Radflek – proposed CERT attributed savings

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1. Introduction

Radflek is a sheet with a reflective surface on either side which is designed to be placed between a radiator and the wall behind it to reduce heat transfer from the radiator to the wall.

Without the sheet heat is transferred to the wall behind the radiator directly by radiation from the radiator, and by convection and conduction from the adjacent air. When the sheet is introduced the radiative transfer is expected to be substantially reduced but the convective component cannot be readily deduced.

To provide a basis for assessment, measurements were undertaken at BBA using their hot-box apparatus using two test walls, one with a U-value of 1.1 W/m²K and one with a U-value of 2.2 W/m²K. The test wall is placed against the open face of the box, which is used as a 'cold box'. The other side of the test wall was open to the laboratory environment at approximately 27°C, and a radiator was positioned 80 mm away from the laboratory side of the test wall.

Tests were done without and with the Radflek sheet between the radiator and the test wall. The cold box was maintained at approximately 0°C and the radiator at approximately 50°C until steady readings were obtained for the surface temperatures on either side of the wall. Each test continued under steady temperature conditions for several hours.

2. Test results

The following results were obtained.

Table 1 : Temperatures in the tests under steady temperature conditions for wall 1 (U = 1.1 W/m²K)

	Temperature (°C)			
	radiator	wall inner	wall outer	cold box
without sheet	50.7	34.5	1.8	0.2
with sheet	50.8	19.9	2.2	1.0

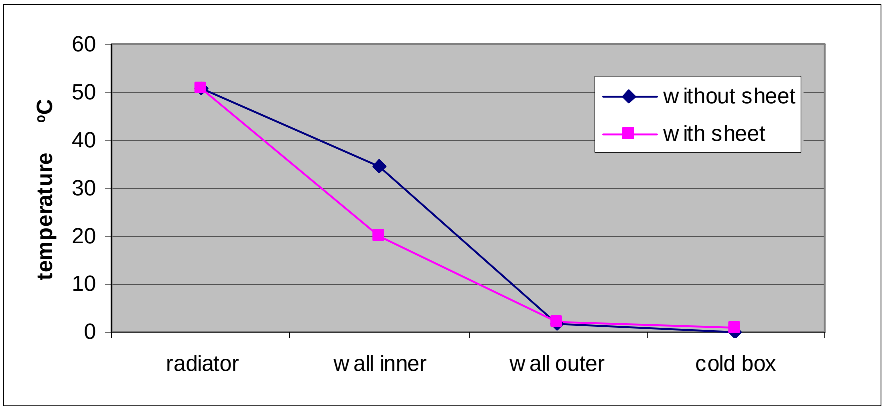

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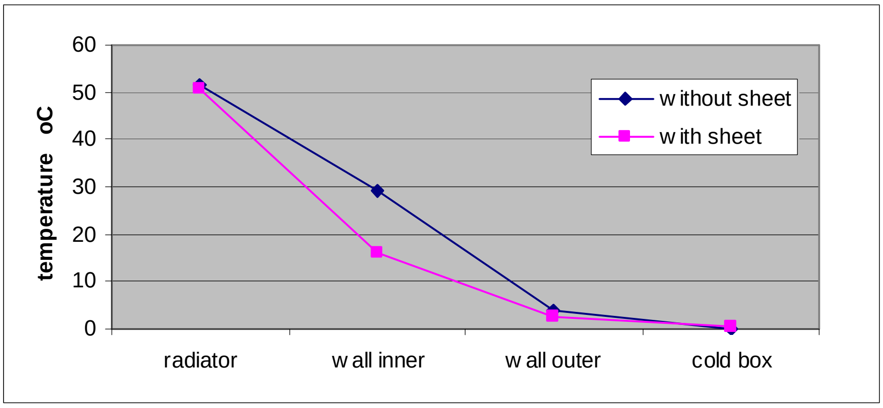
Table 2 : Temperatures in the tests under steady temperature conditions for wall 2 (U = 2.2 W/m²)

	Temperature (°C)			
	radiator	wall inner	wall outer	cold box
without sheet	51.5	29.0	3.8	0.2
with sheet	50.8	15.9	2.4	0.5



3. Analysis of results

3.1 Analysis for when heating is on

The heat flow through the wall can be obtained from the above test data using the temperature difference across it and its known thermal resistance (which is assumed not to vary with temperature). This is then standardised for a radiator temperature of 50°C and an external temperature of 6°C (representing the average external temperature during the heating season).

