NZS 4613:1986

Domestic Solar Water Heaters

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Building Research Association of New Zealand
Department of Scientific and Industrial Research —
  Physics and Engineering Laboratory
Electrical Development Association
Institute of New Zealand Plumbing and Drainage Inspectors
Ministry of Energy
New Zealand Society of Master Plumbers and Gasfitters
Solar Equipment Manufacturers' Association

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AMENDMENTS

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CONTENTS

(Contents continued overleaf)

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RELATED DOCUMENTS

Reference is made in this Standard to the following:

NEW ZEALAND STANDARDS

NZS 1300:1965	General requirements for electrical appliances and accessories
NZS 4223:1985	Glazing in buildings
NZS 4602:1976	Low pressure thermal storage electric water heaters with copper cylinders
NZS 5224:- - -	Power driven circulators
Part 2: 1980	Domestic glandless pumps

AUSTRALIAN STANDARDS

AS 1580:- - - -	Methods of test for paints and related materials Method 408.4 (1980) Adhesion (cross-cut)
AS 2535:1982	Glazed flat-plate solar collectors with water as the heat-transfer fluid — Method for testing thermal performance
AS 2712:1984	Solar water heaters — design and construction
AS 3142:1982	Electric water heaters

NEW ZEALAND LEGISLATION

Drainage and Plumbing Regulations 1978
Electrical Wiring Regulations 1976
Gas Industry Regulations 1978
Radio Interference Regulations 1958
Water Supplies Protection Regulations 1961

OTHER PUBLICATIONS

BENSEMAN, R F and COOK, F W. Solar radiation in New Zealand — The standard year and radiation on inclined slopes. New Zealand Journal of Science Vol. 12 No. 4, December 1969.

BENSEMAN, R F and WESTERN, B. E. A method of testing domestic solar water heating systems. PEL Report No. 725, May 1981.

BLAKELEY, P W and COOK, D C. Household electricity consumption in New Zealand. Paper to world energy conference, Detroit, September 1974.

WESTERN, B E. A short method of testing domestic solar water heating systems for rating purposes. PEL Report No. 859, October 1983.

FOREWORD

This Standard supersedes Standards Association of New Zealand Miscellaneous Publication MP 4613:1979 *Solar water heating equipment* Part 1 *Specification for solar water heating equipment.*

It has been prepared so that recognized test procedures would be available in New Zealand for measuring the thermal performance of a complete domestic solar water heating system. The system would comprize a solar collector arrangement, one or more storage tanks and an electrical heater to ensure that a set water temperature would always be available. In New Zealand, solar water heaters are almost invariably used as pre-heaters to electrically heated tanks. However, other systems may become more widely used and provision for such systems has therefore been made.

There are methods for testing the components such as collectors and storage tanks but no reliable method exists for determining the system performance from the performance of its components.

The test procedures described are based on the technique developed by DSIR (refer Benseman and Western, 1981 and Western, 1983) for testing complete systems over a period of 12 months. The reason for testing over 12 months was to ensure that the system experienced a full range of weather conditions.

Since 12 months is long for general rating purposes, a procedure is needed which will provide a sufficiently accurate result over a shorter period. Any such test must take account of the fact that it is ultimately an estimate of the annual performance which is required.

The use of a solar simulator might seem to answer this problem as it would appear to provide complete control of the test conditions. There is, however, considerable technical difficulty in obtaining artificially an imitation of the solar spectrum uniformly distributed over four or more square metres. The provision of artificial atmospheric conditions covering a sufficient range would involve a very elaborate test installation and the cost of such an installation would probably be prohibitive.

If an estimate of annual performance is to be obtained, then it must be clear that a very short test, that is, lasting a few days, cannot be expected to give such a general result, but only a result which is applicable to the particular conditions experienced.

Often however, a quick test from which only a very approximate estimate of annual performance can be derived, would be adequate, or a quick estimate is desired before embarking on the longer and probably more expensive test procedure.

This Standard, therefore, describes two test procedures, one which lasts 3-4 days and provides a specific result depending on the conditions on one day only and from which a very approximate estimate might be made of annual performance, and another which will take some 30 days, depending on the range of conditions experienced, to provide a reliable estimate of performance. The test would be continued until the desired tolerance of estimation was achieved.

Part 2 of MP 4613 *Code of practice for installation of solar water heating equipment* is also being revised and is being issued concurrently as NZS 4614.

NEW ZEALAND STANDARD

DOMESTIC SOLAR WATER HEATERS

Part 1 General requirements

101 SCOPE

101.1

This Standard provides a specification for solar collectors and ancillary equipment used in domestic type hot water supply systems.

101.2

The specification provides a basis for the selection of materials for, and the design and operation of, such equipment to give satisfactory service under general New Zealand conditions.

101.3

The specification applies to auxiliary systems as well as systems in which water is heated by solar radiation only.

102 DEFINITIONS

102.1

In this Standard, unless inconsistent with the context, the following definitions apply:

ABSORBER. A device within a collector for absorbing radiant energy and transferring this energy as heat into a fluid.

AMBIENT. The environment surrounding the systems being tested. The main influences are air temperature, solar radiation, air velocity, and precipitation in various forms.

The ambient temperature is the air temperature. It may refer to the outside ambient temperature in the neighbourhood of the solar collectors or to the temperature in the neighbourhood of the system tank or tanks, which may be inside the test building.

COLLECTOR. A device containing an absorber. Collectors may be provided singly or as multiple units supplying to a common container.

COLLECTOR APERTURE. The net area available for transmission of solar radiation through the outer air/cover interface.

COLLECTOR COVER. The material covering the collector aperture to provide thermal and environmental protection.

CONTAINER. The vessel, including fittings, in which the heated water is stored; sometimes referred to as a storage container, cylinder or tank.

DOUBLE BARRIER HEAT EXCHANGER. A type of heat exchanger construction in which the failure of two elements or barriers is required before the two heat exchange fluids can mix.

FLAT PLATE COLLECTOR. A non-concentrating collector in which the absorber is essentially planar.

GROSS CROSS-SECTIONAL AREA. The overall or outside area of a flat plate collector. It is usually slightly larger than the absorber area since it includes the framework required to hold the absorber.

INCIDENT ANGLE. The angle between the sun's rays and the normal to the collector.

INCLINATION ANGLE. The angle between the absorbing surface of the collector and the horizontal.

INDIRECT SYSTEM. A solar water heating system in which the fluid passing through the collector is not the fluid ultimately drawn from the hot taps.

LONG TERM MEAN RADIATION. The mean annual total radiation received on 1 m^2 of surface. These values can be obtained from the Meteorological Office data for a 10-year period and represent the average annual radiant energy received by a surface in New Zealand. The mean annual value is divided by 365 to give the long term daily value. These are the values given in Appendix B for Wellington at various inclination angles.

POTABLE WATER. Water fit for human consumption.

PYRANOMETER. A radiometer used to measure the total solar radiation incident upon a surface per unit time per unit area. This energy includes the direct radiation, the diffuse sky radiation and the solar radiation reflected from the ground.

SINGLE BARRIER HEAT EXCHANGER. A type of heat exchanger construction in which the failure of one element or barrier will allow the two heat exchange fluids to mix.

SOLAR CONTRIBUTION. The quantity used to express the total system performance. It is the energy extracted from the incoming solar radiation over a given period and delivered to the hot water system. It may be expressed as an energy quantity or more generally as that percentage of the total energy delivered by the system which is supplied by solar radiation. If expressed as a percentage it may be referred to as SOLAR FRACTION.

