Project Solar LTD
PERFORMANCE ANALYSIS OF RENEWABLE ENERGY SYSTEMS

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Energy Performance Report:
Solar Hot Water System

Energy performance calculations undertaken according to AS/NZS 4234: 2007 (draft)
Heated water systems: Calculation of energy consumption

AS/NZS 4234 is a standard calculation methodology for assessing the expected energy performance of a solar water heating system under standard reference conditions of heat load, climate and system configuration. The calculations are undertaken by computer simulation of previously tested performance of system components operating as a complete system for a full year. The calculations only apply to the configuration of components making up the system being assessed. Any change in the components or their configuration requires a separate calculation to be undertaken.

Report number: SN031 (Provisional)

Client: SUNZ
PO Box 75-685
Manurewa
Auckland

Brand: SUNZ

Model: **CLS2810_Rotex**

Summary of test results

System description:

The Sunz 2810_Rotex system is a pumped flat panel with titanium based absorber system using a 500 L Rotex heat-store tank. The 500 L tank has a dual elements with only the upper element used. The element is thermostatically and timer controlled. The drain-back principle is used for frost protection. There are 150 L above the element. (Details of the system are in the Appendix).

System Name	**CLS2810_Rotex**
EECA Identifier	**SN031**
Heat Exchange Circuit Type	Closed
Heat Exchange Fluid	Water
Pumped or Thermosyphoned	Pumped
Electricity Supply Tariff	Continuous

Calculated System Energy Performance:

	Zone 5 (Auckland) Reference load 39 MJ [a]	**Zone 6 (Dunedin) Reference load 39 MJ [a]**
Energy delivered by solar circuit *[b]*	3325	2917
Supplementary heating *[c]*	249	627
Total energy into tank	3574	3544
Tank storage loss *[d]*	488	451
HW load from system *[e]*	3058	3067
Tank losses (overheating) (kWh)	0	0
Total energy removed from tank	3547	3518

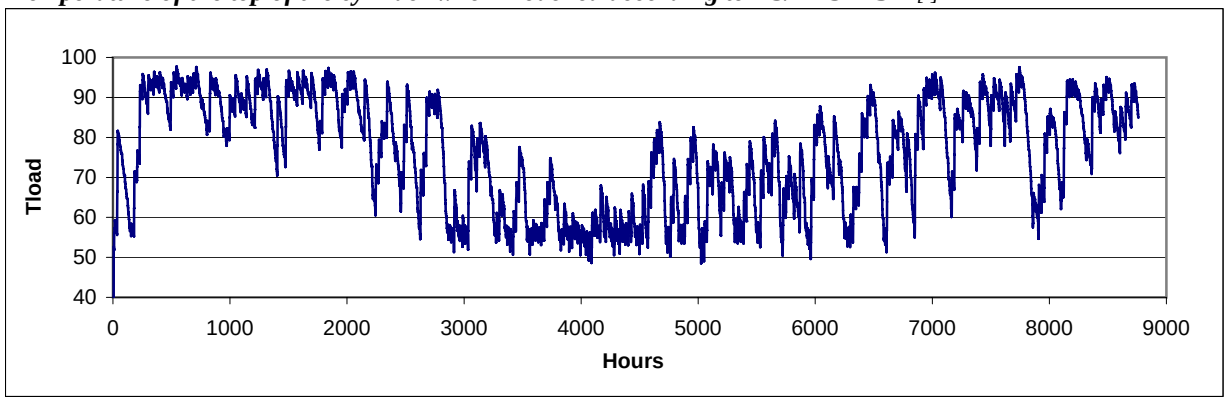
Comparison with conventional hot water system (according to AS/NZS 4234) *[j]*

Annual hot water load delivered (kWh) *[e]*	3056	3056
Reference system storage loss *[g]*	575	624
Reference system electricity consumption	3631	3680
Supplementary heating (kWh) *[c]*	249	627
Pump use(kWh) *[h]*	91	81
Total Annual electricity usage [i]	340	708
Energy Displaced (kWh) [j]	**3291**	**2972**