For example, for wall 1 without sheet:

Temperature difference across wall	34.5 – 1.8	= 32.7 °C
Thermal resistance of wall	1/(1.096 – 0.17)	= 0.742 m²K/W
Heat flow	32.7 ÷ 0.742	= 44.07 W/m²
Temperature difference, radiator to cold box	50.7 – 0.2	= 50.5 K
Heat flow adjusted to 44 K difference	44.07 × 44 ÷ 50.5	= 38.40

Table 3 : Calculated heat flow rates

	Heat flow, W/m²	
	Wall 1	Wall 2
without sheet	38.40	76.92
with sheet	21.08	42.03
difference	17.31	34.89
ratio, with and without sheet	0.549	0.546

The last row of Table 3 gives the same result for both test walls, thus the effect of introducing the sheet is to reduce the heat flow through the wall by a given fraction, not dependent on the U-value of the wall. This can be understood as the introduction of the sheet causing a reduction in the effective temperature seen by the wall. The data in Table 3 are shown graphically in Figure 1, showing a straight-line dependence on the U-value of the wall.

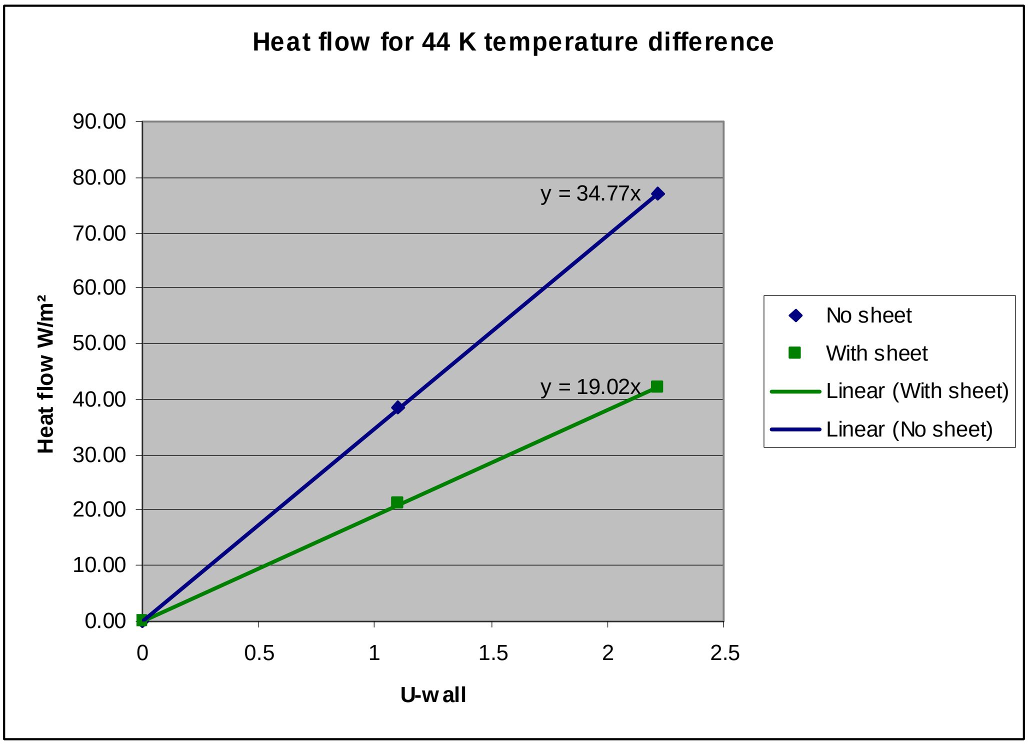


Figure 1 : Heat flow through wall for 44 K temperature difference

From the gradients of the two lines, shown on Figure 1, the effect of the introduction of the sheet behind the radiator is to reduce the heat flow through the wall by (34.77 – 19.02) x U, = 15.75 x U W/m² where U is the U-value of the wall.

3.2 Analysis for when heating is off

When the heating is off we assume that temperature in the room, including the radiator, is at an average of 15°C. The reduction in heat flow is multiplied by 9 ÷ 44 and so becomes 3.22 × U.

4. Energy saving over one year

Standard heating (as used in SAP calculations) is 11 hours per day for 30-week season, amounting to 2310 hours of heating and 2730 hours when heating is off. The reduction in heat flow rate is multiplied by the applicable number of hours per year in Table 4.