SOLAR PREHEATER. A solar water heater not containing a means of auxiliary heating and installed to preheat the cold water supply prior to its entry into any other type of domestic water heater.

SOLAR RADIATION INTENSITY. The rate of solar radiation received by unit surface area in unit time (W/m^2).

SOLAR WATER HEATER. A system normally consisting of collector and a container which may be integral, close coupled or remote, and which heats water by means of radiant energy from the sun. Where it is not a pre-heater it will normally be fitted with, or connected to, an auxiliary heating source.

TOTAL SOLAR RADIATION. The total energy per unit area received by a specified surface over a specified period. For the purpose of the system tests this is the radiant energy received in one 24 hour period. (kWh).

TRANSFER FLUID. The medium, such as air, or other fluid which passes through or in contact with the collector and carries the thermal energy away from the collector.

102.2

For the purposes of this Standard, the word 'shall' refers to practices which are mandatory for compliance with this Standard. The word 'should' refers to practices which are recommended or advised.

103 SELECTION OF MATERIALS

103.1

Materials used in the construction of solar water heaters shall be selected for their suitability to in-service conditions such as direct sunlight, rain, wind, hail, snow and frost, high temperatures and condensation.

103.2

All materials used in the construction of solar equipment shall have an expected in-service life of at least 15 years unless specifically excluded by the manufacturer.

103.3

All materials that are joined directly to, or contact other materials shall have sufficient chemical compatibility with those materials to prevent corrosion or other deterioration that would impair their function during their intended service life. Materials used in collectors shall be such that no gases or decomposition products of a toxic or hazardous nature and level, or which tend to reduce the efficiency or life of the collector, are produced under service operating conditions.

103.4

The design and construction of solar equipment shall not introduce, or cause the introduction of, toxic substances or impurities into potable water.

104 DURABILITY

104.1

Collectors shall have an expected service life of at least 15 years with no loss of fitness for purpose or rapid aesthetic degradation during this period. Replaceable material, such as plastic translucent covers, and maintainable material such as paint finishes, may be specifically excluded by the manufacturer provided this is specified and replacement or maintenance details are provided.

104.2

Other components of any system should have a life expectancy similar to that of similar components in a hot water service system.

104.3

Compliance with this section shall be by assessment carried out by an independent accredited authority.

105 COMPLIANCE WITH NEW ZEALAND STANDARDS

105.1

All materials used, and all components and ancillary equipment, shall comply with the requirements of relevant New Zealand Standards.

NOTE — Attention is drawn to the need to comply with the requirements of the following regulations:

Drainage and Plumbing Regulations
Electrical Wiring Regulations
Gas Industry Regulations
Radio Interference Regulations
Water Supplies Protection Regulations

Part 2
Design and construction

201
COLLECTOR

201.1
Absorber

201.1.1

The absorber shall be so designed that solar radiation is effectively converted to heat.

201.1.2

The absorber shall be capable of conducting the generated heat effectively to the transfer fluid.

201.1.3

Where water is used as the transfer fluid the absorber material in contact with the water shall be compatible with other materials in the water circulation both within the collector and the solar water heater.

201.2
Attachment of absorber tubing

Where the fluid-ways of the absorber are formed from tubing as opposed to being formed integrally with the absorber plate, the tubing shall be permanently and firmly attached to the absorber plate. The joint between the tubing and the absorber plate shall be capable of withstanding the stagnation temperature of the absorber without any degradation.

201.3
Painted absorber coatings

Where the absorber surface is painted, the adhesion of the paint coating shall be such that, when tested in accordance with AS 1580 Method 408.4, it shall achieve an adhesion classification of 0. The test shall also be carried out after 24 hours at 120 °C and an adhesion classification of 0 shall be achieved.

201.4
Thermal insulation of collector

201.4.1

The collector shall be insulated at the back of the absorber so that the thermal resistance exceeds 1.0 m^2 °C/W.

201.4.2

Thermal insulation material used in the fabrication of the collector shall comply with the following requirements:

(a) It will not become depressed and leave uninsulated voids during transportation or installation, or cause corrosion of any part of the collector with which it is in contact

(b) Be placed and contained so that its efficiency is maintained and contact with, or absorption of, moisture prevented and attack by vermin is deterred

(c) It will not degrade or outgas when subject to the temperature reached under stagnation conditions.

201.4.3

Where the design of the collector unit is such that insulating material will be exposed to sunlight under operating conditions, the insulation material shall not be subject to degradation by ultraviolet radiation.

201.5
Collector case

201.5.1

The collector case shall be durable (see 104), weathertight and sufficiently robust to withstand transport, installation and service forces.

201.5.2

The collector shall be designed to prevent retention of condensation. Unless hermetically sealed, internal spaces should be vented by drain holes of at least 5mm diameter at the lowest point or points.

201.6
Translucent cover plates, gaskets, sealants, hoses and grommets

201.6.1

The collector cover shall be of glass or other suitable transparent material.

Evidence as to suitability which would normally be required include:

(a) Minimal change in spectral transmission on weathering during its service life

(b) Thermal coefficients of expansion which can be easily accommodated by the sealing detail

(c) Ability to shed soiling under natural rain washing

(d) Resistance to thermal shock, such as sudden rain when the collector is at its maximum operating temperature.

Where glass is used for glazing the design shall comply with the relevant requirements of NZS 4223.

201.6.2

The translucent cover material shall be securely fastened and sealed in a fashion which makes provision for thermal expansion and contraction of the cover and the collector case. Except where it is known that the seal has a life equal to that of the collector, and that servicing of the internal components of the collector will not be required, the seal shall be designed so as to be capable of renewal at specified intervals.

201.6.3

Where the design of the collector is such that sealing materials, gaskets, grommets, or hoses will be exposed to heat or sunlight under operating conditions, the manufacturer of the equipment shall have obtained test results to show that exposure to ultraviolet radiation, heat, and moisture does not impair the ability of the material to fulfil its function. Sealants and gaskets shall continue to adhere to their substrate and withstand the forces generated in service by thermal expansion of collector components. Hoses shall remain crack free, and hoses and grommets remain flexible and liquid-tight.

202 ROUTINE TESTS BY MANUFACTURER

202.1

Collectors which have been type tested in accordance with 203 shall be submitted by the manufacturer to those tests considered necessary to ensure continued compliance of production collectors with the manufacturer's specification and this Standard or to such tests as may be required under a scheme of supervision and control for certification purposes.

202.2 Pressure test

202.2.1

Where absorbers are an assembly of components, or manufactured in such a manner that leaks are a possibility, every absorber assembly shall be pressure tested without showing evidence of leakage.

202.2.2

High or mains pressure collectors shall be tested either hydraulically for 60 s at not less than 2 MPa (200 m head of water) or pneumatically for 60 s at not less than 700 kPa. Low pressure only collectors shall be tested hydraulically at twice their rated maximum working pressure.

202.3 Paint absorber coating

Where paints are being used as absorber coatings, an adhesion test as per 201.3 shall be carried out on every batch and at intervals not greater than eight hours for continuous production, by painting a panel of the same substrate, after the same pretreatment, under the same conditions.

203 TYPE TESTS

203.1 Thermal performance

203.1.1

Where the thermal performance characteristics of a glazed flat-plate collector operating with water as the transfer fluid is required it should be tested in accordance with AS 2535. The thermal performance characteristics may be used to estimate the performance of the collector when subjected to different ambient conditions and load requirements and can be used as a basis for rating different collectors.

