Filsol Solar Stamax solar water heating systems

Comparative outputs and efficiency factors contributing to the sizing of all Filsol domestic household installations

An aerial view of Filsol Stamax collectors fitted to roofs at Angelina Street, Cardiff.

Issued by S. Young.
05/02/07

Filsol collectors are an approved product within the Low Carbon Building Project grant schemes (pages 1 and 2)

Contents	Page number

Introduction

This document highlights the efficiency that can be achieved by the Filsol Solar Stamax thermal system and provides an indication as to the type of output that can be expected from systems using other forms of solar collectors, inclusive of copper pipe flat plate collectors and evacuated tubes.

The Filsol collector utilises an absorber plate that is manufactured (within the UK) using two thin sheets of stainless steel, these are then seam welded around the outside edge and then intermittently spot welded throughout the body of the panel creating a matrix.

The absorber then has the flow and return ports fitted and is clamped within a 'jig' and inflated using compressed air.

The resulting absorber has a quilted effect over the main part of the absorber, including an expanded header and riser moulded in during the process. The resulting effect is an absorber with the minimum water content to maximum absorber surface area, creating a responsive and efficient solar collector.

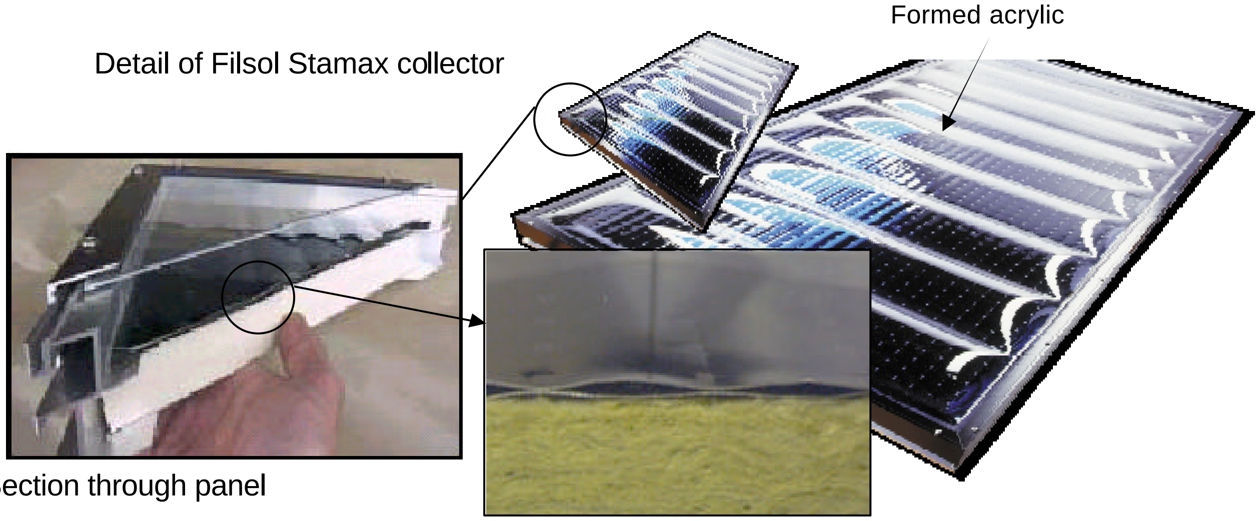
The special selective surface coating is then applied to the absorber and the absorber is then fitted into the collector housing and glazed with the familiar 'blown' acrylic cover.

The acrylic cover is formed into this shape for three distinctive reasons.

1) The distance between the collector and glazing is maximised, reducing thermal transmission losses.
2) The overall strength and impact resistance is greatly increased over that of flat glazing.
3) The design limits thermal currents that can occur with flat glazed collectors, improving the collectors' efficiency.

Formed acrylic

Detail of Filsol Stamax collector



Section through panel

Detail of 'quilting' effect

Tested & certified to EN 12975-2

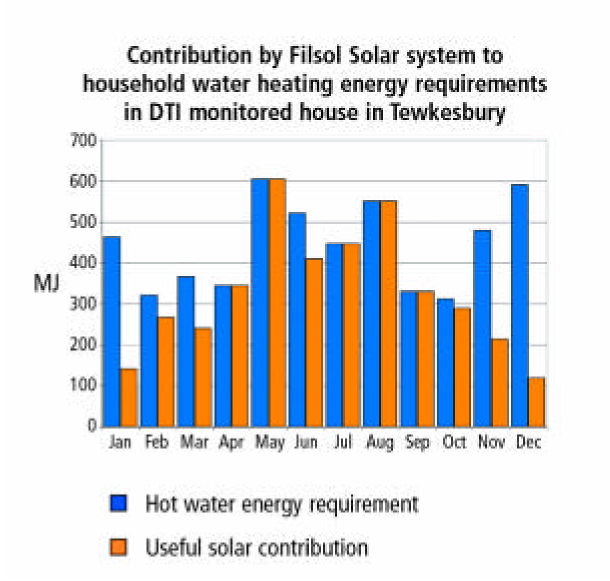
Sizing data

All systems designed by Filsol for the domestic housing market have been sized using the data below in their calculations.