Table 4 : Annual energy saving

	------- heating on -------			------- heating off -------			
U wall W/m²K	delta-q W/m²	heating hours	kWh/m²/yr	delta-q W/m²	non-heating hours	kWh/m²/yr	total kWh/m²/yr
0.42	6.62	2310	15.3	1.35	2730	3.7	19.0
0.69	10.87	2310	25.1	2.22	2730	6.1	31.2
1	15.75	2310	36.4	3.22	2730	8.8	45.2
1.44	22.68	2310	52.4	4.64	2730	12.7	65.1
2.1	33.08	2310	76.4	6.77	2730	18.5	94.9

The right-hand column of Table 4 gives the kWh saving in heating energy per m² of Radflek placed between a radiator and an external wall. This is the reduction in heat requirement to the rooms and should be divided by the efficiency of the heat generator to obtain the reduction in delivered energy.

The following tables give parameters which have been established for similar calculations in CERT, and which are applied to the above results to give carbon emission savings.

Table 5 gives the seasonal efficiency (SEDBUK) used in CERT, for gas, oil and coal central heating in the existing stock.

Table 5: Heating type seasonal efficiencies

Heating Type	Seasonal Efficiency
Gas CH	78%
Oil CH	82%
Coal CH	60%

Table 6 gives the CO_2 emission factors used in CERT for each central heating type.

Table 6: CO_2 emission factors

Heating Type	$kgCO_2/kWh$
Gas CH	0.1899
Oil CH	0.2493
Coal CH	0.2996

Table 7 gives the values used in CERT for the weighting of each central heating type. These are percentages of all applicable heating types.

Table 7: Weighting for heating types

Heating Type	Weighting
Gas CH	91%
Oil CH	8%
Coal CH	1%

Table 8 shows the U-values associated in CERT with each of the four age bands of uninsulated wall types, and each type as a percentage of the number of dwellings with uninsulated walls in the housing stock.

Table 8: Weighting of wall types for solid and uninsulated walls

Wall U-value W/m^2K	(Uninsulated) wall type	Percentage of total
0.69	Post 83 cavity walls	9%
1.0	76-82 cavity walls	5%
1.44	Pre'76 cavity walls	46%
2.1	Uninsulated solid walls	40%

Table 9 shows the U-values associated in CERT with all wall types, both insulated and uninsulated, and the percentage by number of dwellings in the housing stock.

Table 9: Weighting of wall types for all walls

Wall U-value W/m^2K	Wall type	Percentage of total
0.42	Insulated cavity walls	44%
0.69	Post 83 cavity walls	5%
1.0	76-82 cavity walls	3%
1.44	Pre'76 cavity walls	26%
2.1	Uninsulated solid walls	22%

Table 10 applies the above efficiencies and CO_2 emission factors (Tables 5 and 6), to give the resulting values for the reduction in kg of CO_2 per year per m² of Radflek placed between the radiator and the wall, for all wall types and all heating types.

Table 10: All wall and heating types - $kgCO_2/yr$ reduction per m² of Radflek (applies to external walls only, not internal dividing walls)

	Insulated walls	Post '83 cavity walls	76-'82 cavity walls	Pre '76 cavity walls	Uninsulated solid walls
Gas CH	4.62	7.59	11.00	15.84	23.10
Oil CH	5.77	9.48	13.74	19.78	28.84
Coal CH	9.47	15.57	22.56	32.48	47.37

Table 11 applies the weighting by heating type (Table 7) to give the reduction in kg of CO_2 per year per m^2 of Radflek for each wall type.

Table 11: Reduction of $kgCO_2$/yr per m^2 of Radflek weighted by heating type

Wall type (external walls only)	$kgCO_2$/yr per m^2 of Radflek
Insulated walls	4.74
Post '83 cavity walls	7.80
76-'82 cavity walls	11.30
Pre '76 cavity walls	16.27
Uninsulated solid walls	23.72

Table 12 then applies the weightings by wall type (Tables 8 and 9) to give the overall $kgCO_2$ saving per year per m^2 of Radflek for (a) uninsulated wall types and (b) all wall types.

Table 12: Reduction of $kgCO_2$/yr per m^2 of Radflek weighted by heating and wall type

Group of wall types (external walls only)	$kgCO_2$/yr per m^2 of Radflek
(a) Uninsulated solid and cavity walls	18.20
(b) All walls, insulated and uninsulated	12.33

The results in Table 12 are derived using the same methodology as that used for the results for radiator panels in the Ofgem CERT 2008-2011 Technical Guidance Manual[1], paragraphs 1.80 and 1.81.

It should be noted that the above values assume that all installations are behind radiators on external walls of a dwelling. No savings are attributed to installations behind radiators on internal dividing walls in a dwelling.

[1] www.ofgem.gov.uk/sustainability/environment/energyeff/infprojmngrs/pages/infpromngrs.aspx