203.1.2

Where the performance of a complete system is required refer to Part 3.

203.2 Pressure test

203.2.1

High or mains pressure collectors shall be tested hydraulically for 60 s at not less than 2 MPa (200 m head of water).

203.2.2

Low pressure only collectors shall be tested hydraulically for 60 s at twice their rated maximum working pressure.

203.3 Resistance to stagnation conditons

When subjected to solar radiation under conditions of no fluid flow, in accordance with Appendix E, there shall be no appearance to the naked eye of any structural failure of the collector which would impair its serviceability or durability.

203.4 Structural strength

203.4.1

The collector as a fully assembled and finished unit shall withstand without leakage, damage or undue permanent distortion, a force equal to not less than 50 % of its gross weight when charged with water, applied vertically downward at any one of its corners with the other three corners rigidly fastened in a horizontal plane.

203.4.2

The collector case shall be capable of transferring wind, earthquake and gravity loads to the fixings and/or mountings.

203.5
Torque test on fittings

203.5.1
Test sample

For solar water heaters for operation at a head exceeding 20 kPa (2 mH_2O), the torque test shall be performed on the unit that was subjected to the pressure test (see 203.2).

203.5.2
Requirement

203.5.2.1

Solar water heaters and water fittings on both container and collectors shall withstand without apparent distortion a torque of 34 N.m applied at the end of each water fitting.

203.5.2.2

Care shall be taken that the fitting is not crushed during this test.

203.5.2.3

For solar water heaters having non-metallic single shell containers or non-metallic collectors, each water connection shall be undone after the torque test and there shall have been no movement between the connection and the container or collector as a result of this test.

204 FINAL INSPECTION

204.1

A collector which has been tested in accordance with 203.2 to 203.5 inclusive shall be dismantled and inspected visually for evidence of damage to, or deterioration of, internal components. Acceptance criteria shall be as follows:

(a) Collector cover: No evidence of breakage, separation from the box, or deformation having resulted in permanent or temporary contact with the absorber or (where applicable) another cover plate. No evidence of materials other than water having condensed on the inner surface of a cover

(b) Absorber: No evidence of breakage, rupture, separation from attached fluid conduit, collapse of fluid conduit, brazing alloys having melted during testing, or deformation having resulted in physical contact with a collector cover or other component with which contact is not intended

(c) Absorptive surface: No evidence of checking, chalking, crazing, cracking, blistering, flaking, or any corrosion on coated surfaces of absorbers affecting more than 1 % of the surface area

(d) Collector case or enclosure: No evidence of cracks or openings having been caused by testing, nor any sign of incipient corrosion, or possibility of any leakage

(e) Gaskets and sealants: No evidence of separation of the gasket or sealant from the sealed surfaces, of cracking, or of any displacement or of any change (for example, loss of elasticity or adhesion) resulting in loss of effective sealing action

(f) Thermal insulation: No evidence of disintegration, delamination, contraction, expansion, or melting of the thermal insulation.

Part 3
Determination of the thermal performance of complete systems

301
PURPOSE

301.1

The purpose of the test is to introduce the solar water heater into an environment that would be representative of a good domestic installation, and then subject it to a programmed demand for hot water that is as nearly as possible representative of that to be expected in an average home. The energy use of the solar assisted system can then be measured under realistic conditions.

301.2

Two test procedures are described, one designed to provide an approximate indication of performance after a few days of testing and the other involving some weeks of testing which will give a measure of annual performance to a stated tolerance.

302
APPLICATION

302.1

The method applies to a solar water heater in which cold water from a main supply enters through a single inlet, is preheated by solar radiation, and then boosted if necessary with electrical energy so that the water temperature is raised to the required level. The water is delivered finally through a single outlet to the household plumbing system.

302.2

It is not applicable to a system where there is no boosting facility, or to a system using any energy source other than electricity, for example, gas, oil or solid fuel, as a boosting means.

302.3

The collectors may be of any configuration and may use any transfer fluid.

303
TEST INSTALLATION AND TEST SITE

303.1
General

The test site and the mounting of the solar water heater should be chosen so that they duplicate a favourable house location, that is, the site should receive a large proportion of the total available solar radiation, should face north, should not be shaded during the main heating period of the day, and should not be unduly exposed to wind.

303.2
Test site

The test site shall be totally free of shading during the three hours each side of solar noon.

NOTE — For north-facing surfaces most of the useful solar radiation is received during the middle of the day, and shading at the beginning and end of the day has little effect on the performance of most fixed collectors, since at large incidence angles the normal component of radiation is very small, and amounts to no more than a few percent of total useful insolation.

303.3
Equipment enclosure

An enclosure shall be provided either as part of the collector mounting structure or as an adjacent building. This enclosure shall house any items of the system under test which would normally be inside a house and where appropriate may also house any measuring equipment. The enclosure shall comprise roof, walls and floor and be of sufficient height to allow water cylinders to be mounted within it. The enclosure shall be essentially free of draughts but need not be thermally insulated.

303.4
Site foreground

For at least 10 m in front and to the sides of the test site, the ground shall have a solar reflectivity no greater than 0.2.

NOTE — This condition is satisfied by asphalt, weathered concrete, grass, and many paving surfaces. The object is to exclude situations where unrealistic amounts of reflected radiation are directed to the collectors.

303.5
The installed system

303.5.1

The system under test shall be a total system including all components from the cold water drawn from the local supply to the pipe from which must be delivered hot water at the times, temperatures, and in the quantities specified. The nominal rating of the electric heating element shall be 1500 W unless the system is specifically designed otherwise and in any case shall not be less than 1000 W.

303.5.2

The supplier or his agent shall be allowed to install the system such that maximum performance may be achieved.

303.6
Electrical supply

A nominal 230 V, 50 Hz electrical supply shall be available, normally of 1500 W for the heating element and 50-200 W for pumps and controls. It would be unusual to require more than 2000 W.

304
TEST CONDITIONS

304.1
Water supply rate

304.1.1

When discharging freely through at least 1 m length of 15 mm N.B. copper tube, the system should be capable of maintaining a flow of not less than 10 L/min.

304.1.2

The supply pressure shall be not less than 350 kPa (35 mH_2O) but may be dropped to a lower pressure by a heading tank or pressure reducing valve as required.

304.2
Hot water demand

Hot water shall be drawn daily from the system for the period of the test. One of three schedules shall be used, requiring 205, 160 or 130 litres of hot water per day. The temperature of these daily demands, and the times at which specified proportions are to be supplied are listed in table 1.

NOTE — All three delivery schedules require about the same amount of energy and if delivered by a fully electric system would use about 4000 kWh annually. This is close to the national average (refer Blakeley and Cook, 1974). The reason for testing with different schedules is that the energy contributed by the solar preheater is very significantly affected by the quantity of water drawn through the system each day. For example, the energy savings under schedule C could be only about 60 % of those under schedule A.

304.3
Alternative demand

An alternative schedule may be used if the system to be tested is intended for use in a situation where the hot water requirements are significantly different from the national average. The reasons for adopting an alternative schedule must be clearly stated in the test report.

305
SHORT TEST FOR THERMAL PERFORMANCE

305.1

This test is to be used when it is considered that an approximate estimate of performance is sufficient, to decide if it is worth embarking on the more accurate long test or simply to determine if a system is functioning.