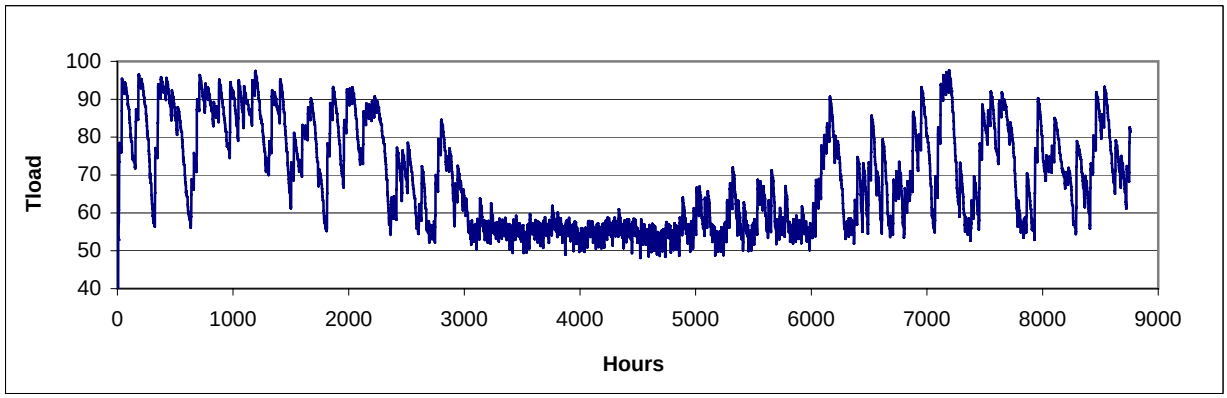
No Solar Test *[k]*

Climate Zone of Test	Zone 5	Zone 6
Peak winter load applied	39 MJ/day	39 MJ/day
Boost mode	Timer	Timer
Minimum delivery temperature	45 ºC	46 ºC

Temperature of the top of the cylinder when modelled according to AS/NZS 4234 *[l]*



Zone 5: Auckland



Zone 6: Dunedin

TRNSYS™ Modelling:
This system has been computer modelled according to the AS/NZS 4234 "Heated water systems: Calculation of energy consumption" , for the Zones 5 (Auckland) and 6 (Dunedin) at a **Peak Daily Load (PDL) of 39 MJ.**

This system has been modelled based on a continuous supply tariff. This tariff covers the use of ripple control where the electricity supply is sporadically interrupted to manage network loading. This report does not apply where the water heater has been connected to a time limited supply option. See Appendix B1 of AS/NZS4234 for more information.

The computer modelling used for this report is based on a number of assumptions, which are outlined in AS/NZS 4234. The system is modelled based on its operation for a year, using reference hot water demand and climate conditions. Whilst these reference assumptions are typical of the conditions to be expected in the respective zone, New Zealand has widely differing climatic conditions throughout each zone. Therefore the energy performance of the system modelled may differ quite significantly to the actual performance in a specific location.

The thermal simulation program, TRNSYS™ version 15 has been used in this modelling. The results are based on the information that has been supplied by the New Zealand system supplier. Modelling has been undertaken by Project Solar Ltd, on the 11. June 2008

These results are Provisional for 6 months from the test date due to the absence of system testing to the Standard AS 2535.1-1999. Test methods for solar collectors – Thermal performance of glazed liquid heating collector. This report is based on performance test result from the ISFH test facility. Test report S1602

Whilst all reasonable care has been taken to ensure the reliability of these results, Project Solar Ltd is not liable for any losses arising from the use of, or decisions made, based on these results. It is the responsibility of the New Zealand manufacturer / supplier of this system to inform Project Solar Ltd of any changes in the specification of any components which are included as part of this system. This report may not be reproduced, except in full, without the written permission of Project Solar Ltd.

Testing Officer:

Adrian Kerr
Project Solar Ltd

Appendix: Configuration of System.

Hot Water Storage Tank

Manufacturer	Rotex Gmbh
Model Number	Sanicube 500 L SC38/0/0
Rated Volume	
Total Volume	500 L
Inner Shell Material	Plastic composite
Standing Heat-loss (kWh/24h at (Tcyl-Tamb)=55ºC	1.40 kWh
Test Lab for Standing Heat-loss Date of test	
Number of Electric Elements	2
Mid positioned element - Heating Capacity	6 kW
Mid positioned element - Element Tariff	Continuously energized
Bottom element - Heating Capacity	3 kW
Bottom element - Element Tariff	Not Connected
Thermostats' Temperature Dead-bands: ON/OFF Temperatures	5ºC:55ºC – 60ºC
Controlled / Uncontrolled Pump Flow (l/h)	Controlled flow system (120 L/hr)
Tank TPR Valve Opening Temperature	99ºC

Solar Collector

Manufacturer	Silimpeks Solar Energy Systems
Model Number	Marvel CLS 2810
Type	Flat Panel
Gross Area per panel	2.780 m^2
Aperture Area per panel	2.530 m^2
Absorber Area per panel	2.510 m^2
Number of Panels used in System	3
Total system aperture area	7.590 m^2
Cover Material	
Absorber Material	Titanium based absorber
Panels connected in parallel / series	--
Test Lab for AS/NZS 2535. Date of Test.	Provisional: ISFH to EN 12975-2. Test # S1602
	$\eta o = 0.772$
	a1 = 3.840
	a2 = 0.0011

