SPACE HEATING REQUIREMENTS

Space heating requirement(useful)								kWh/year
								10361.00

9a. ENERGY REQUIREMENTS**Space heating:**

Fraction of heat from secondary system								0.10
Heating system efficiency, %						94.0		
Efficiency of secondary system, %						60.0		
Space heating fuel(main)requirement								9921.00
Space heating fuel(sec.)requirement								1727.00

Water heating:

Water heating requirement				4113.0				
Efficiency of water heater						94.0		
Energy required for water heating								4376.00

Electricity for pumps and fans:

Central heating pump				130.0				
Boiler with fan-assisted flue				45.0				
Total electricity for pumps & fans								230.00

10a and 11a do not apply

12a CARBON DIOXIDE EMISSIONS

		Energy kWh/yr	Emission factor	Emissions kg/yr
Space heating - main		9921.0	0.265	2628.947
Space heating - sec.		1727.0	0.025	43.173
Water heating		4376.0	0.265	1159.623
Electricity, pumps and fans		230.0	0.422	97.06
Energy for lighting		1104.0	0.422	465.677
Total CO2 emissions				4394.00

Emissions per m² for space and water heating

Emissions per m² for lighting

kg/m²/year

23.84

2.83

Target carbon dioxide emissions

= 4394 / 164.8

26.67

New dwelling

calculated by program SAPPER version 8.01.0 SAP 2005 Worksheet 9.81. Printed 20.9.2011

Name of Project Example , BRS UKFind out More details
www.brsuk.co.uk
GLASGOW

Location Scotland
 Date of calculation 20.09.2011
 SAP calculation by: Raymond McGurk
 76 Queen Elizabeth Avenue
 Hillington Park
 Hillington
 G52 4NQ
 Filename: Domestic House Example

SAP 2005 OVERHEATING ASSESSMENT

calculated using SAPPER version 8.01.0 SAP 2005 Worksheet 9.81

SUMMER SOLAR GAINS**Summer access factor from table 6d**

		m ²	Flux	g	FF	Z(s)	gains(W)
SE type 1	0.9 x	12.83	112.0	0.76	0.7		
NWtype 1	0.9 x			0.76	0.7		
Total solar gains from windows and rooflights							
Internal gains							977.90
Total summer gains							977.93

Summer ventilation heat loss

Summer ventilation (air changes / hour	5						
Volume of heated space m ³		395.52					
Summer ventilation heat loss	5 x 0.33 x	395.52					652.608
Summer total fabric losses							199.59
Summer total losses							852.19
Summer solar gains							
Internal gains							977.93
Summer total gains							977.93
Summer Gains/Loss ratio	977.93 /	852.19					1.15

Summer mean external temperature

Region	West Scotland				
Mean external temperature					14.0

Solar shading

Shading by blinds, curtains or shutters

Fraction of daylight hours used 0

Zblinds = 0 x 0 + (1 - 0)

Shading by overhangs

Overhang type	Total area	Shaded area	D / H ratio	Zoverhangs

Summer threshold internal temperature

Thermal Mass Parameter (TMP)		8
DeltaTmass	(2 - 0.2) x	8
Threshold internal temperature	14 + 1.15 +	0.4
		15.55

From Table P3 the overheating risk is not significant

Printed 20.9.2011

SAPPER version 8.01.0 SAP 2005 Worksheet 9.81

Copyright Reginald James 2006

Boiler efficiency declared by manufacturer.

Window type 1 U-value from manufacturer's declaration

Door (2) U-value from manufacturer's declaration
Roof light U-value from manufacturer's declaration