305.2
Test procedure

With the system set up as described in 303, the following procedure is to be followed:

(a) Determine the schedule of daily demand and

Table 1
DAILY DEMANDS AND DELIVERY TEMPERATURES FOR COMPLETE SYSTEM TESTS

Delivery time (1)	*Daily demand (2)*			*Proportion of daily total*
	Schedule A	*Schedule B*	*Schedule C*	
HRS	*L*	*L*	*L*	*%*
0700	14.4	11.2	9.1	7
0730	47.1	36.8	29.9	23
1000	41.0	32.0	26.0	20
1300	14.4	11.2	9.1	7
1600	20.5	16.0	13.0	10
1800	12.3	9.6	7.8	6
2200	55.3	43.2	35.1	27
Total	205	160	130	100
Delivery (3) temperature	50 °C	60 °C	70 °C	

NOTE —
(1) Local clock time
(2) Litres at 15 °C
(3) A tolerance of ±3 °C is permitted

delivery temperature which is to be used for the test (see 304.2)

(b) Disconnect the collector so that no solar input is possible. If this cannot be done the collectors may be covered although it is often difficult to do this such that no solar input occurs.

NOTE —
(1) The use of 60-70 mm thickness of white expanded polystyrene will keep the solar input to less than 20 W.
(2) If collectors are disconnected it may be desirable to cover them to prevent damage, caused for example, by boiling.

(c) With the collectors inoperative, subject the system to draws of water so that the solar store (either separate tank or part of a combination tank) contains no heated water. Then allow the electrical heater to raise the water temperature in the electrically heated tank, or part of tank, to the temperature corresponding to the chosen schedule

(d) Choose a time, preferably in the early morning, when there is no electrical input and reconnect and/or uncover the collectors so that the system functions normally.

The system shall then be subjected to the chosen schedule for 24 hours. During this time the tank must be maintained at the chosen temperature and the following measurements made:

(i) Total solar radiation received per square metre by the collectors.

(ii) Input to the electrical heating element.

(iii) Mean temperature of the cold inlet water.

(iv) Mean temperature of the water drawn off.

(v) Mean ambient temperature in the neighbourhood of the collectors during daylight hours.

(vi) Mean ambient temperature in the neighbourhood of the electrically heated tank during the 24 hours.

(vii) Mean wind speed during daylight hours.

(viii) Quantity of water delivered during each 24 hour period.

(e) After 24 hours, make the collectors again inoperative and repeat the measurements of subsection (d), except for items (i), (v) and (vii) over a further 24 hours

(f) During a further 24 hours repeat the measurements of subsection (d), except for items (i), (v) and (vii).

305.3 Results and calculations

305.3.1

For the measurements to be valid, the following conditions must be satisfied:

(a) The quantity of water drawn off and the mean temperature of the delivered water shall be within the limits described in 307

(b) The temperature of the cold inlet water shall not vary over a range of more than 2 °C (See Appendix D)

(c) The mean ambient temperature in the neighbourhood of the electrically heated tank shall not vary over a range of more than 5 °C.

305.3.2

Then the system performance for the particular value of total solar radiation obtained, will be given by the solar contribution (E_S) using the equation:

$E_S = 2E_3 - E_2 - E_1$ (see Appendix A)

where E_1, E_2 and E_3 are the inputs to the electrical heating element for the first, second and third 24 h periods respectively.

305.3.3

Then the performance expressed as a percentage of the energy used will be given by the solar fraction:

$$F_S = \frac{E_S \times 100}{E_3}$$

NOTE — The mean wind speed is not used in calculating performance but should be known as an indication of the conditions during the test.

306 LONG TEST FOR THERMAL PERFORMANCE

306.1 General

306.1.1

The system shall be installed on the test site in accordance with provisions of 303 and shall operate for a period of at least 3 days before any test data are recorded formally.

306.1.2

The test may start at any time of the year and shall continue until the conditions of 306.3.6 are satisfied.

306.1.3

The system shall be operated to the chosen schedule (see 304.2), measurements shall be made in 24 hour periods and each period shall start at a suitable time in the morning before 0900 hours. A time should be chosen so that the tank may be expected to be up to temperature and the electrical heater not operating. 0700 hours or just before would be appropriate in terms of the schedule of table 1.

306.1.4

The procedure shall be carried out for each of the schedules of table 1 unless there is a clear reason why results are not required at any particular schedule or some other schedule is required. When changing from one schedule to the next, a settling period of at least two days shall be allowed before results are again formally recorded.

306.2 Measurements

306.2.1

The following measurements shall be made every day at the time chosen for the start of each 24 hour test period:

(a) Input to the electrical heating element during the previous 24 hours

(b) Total solar radiation received by the collectors during the previous 24 hours.

306.2.2

The following measurements shall be made during each draw of water:

(a) Quantity of water drawn off. If the control of the draw of water is sufficiently accurate, (see 307) measurement of each draw may be unnecessary

(b) Mean temperature of the water drawn off.

306.2.3

The following measurements shall be made throughout each 24 hour period:

(a) Mean ambient temperature in the neighbourhood of the electrically heated tank

(b) Mean ambient temperature in the neighbourhood of the solar store

(c) Mean temperature of the cold inlet water (See Appendix D)

306.2.4

The following measurements shall be made during daylight hours for each 24 hour period:

(a) Mean ambient temperature in the neighbourhood of the collectors

(b) Mean wind speed in the neighbourhood of the collectors.

If it is difficult to measure ambient temperatures during the entire test periods measurements may be made during the drawing of water only, in which case a weighted mean temperature shall be calculated to allow for the distribution of the draws during the period.

NOTE — A weighting found to give satisfactory representation of the mean in one particular application is given in Appendix C. It is essential that the persons carrying out the test evaluate a suitable weighting for the circumstances.

306.3 Analysis procedure

306.3.1

Daily integrated values of energy used, energy delivered and total solar radiation are obtained from which daily values of the solar contribution are calculated.

306.3.2

The relationship between solar contribution and total solar radiation is then represented by linear regression of solar contribution per day on total solar radiation per day. From this a regression estimate is made of the solar contribution at the long term mean daily radiation (See Appendix B).

306.3.3

In order to obtain values of solar contribution it is first necessary to measure the losses from the electrically heated tank.

306.3.4
Measurement of losses

With the collectors disconnected from the solar store the measurements described in 306.2 shall be made (with the exception of solar radiation and outside ambient temperature) for at least 4 days and until the mean value of loss coefficient has been determined with a standard error of ±5 % or better.

NOTE —
(1) If the solar store is combined with the collectors, it may be necessary to reconnect the cold water inlet to the electrically heated tank.

(2) It may be a wise precaution to cover the collectors while they are disconnected to prevent damage by overheating.

306.3.5
Calculation of loss coefficient

The losses during any 24 hour period will be given by:

$$E_m = E - c \sum_{1}^{n} Q_n(\theta_d - \theta_i)$$

The loss coefficient will be given by:

$$K = \frac{E_m}{\theta_d - \theta_a} \quad \text{kWh per °C day}$$

306.3.6
Termination of testing

Once the preheat period has passed, (see 306.1.1) measurements shall be made every day in accordance with 306.1 and 307 until the following conditions are satisfied:

(a) At least 8 integrated daily values of electrical energy used by the system and total solar radiation have been recorded and the values are consecutive

(b) The daily total solar radiation values are distributed over a range of at least 2:1

(c) There are at least 3 values of daily total solar radiation on each side of the long term mean daily radiation at which the estimation of solar contribution is required

(d) The standard error of regression estimate is less than 5 % of the estimated value of solar contribution.