(i) Solar collector efficiency over the range of operating temperatures likely to be encountered in an average year has been estimated to be 65% for Filsol Solar's flat plate collectors based on test data derived on the panel at Cardiff University (tests performed to BS6757).

(ii) Radiation data obtained from 21 year average year figures from Kew Observatory gives a figure of 1,100 kWh / m^2 for the site. At 65% efficiency this results in a solar collector output of 715 kWh / sqm / year for the Filsol Solar Ltd flat plate collectors.

(iii) When this figure is adjusted to account for all solar and DHW system losses the expected average solar water heating system output would be in the region of 440kWh / sqm / year.



Dti side-by-side test results
** Scanned page from Dti report*

Figure 7.1 shows the results from the single hot water run off sequence
Systems, each designed to heat 150ltrs of water per day were tested at Cranfield University for the Dti

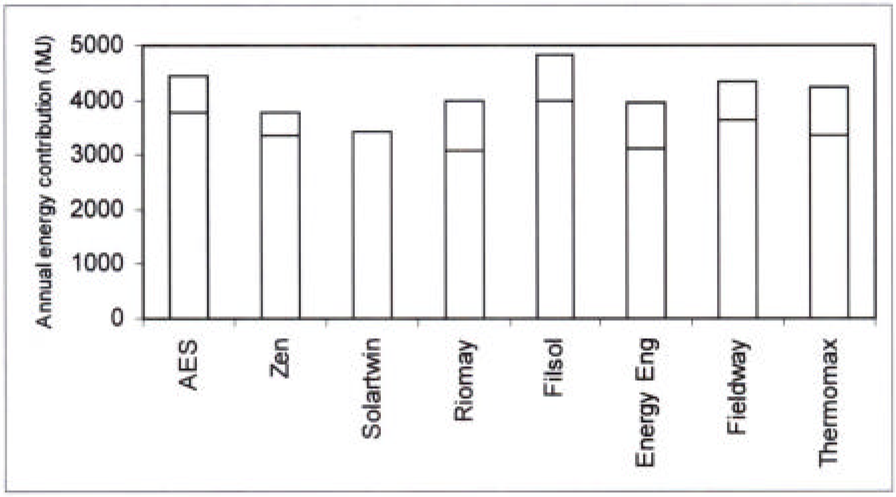


Figure 7.1: Estimated annual performance for each system (single evening run off)

The figure demonstrates very clearly the impact of considering parasitic energy consumption. As expected the effect is most pronounced for the Solar Twin system, where the parasitic energy consumption is zero. When total hot water output is considered this system provides the lowest contribution. However when parasitic energy consumption is taken into account it moves from eighth place to fourth place: a clear demonstration of how important it is to consider all energy paths before assessing systems.

The position of the dividing line, expressed in MJ on Figure 7.1, can be interpreted directly in terms of the primary energy saved by each system, when gas would otherwise have been used to heat the water provided. This can also be expressed in terms of the net reduction in CO_2 emission. Using the values presented above yields:

$$RCO_2 = 0.074 \times Q_{out} - 0.188 \times E$$

where:

RCO_2 is the reduction in CO_2 emission in kg and

E is the system electricity consumption in MJ.

The resulting values are tabulated for all the systems in Appendix C.

Dti side-by-side test results
**Scanned page from Dti report*

Figure 7.2 shows the results from the split hot water run off sequence
Systems, each designed to heat 150ltrs of water per day were tested at Cranfield University for the Dti

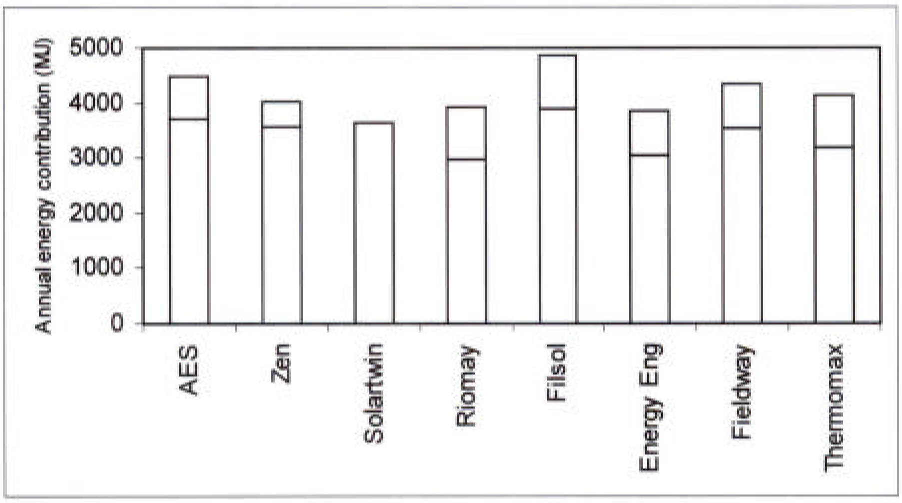


Figure 7.2: Estimated annual performance for each system (split run off schedule)

Once again, including parasitic energy in the assessment makes a significant difference. In this case the Solar Twin system moves from eighth to third place in the ranking.