System Controller

Manufacturer	SolaStat
Model Number	Plus
Pump Activation Temperature Dead-band: ON/OFF Temperatures (as compared between Cylinder Temperature and Panel outlet Temperature)	7ºC: ON 10ºC. OFF 3ºC
Period when power supplied to mid-element	Continuously energized
Period when power supplied to Bottom element	Not Connected
Maximum Temperature allowed in Cylinder	85 ºC

Controller Functions:

1) Differential controller
2) Overheat protection (85 C)

System Pump

Manufacturer	Wilo
Model Number	Star Z6
Power Consumption	46 W
Flow rate in Simulation (according to AS/NZS 4234's prescription for an uncontrolled-flow system)	2 l/min = 120 l/hour
Flow meter used in system	Yes

Plumbing

Simulated Pipe length from Panel to Cylinder	10 m
Simulated Pipe length from Cylinder to Panel	10 m
Insulation Material around Piping	Aeroflex
Insulation Thickness	13 mm
Insulation Thermal Conductivity at 24ºC	0.037 W/m.K
Insulation Thermal Conductivity at 32ºC	0.038 W/m.K

Additional information specific to the design of this system.

Notes:

1. Explanation of the results:

This report describes the expected performance of the solar system when modelled according to the parameters outlined in the Standard AS/ZS 4234: 2007 (draft). Actual performance when installed will differ from that described in this report due to factors including the timing and quantity of hot water draw-off, the slope and orientation of the collector panels, and the distance between the storage cylinder and the collector(s). However, this report allows for the comparison of likely energy savings achieved by different solar systems, due to the standardization of the calculation methodology.

Copies of the standard are available from Standards New Zealand www.standards.co.nz

2. System operation

The report provides information on the expected performance of the system as a whole. The system components may consist of collector, hot water storage tank, pump, controllers, supplementary heating equipment and pipe work connecting the components. Changes in any of these components will generally result in energy performance being different from that provided in this report. Separate calculations should be undertaken for systems other than that described in this report.

Where there are elements of the system that may differ in actual installation these are prescribed by the standard eg length of pipe work, and collector orientation and inclination.

3. Collector area

A collector is made up of one or more panels which may be in the form of a flat plate, array of glass tubes or a heat shield.

The aperture area is the area in which unconcentrated light enters. The absorber area is the effective area of the panel which absorbs solar energy. In the case of glass tubes, this is typically the planar area of the outer surface of the absorbing glass wall except in the case of parabolic reflectors where the circumference area of the absorbing tube is used. Different interpretations of absorber area can be used, providing it is consistent with the definition used in the test report to AS 2535 (or equivalent).

4. Notations used in report:

[a] The Peak Daily Load (PDL) refers to the maximum daily load required of the water heater during the year. In AS/NZS 4234, the maximum energy demand is required during August. The volume of water discharged from the system on any day is related to the difference between the hot and cold water temperature, the month, and the PDL tested. There are two PDL's used: 39 MJ for 4-6 person households, and 25.6MJ for 1-3 person households.

[b] The energy delivered by solar circuit into the storage tank. It does not include the losses from the solar collector, or pipe losses.

[c] The annual electricity demand of the supplementary heater that is required to meet the hot water delivery requirements of the Standard.

[d] The tank storage loss is the calculated thermal loss from the storage tank during the simulation. It is dependent on the insulation of the tank and the temperature of the water at each level in the tank.

[e] The hot water load from system is the difference in temperature between the cold water entering the tank, and the hot water exiting the tank and the volume of water used, converted to kWh.

[f] To enable the electricity savings achieved by the solar system to be determined, the electricity consumption of a reference hot water system is determined. In this case, the reference system is a NZ MEPS compliant 180 L, steel cylinder with an enamel lining. This type of hot water cylinder is commonly used in New Zealand. This includes the energy lost through storage losses. The energy savings achieved by the system is in part dependent on the PDL tested to.

[g] The annual heat loss of the reference hot water storage tank. In New Zealand, the Reference Tank is a 180 L hot water cylinder, compliant to the minimum NZ MEPS requirements, as defined in AS/NZS 4692.2:2005.

[h] The annual electricity demand of the solar circulation pump.

[i] The total electricity demand of the solar system.

[j] The quantity of electricity that is avoided though the use of the water heater, when compared to what the 180l reference domestic hot water system would use to achieve the same hot water delivery requirements. If systems do not achieve 50% energy savings from solar, they are modelled as a small system (25.6 MJ).

[k] The No-Solar test ensures the solar water heater has sufficient flexibility in meeting the hot water demand during extended periods of no solar radiation. In order the meet the requirements of the Standard, all hot water deliveries throughout the year must be hotter than 45ºC.

[l] The temperature at the top of the cylinder throughout the year for the simulation is shown to improve the understanding of how the test system has performed under the test conditions. There are 8760 hours in a year, excluding leap years.