306.4
Results and calculations

306.4.1

The daily measurements described in 306.1 shall be used to calculate the solar contribution (E_S) per day from the equation:

$$E_S = c \sum_{1}^{n} Q_n \theta_d + K(\theta_d - \theta_a) - E$$

These daily values of E_S may be regarded as a function of R the daily total solar radiation received and a linear regression shall be calculated of E_S on R.

306.4.2

When enough consecutive points have been obtained to satisfy the conditions of 306.3.6 a regression estimate of solar contribution (E_S) at the long term mean value of radiation is determined (see Appendix B). This value multiplied by 365 is the estimate of annual solar contribution with a standard error of ±10 %.

306.4.3

The solar fraction will then be given by:

$$F_S = \frac{E_S}{E_S + E} \times 100\%$$

where $E_S + E$ is the average of this sum over the period of the test.

This represents the percentage of the energy produced by the system, (including losses from the electrically heated tank) which is provided from incident solar energy.

306.5
Length of test and tolerance of estimate

306.5.1

The conditions listed in 306.3.6 are concerned with the minimum requirements. It is unlikely that weather conditions would be such that 8 daily values of solar contribution and total solar radiation would be sufficient to satisfy the requirements. However, observation has shown that 20 values would probably be sufficient and it is unlikely that more than 30 would be necessary.

306.5.2

Studies of the results of many tests over 12 months have shown that the above procedure will produce the result of 12 months of test to within 10 %. The standard error of regression estimate is not itself sufficient in this case to define the confidence interval.

306.6
Variations on the set temperatures

If the system under test employs a special system of temperature control such that the temperature tolerances on the delivered water (see 307) cannot be met, and this temperature control is an essential part of the system operation, then the range of temperature of the delivered water shall be noted together with the percentage of the delivered energy which is outside the temperature limits and the equation of 306.4 for the solar contribution shall be separately evaluated for all draws which are above or below the temperature limits.

307
INSTRUMENTATION

307.1
Hot water demand

The quantity of water delivered shall be measured and controlled by any means that ensures that the volume delivered at any particular time is within ±5 % of the volume detailed in table 1 and that the total daily volume delivered from the system is within ±2 % of the schedule requirement. All demands shall start within five minutes of the times specified, and be completed within the period appropriate to a flow of 10 L/min.

NOTE — Either volumetric or gravimetric control and measurement may be used. The timing of draws must be close to the defined times because some systems are affected significantly by the time of demand.

307.2
Delivery temperature

307.2.1

The electrically heated cylinder shall be controlled so that it can always deliver water within ±3 °C of the temperature required by the particular schedule. The temperature shall be measured at a location in the delivery line not more than 200 mm from its point of connection to the cylinder. The temperature shall be measured to an accuracy of ±0.5 °C, and only when water is flowing from the delivery line.

307.2.2

If the system under test employs a special system of temperature control such that the above tolerances cannot be met, then the system would only be acceptable for test if those wider tolerances were an essential part of the system operation (see 306.6). In this event the test report shall make clear that the increased temperature variations were an integral part of the system function.

307.2.3

The measuring device shall have a time constant not greater than 10 seconds so that an accurate measurement can be achieved during the relatively short time taken to satisfy the smaller demands.

NOTE — Because bi-metallic thermostats are difficult to set accurately, a suitable controller that can be installed in the thermostat pocket of the electrically heated cylinder may have to be supplied by the test laboratory.

307.3
Ambient temperature

All ambient temperatures shall be measured by any convenient means which gives an accuracy within ±0.5 °C. Thermocouples, and resistance thermometers are particularly suitable since these permit remote monitoring.

307.4
Cold water supply

The temperature of the cold water entering the system shall be measured by any convenient means which gives an accuracy within ±0.5 °C.

307.5
Electrical energy

The electrical energy used by the system shall be measured with a kilowatt-hour meter accurate to within ±1 %.

307.6
Solar radiation

The total global solar radiation received by a surface at the same inclination angle and solar orientation as the system collectors, shall be recorded and integrated over each day for which the energy use is recorded. The instrument and associated equipment shall be capable of measuring the integrated value of radiation received over any 24 hour period with an accuracy within ±2.5 %.

307.7
Mean wind speed

A suitable cup anemometer shall be mounted at the test site at a height of approximately one metre above the highest point of the 'roof'. This instrument should be of the accuracy commonly employed for meteorological observations.

307.8
Checks and calibration

The measuring equipment shall be checked regularly to ensure that measurements remain within the specified tolerances.

308
CONTENTS OF TEST REPORT

308.1
System information

Name of manufacturer —
Brand name of system —
Total collector aperture — m^2
Capacity of solar store — litres
Capacity of electrically heated tank — litres
Thermosiphon or pumped system —
Number of collectors —
Number of tanks —

General description of the system; that is, materials used for case, insulation, absorber, sealants, gaskets, cover and absorber finish coat.

A photograph and/or drawing should be included.

308.2
Short test for thermal performance

State what schedule was used for the test —

A table of measured quantities shall be provided as shown below:

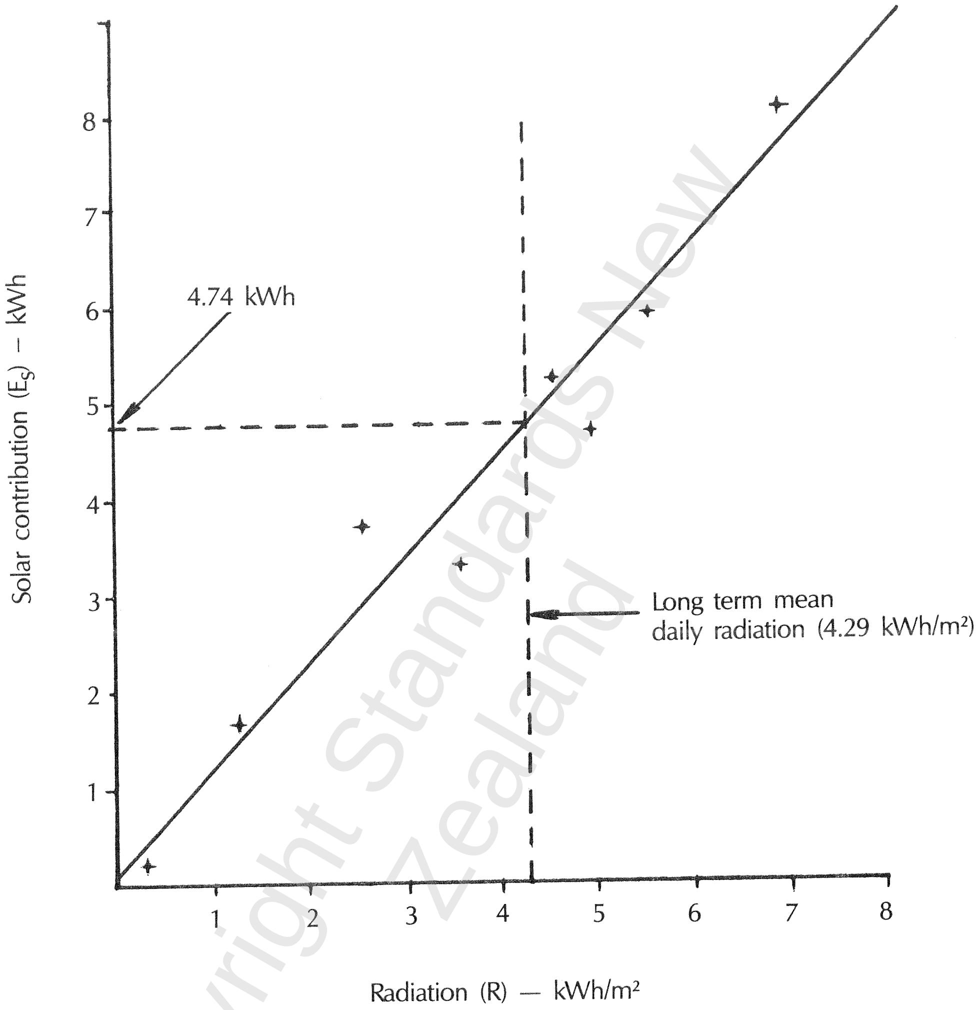
308.3
Long test for thermal performance

State what schedule (or schedules) was used for the test.