The figure shows that most of the systems produce slightly less energy when the split run off schedule is used. This is initially a surprising result: it might be expected that running off water early in the day and introducing cold water into the tank would give the system the chance to operate at a higher efficiency during the afternoon, and result in increased output. However, the run off process is likely to disrupt stratification in the tank, which to some extent will reduce this effect. Furthermore, the requirement for hot water first thing in the morning does mean that some must be stored overnight, with corresponding losses. The results presented here indicate that taken together these two effects are just sufficient to overcome the benefits of operation at higher efficiency during the afternoon.

The one exception to this rule is the ZEN system, which actually performs better when faced with the split run off schedule. The reason for this is that the storage tank which is integrated with the ZEN system has a capacity of only 140litres. When a single draw off of 150litres is made in the evening the last 10litres will be effectively at incoming mains temperature, and in comparison with systems with a storage capacity in excess of 150litres the output of the system will be reduced by one part in fifteen, or about 6%. However, when the draw off is spread throughout the day the smaller tank of the ZEN system gives faster recovery and, in contrast to the other systems, performance improves.

Parasitic energy consumption

Set out below is the record of the actual parasitic consumption of the Filsol solar system installed for the side-by-side tests carried out by the Dti.

Pump settings & power rating (Watts):

? 39W *(standard selected setting)*
?? 62W
??? 88W

Month	Electricity consumption (kWh)	Average daily hours running
January	5.5	4.6
February	6.4	5.9
March	8.9	7.4
April	10	8.5
May	12	10
June	13	11
July	12.5	10
August	11.4	9.4
September	9.7	8.3
October	8	6.6
November	6	5
December	5.5	4.5
Total	109	

Financially this equates to around £8 to £11, using a cost per kWh (unit of electricity) of 7.5p to 11.0p

*Hydraulic flow required for systems:
0.75 to 1litre per square meter of solar absorber

Field tested output data

The data shown below was collected during the monitoring of a Filsol active water heating installation at Tewkesbury, commissioned by the Dti.

The results are from a solar system fitted to a domestic property that was then independently monitored by the Dti.

Tewksbury Site details:

Nearest 20yr met. station	Birmingham
Collector area	$4m^2$
Collector orientation	220^0
Collector tilt	30^0
No. of occupants	4

The resulting data enabled the evaluation of the solar fraction as shown in the table below, which has been scanned from the original document DTI/Pub URN 01/781.

1998	SOLAR CONTRIBUTION (MJ)	DHW ENERGY REQUIREMENT (MJ)	USEFUL SOLAR CONTRIBUTION (MJ)	SOLAR FRACTION (%)
JAN	142	463	142	31
FEB	268	322	268	83
MAR	241	366	241	66
APR	359	344	344	100
MAY	702	605	605	100
JUN	410	521	410	79
JUL	514	447	447	100
AUG	685	551	551	100
SEP	399	330	330	100
OCT	290	313	290	93
NOV	215	479	215	45
DEC	120	591	120	20
TOTAL	4345	5332	4075	
AVERAGE				76

This chart shows an average solar fraction of 76% is achieved, i.e. this system would have provided 76% of the households' hot water requirement.

Even with this data available, Filsol only state the given figure of between 60 and 70%, thus ensuring there are no unhappy customers expecting more than has been stated within their quotation.

Collector warranty & life expectancy

- The collector carries a full warranty for 10 years.
- The expected life of the collector is in excess of 25 years (based on previous collectors, as original, fitted & still in service after 25 years)
- The expected service life of the absorber plate (provided the installation manual is followed correctly) is a lifetime, 70 years+

Collector technical details

Stainless Steel, 18% chromium 10% Nickel AISI.

0.5mm thick interrupted seam welded, inflated at 5.7bar.

Selective coating colourless oxide of Chromium, Iron and Nickel, appearing blue. Absoptance 0.93, emittance 0.12.

Chassis, Aluminium extrusion alloy 6063.

Glazing, 3mm Acrylic geo-thermal cover with 89% transmission,ISO180/179.

Exterior trim, Black powder coating to BS 53900.

Insulation, Poly Isocyanurate foam, CFC, HCFC free.

Global warming potential < 5, Ozone depletion value 0.

Backing plate, 0.6mm Aluminium extrusion, alloy 6063.

Roof fixings, Stainless Steel coach bolts, lengths to suit application.

Dimensions:

FS20 2,060mm high x 1,060mm wide: 2.0sqm absorber area

FS16 1,899mm high x 975mm wide: 1.6sqm absorber area

FS14 1,779mm high x 879mm wide: 1.4sqm absorber area