A graph shall be drawn as shown in fig. 1.

Conditions	*Input* kWh	Q litres	θ_i °C	θ_d °C	θ_c °C	θ_a °C	V m/s
Collectors operating	R = E_1 =						
Collectors not operating	E_2 =						
Collectors not operating	E_3=						

E_S = F_S =



$E_S = 0.085 + 1.085R$

Solar contribution per day at a long term mean daily radiation of 4.29 kWh/m² is 4.74 kWh.

The estimated annual solar contribution for an average year is 1730 kWh ±10 %.

Assuming a mean daily value for E of 5.06 kWh, the solar fraction at the mean value of radiation is

$$\frac{4.74}{9.80} \times 100 = 48\%$$

Fig.1
EXAMPLE OF A LINEAR REGRESSION EQUATION OF E_S ON R

Part 4 Materials, components and equipment

401 CONTAINER

401.1 General

The casing of any container intended for use outdoors or where exposed to the weather shall be resistant to weather, shall not allow ingress of water and shall meet the durability requirements of 104.

401.2 Solar store and combined solar/auxiliary heater store

401.2.1

Single shell type containers shall comply with the requirements of AS 2712 or be constructed to the intended performance of the container of thermal storage water heaters complying with NZS 4602.

401.2.2

Composite shell type containers shall comply with the requirements of AS 2712.

401.2.3

A container or combined solar/electric store whether or not it includes storage for solar heated water shall, using electrical energy only, have characteristics of hot water supply at least equivalent to the minimum requirements laid down by the relevant Electrical Supply Authority for the district in which it is to be installed. A combined solar/gas heated store shall comply with the requirements of the Appliance Approvals Committee of the Gas Association of New Zealand Inc.

401.2.4

The thermal insulation of the container shall have an insulation value of not less than 1.5 m² °C/W.

401.3 Fittings

Fittings shall be appropriately located to minimize mixing of hot and cold water and shall meet the torque test requirements of 203.5.

402 PUMPS

402.1

Pumps should comply with the performance requirements of NZS 5224:Part 2.

403 ELECTRICAL COMPONENTS AND EQUIPMENT

403.1

Electrical components and equipment shall comply with the requirements of NZS 1300.

404 PRESSURE AND TEMPERATURE RELIEF VALVES

404.1

All unvented solar water heaters shall be fitted with means of temperature protection and pressure relief as required by AS 3142, and paragraphs (a) to (d) below:

(a) The thermal discharge rating of the valve shall be not less than the total output power of the collectors at 99 °C and 1200 W/m² and 40 °C effective ambient, plus any supplementary heater.

Where the supplementary heater is a separate unit connected as a circulator to the container, any thermal relief device fitted to the supplementary heater shall not be considered as providing protection for the container.

NOTE — Supplementary heaters may be booster or defrost heaters.

(b) Unless otherwise required by the local authority unvented systems shall be provided with a pressure relief valve (expansion relief valve) having provision for manual operation, for fitting to the cold water supply to the system at a location as low as feasible for the container installation and separated from the container by at least 1 m of uninsulated pipe. The pressure setting differential between the cold water pressure relief valve and the hot water pressure relief valve shall be as required by the local authority. The pressure setting of the cold water relief valve shall be lower than that of the hot water relief valve

(c) Unvented collectors having a volume of transfer fluid in the absorber and headers greater than 5L per square metre of aperture shall be fitted with a combination pressure and temperature relief valve on the header. The thermal discharge rating of the valve shall be not less than the output power of the collectors at 99 °C and 1200 W/m² and 40 °C effective ambient.

NOTE — Where the collector is used as a preheater for a water heater connected in series downstream of the collector, the thermal output of the water heater need not be taken into account.

(d) Unvented collectors which are provided with isolating valves on the connecting lines shall be fitted with a pressure relief valve.

Where solar water heater is intended for use as a pre-heater in series with an unvented automatic storage water heater, the pressure and temperature relief device(s) on the automatic storage water heater shall not be considered as a means of providing relief for the solar water heater component of the system, and the solar water heater shall be fitted with means of temperature and pressure protection as specified above.

405 TRANSFER FLUIDS

405.1 Non-hazardous transfer fluids

Only non-hazardous transfer fluids shall be used in indirect solar water heaters which employ a single-barrier heat exchanger.

NOTE — For the purposes of the Water Supplies Protection Regulations 1961, fluids such as glycerol (glycerine) and propane-1,2-diol (propylene glycol), either pure or mixed in any proportion with potable water are deemed to be non-hazardous.

405.2 Hazardous transfer fluids

405.2.1

Hazardous transfer fluids shall be used only in indirect solar water heaters which employ a double-barrier heat exchanger.

NOTE — Ethanediol (ethylene glycol), commonly used as an automobile antifreeze is hazardous when mixed with water in proportions likely to be effective in preventing freezing of collectors.

405.2.2

Where hazardous transfer fluids are used as mixtures with potable water drawn from a reticulated supply, the arrangements for filling the solar system with water are required to comply with the Water Supplies Protection Regulations 1961 by employing:

(a) An air-gap separation of not less than twice the internal diameter of the filling pipe, but in no case less than 25 mm; or

(b) A backflow preventer of a type approved by the local authority; or

(c) Other device approved by the local authority.

405.3 Marker dyes

405.3.1

A marker dye should be introduced into the transfer fluid of indirect solar water heaters to give warning of leaks.

405.3.2

Marker dyes shall be compatible with, and shall not increase the hazardous nature of, the transfer fluid.

NOTE — The non-hazardous synthetic red food colour, index number 16185, C1 food red 9 (also known as amaranth), is reasonably stable at 65 °C and may be suitable as a marker dye. Resorcinolphthalein (also known as fluorescein, sodium fluorescein or uranine) is highly visible in concentrations in water of 1 part per million and may also be suitable as a non-hazardous marker dye at that concentration.

Part 5
Marking and information

501
MARKING

501.1

The collector shall be clearly and permanently marked with the following information:

(a) The name of the manufacturer or his trademark;

(b) The model name or number, or both;

(c) Serial number;

(d) Place of manufacture;

(e) Maximum working pressure (kPa or MPa);

(f) Collector aperture (m^2);

(g) Fluid capacity.

501.2

Any specific limitations required by the equipment design or materials, see following examples:

Collector must be covered from direct sunlight when not filled with transfer fluid
Collector not suitable for potable water
Designed for forced circulation only

502
ADDITIONAL INFORMATION

502.1

The collector manufacturer shall provide with the collector(s) the following information:

(a) Installation instruction, including mounting details, handling recommendations, load limitations, and safety precautions;

(b) Maintenance recommendations, for example, cleaning of cover, replacement of cover or painting of absorber;

(c) Connector sizes and locations;

(d) Minimum acceptance angle;

(e) Linear dimensions (in millimetres) and gross and aperture areas (in square metres) representative of the collector model, together with the allowable tolerances on these values.

APPENDIX A
DETERMINATION OF SOLAR CONTRIBUTION

A1

If E_1, E_2 and E_3 are the values of electrical input for test periods 1, 2 and 3, then:

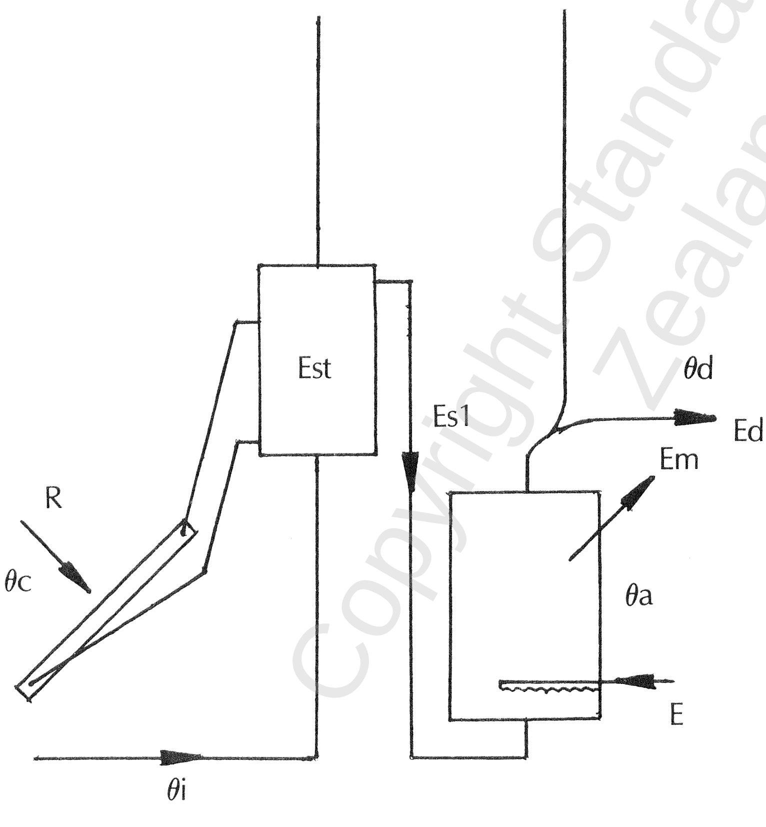
Period 1: $E_d = E_d + E_m - E_{S1}$

Period 2: $E_2 = E_d + E_m - E_{st}$

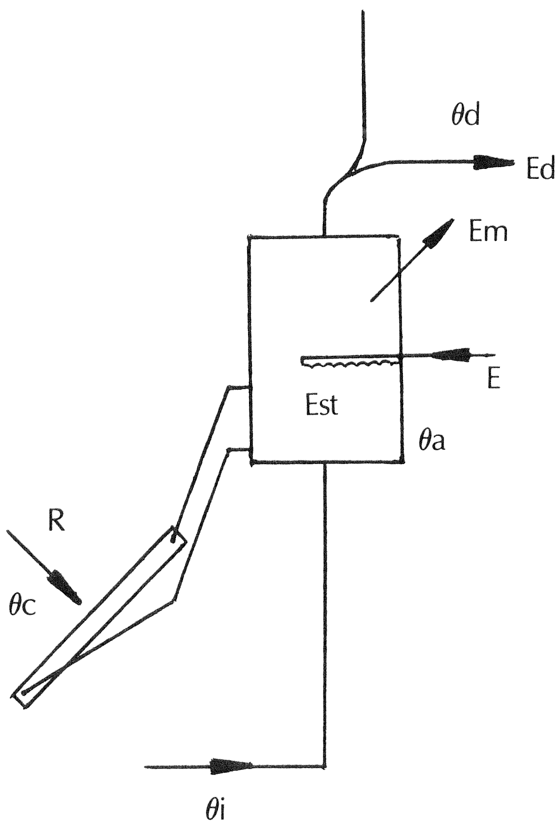
Period 3: $E_3 = E_d + E_m$

$E_S = E_{S1} + E_{st} = 2E_3 - E_2 - E_1$

where E_S is the solar contribution.



SEPARATE SOLAR STORE AND ELECTRICALLY HEATED TANK



COMBINED SOLAR STORE AND ELECTRICALLY HEATED TANK

APPENDIX B
AVERAGE RADIATION — WELLINGTON

B1

Long term daily mean radiation received (kWh/m²) on surfaces at various inclination angles:

Inclination angle	*Long term daily mean radiation* (kWh/m²)
0°	3.80
10°	4.06
20°	4.23
25°	4.29
30°	4.31
35°	4.31
40°	4.29
50°	4.17

Comprehensive values of radiant energy received are available only for the main centres of population of Auckland, Wellington, Christchurch, and Invercargill plus Ohakea. The values for Wellington are given because these are very close to the average for these main centres (refer Benseman and Cook, 1969).

APPENDIX C
DETERMINATION OF WEIGHTED MEANS FOR AMBIENT TEMPERATURE AND WATER DRAW OFF

C1

Mean ambient temperature over 24 hours

C1.1

If the mean temperature during each draw of water is given by:

Time of draw	*Mean temperature during draw*
0700	θ_1
0730	θ_2
1000	θ_3
1300	θ_4
1600	θ_5
1800	θ_6
2200	θ_7

C1.2

Then a weighted mean in certain circumstances has been found to be approximated by the following equation:

$$\theta_n = \frac{2\theta_1 + \theta_2 + \theta_3 + \theta_4 + \theta_5 + \theta_6 + 2\theta_7}{8}$$

C1.3

This is an adequate weighted mean to allow for the variations over 24 hours in many situations. However, it is desirable to examine meteorological records to ensure that it or some variation of this procedure is sufficient for any particular locality.

C2

Mean temperature of water draw off over 24 hours

C2.1

If θ_1, θ_2 ... θ_n are the mean temperatures obtained during n draws and U_1, U_2 ... U_n are the respective proportions of each draw making up the daily total, then the weighted mean over 24 hours is given by:

$$\frac{(\theta_1 U_1 + \theta_2 U_2 \ldots + \theta_n U_n)}{(U_1 + U_2 \ldots + U_n)}$$

C2.2

In the example of table 1, if the temperatures are $\theta_1 \ldots \theta_7$, then the weighted mean will be:

$$\frac{(7\theta_1 + 23\theta_2 + 20\theta_3 + 7\theta_4 + 10\theta_5 + 6\theta_6 + 27\theta_7)}{100}$$

C2.3

If all the water draw temperatures are within ±2 °C of the scheduled temperature the arithmetic mean is sufficient.

APPENDIX D VARIATION IN INLET WATER TEMPERATURE

D1

In general the inlet water temperature will vary slowly throughout the year and the rate of change will not be sufficient to affect the test results. If relatively rapid changes are observed then it may be necessary to draw off substantial quantities to avoid local heating effects in the pipes of the water main.

D2

The inlet water temperature measured during a draw will not affect the energy used during that draw but will only influence the energy used after. Since the draw quantities vary from 6 % to 27 % of the day's draw it is difficult if not impossible, to allow for variations in inlet water temperature.

D3

During any particular test it is important that the mean inlet water temperature during each draw does not vary over a range of more than 2 °C.

APPENDIX E
STAGNATION (NO-FLOW) EXPOSURE TEST FOR COLLECTORS

E1
Scope

E1.1

The objective of this test is to check the ability of a collector to withstand temperatures close to the maximum temperature that it will encounter during its life. Such conditions occur during stagnation with high solar radiation levels. Accordingly, the test specifies a cumulative exposure of 30 days (not necessarily consecutive), on each of which the total recorded solar energy incident on the plane of the collector is at least 17 MJ/m² (4.7 kWh/m²), and a single exposure to a high stagnation temperature for a 90 min period.

E1.2

The maximum stagnation temperature will vary depending on the designed use of the collector. For example collectors for drain down systems will have a maximum stagnation temperature when empty. Collectors for forced circulation systems will have a maximum stagnation temperature when full of water but no flow, representing a circulation system failure.

E2
Apparatus

E2.1

The basic outdoor exposure apparatus shall consist of a north facing frame located away from shadowing structures or surfaces and either adjustable in inclination angle itself or permitting the collector mounted on it to be so adjusted.

E2.2

There shall be a means to measure the radiation incident on the collector plane. Wind speed, ambient temperature, and precipitation-measuring devices shall be installed in the near vicinity of the test site.

Arrangements should be made to measure the temperature of any critical materials or heat sensitive components during the test.

E3
Procedure

The procedure shall be as follows:

(a) Install the collector on the frame and adjust the inclination angle to provide for maximum solar insolation

(b) Collectors shall be fitted with pressure relief valves set at the collector's maximum rated working pressure excepting for collectors designed to be directly open-vented which shall be installed with the vent as specified by the manufacturer.

All other connections shall be sealed.

(c) Fill collector with potable water or other recommended transfer fluid while cold

(d) Collectors intended for use in systems that drain down when not operating shall be allowed to boil dry during the test period and shall not be replenished. This type of collector shall not be exposed to the 90 min test until the collector has boiled dry

(e) Collectors not intended for drain down systems shall have the water or transfer fluid level replenished in the collector as required

(f) The collector shall be exposed to solar radiation until a cumulative exposure of 30 days (not necessarily consecutive), on each of which the total recorded solar energy incident on the plane of the collector is at least 17 MJ/m² (4.7 kWh/m²) is reached. Attainment of the 30 days total exposure during winter months may not be possible.

(g) Collector inclination angle should be adjusted at least once a month to achieve maximum insolation levels

(h) Record daily the values of total solar radiation, mean ambient temperature, wind speed and precipitation and, if appropriate, the temperatures of any critical materials or heat sensitive components

(j) At any suitable time during the test (after first 10 days) the collector shall be subjected to a single 90 min exposure period during which the insolation in the plane of the collector shall be not less than 900 W/m². Supplementary planar diffuse reflectors, or a solar simulator, may be used to achieve the conditions of insolation for the 90 min test. The wind speed during this period shall be below 5 m/s. During the 90 min test, the measurements above shall be recorded at 5 min intervals.

(k) Visually inspect the collector on a regular weekly schedule and note any changes in its appearance

(m) Terminate the test after 30 days (not necessarily consecutive) on each of which the incident energy is at least 17 MJ/m² (4.7 kWh/m²) in the plane of the collector, or when there is evidence of structural or materials deterioration which would impair the operation of the collector, whichever is the sooner.

E4
Report

The report shall describe the following:

(a) The make and model identification of the collector

(b) Specification of collector, i.e., materials used for case, insulation, absorber, sealants, gaskets, and cover plate. Also absorber finish coat

(c) Designed maximum use of collector, i.e., drain down, thermosyphon only

(d) The rated maximum working pressure (also stagnation test pressure)

(e) Details of insolation and temperature measurements and the dates and duration of the test

(f) Any changes in the physical construction or appearance of the collector noted during the weekly inspections

(g) Details of the condition of the collector following the test with particular regard to:
(i) Any structural failure;
(ii) Any burning, scorching, or out-gassing;
(iii) Any glazing seal failure.

(h) A statement as to whether any of the above conditions have affected the serviceability or durability of the collector.

APPENDIX F
NOMENCLATURE

* R = Total solar radiation received per day. (kWh/m^2)

E = Input to the electrical heating element. (kWh)

* E_S = Solar contribution. (kWh)

F_S = The solar fraction, i.e., the solar contribution expressed as a percentage (%)

Est = Energy stored in the solar tank or solar store portion of a combined tank. (kWh)

Ed = Energy delivered in the hot water. This is the increased energy content of the water over that of the incoming cold water. (kWh)

Em = Energy loss from the electrically heated tank in a 24 hour period (kWh)

Qn = Quantity of water delivered during any 24 hour period (litres)

V = Mean wind speed during daylight hours. (m/s)

n = Number of water draws in each 24 hour period.

θi = Daily mean temperature of the inlet water to the system. (°C)

θd = Mean temperature of the water drawn off in any one draw. (See Appendix C). (°C)

$\overline{\theta d}$ = Daily mean temperature of water drawn off. (°C)

θc = Mean ambient temperature in the neighbourhood of the collectors during daylight hours. (°C)

θa = Mean ambient temperature in the neighbourhood of the electrically heated tank during any 24 hour period. (See Appendix C). (°C)

c = Specific heat of water. (0.001163 kWh per litre. °C at 15 °C and assuming the density of water is 1 kg per litre).

U = Proportion which one draw comprises of the daily total.

* See Definitions (102)

Other New Zealand Standards for water supply, use and disposal:

NZS 4601		1971	Performance of water fittings and appliances
NZS 4602		1976	Low pressure thermal storage electric water heaters with copper cylinders. Amend: 1, 1976
NZS 4603		1985	Installation of low pressure thermal storage electric water heaters with copper cylinders (open-vented systems)
NZS 4604		1978	Dairy-type thermal storage electric water heaters with copper cylinders
NZS 4605		1978	Code of practice for the installation of dairy-type thermal storage electric water heaters
NZS 4610		1982	Household septic tank systems
NZS 4611			Non-thermostatic shower mixing valves
	Part 1	1982	Specification for materials, design and construction. Bound with NZS 4611: Part 2
	Part 2	1982	Code of practice for installation. Bound with NZS 4611: Part 1
NZS 4614		1986	Installation of domestic solar water heating systems
NZS 4616		1984	Washbasins (± AS 1730: 1975) Amend: 1; 2; 3; A

NOTES

APPROVED TO NEW ZEALAND STANDARD

THE NEW ZEALAND STANDARD CERTIFICATION MARK SCHEME

The 'S' Mark appearing on a product, container or label is an assurance that the goods are manufactured under a system of supervision, control, and testing (including periodical inspection at the manufacturer's works by SANZ Certification Officers) designed to ensure compliance of the commodity, process, or practice with the relevant New Zealand Standard. The New Zealand Standard Certification Mark, registered as a certification trade mark under the Trade Marks Act 1953, may be used only in terms of a licence issued by SANZ, and must be accompanied by the licence number and the NZS number.

Used correctly in conjunction with advertising the 'S' Mark can provide a strong assurance of product quality for a manufacturer when selling his goods and thus becomes a powerful marketing tool.

Manufacturers may obtain particulars of the conditions of licensing from the Director, Standards Association of New Zealand, Private Bag, Wellington.

Declared on 30 May 1986 by the Standards Council to be a Standard specification pursuant to the provisions of section 23 of the Standards Act 1965.

First published June 1986

The following SANZ references relate to this Standard:

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Draft for comment No. DZ 4613
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