AS/NZS 4234:2008
(Incorporating Amendment Nos 1, 2 and 3)

AS/NZS 4234:2008

Australian/New Zealand Standard™

Heated water systems—Calculation of energy consumption

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee CS-028, Solar Water Heaters. It was approved on behalf of the Council of Standards Australia on 25 July 2008 and on behalf of the Council of Standards New Zealand on 28 July 2008.
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The following are represented on Committee CS-028:

Australian Chamber of Commerce and Industry
Australian Electrical and Electronic Manufacturers Association
Australian Industry Group
Australian and New Zealand Solar Energy Society
Chartered Institution of Building Services Engineers
Department of Energy, Utilities and Sustainability (NSW)
Energy Efficiency and Conservation Authority of New Zealand
Gas Appliance Manufacturers Association of Australia
Institution of Professional Engineers New Zealand
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New Zealand Solar Industries Association
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PREFACE

A3 This Standard was prepared by the Joint Standards Australia/New Zealand Committee CS-028, Solar Water Heaters to supersede AS 4234—1994. The performance evaluation procedure defined in this Standard has been designed to provide a means of evaluating the annual task performance of heated water systems.

This Standard incorporates Amendment No. 1 (March 2011), Amendment No. 2 (November 2011) and Amendment No. 3 (November 2014). The changes required by the Amendments are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

Testing of solar and heat pump water heating systems under outdoor conditions has been defined in AS 2984, *Solar water heaters—Methods of test for thermal performance—Outdoor test method*. Outdoor testing requires a long test period (8–10 weeks) due to the need to obtain stable inputs for a range of operating conditions. The major drawback of outdoor testing is that the tests must be repeated for every variation of system configuration offered by the supplier. The procedure defined in this Standard overcomes the time and cost limitations of using the outdoor test standard AS 2984.

The performance evaluations are based on modelling annual performance in a range of climatic conditions using the TRNSYS simulation program. TRNSYS is specified as the modelling package because of its flexibility and capacity to model the wide range of renewable energy water heaters used in Australia and New Zealand.

A3 It is the committee's intention that determination of the standardized annual energy use for other products, such as integral solar water heaters (combined solar collector and storage tank), will be added to this Standard by amendment. Interim test procedures for these products may be accepted by rating authorities.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

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SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out a method of evaluating the annual energy performance of water heaters using a combination of test results for component performance and a mathematical model to determine the standardized annual purchased energy use. The procedure is applicable to electric, gas and solar water heaters with integral boosting or preheating into a conventional storage or instantaneous water heater and to heat pump water heaters. For solar and heat pump water heaters, displaced purchased energy relative to reference water heaters is also calculated. Solar and solar boosted heat pump water heater types not covered in the application of this Standard can be tested under AS 2984 to obtain an annual performance assessment.

There are no product design or operation requirements in this Standard. System operating parameters specified in this Standard are only for the purpose of performance modelling.

1.2 APPLICATION

The procedure in this Standard uses a mathematical model to assess annual energy, hence the application of the procedure is restricted by the availability of suitable mathematical models. The analysis required by this Standard shall be based on the TRNSYS simulation model (version 15 or later) with modifications to suit typical packaged solar and heat pump water heaters. The TRNSYS software package is available from The University of Wisconsin (see Appendix E). Weather data and typical modelling data files (TRNSYS deck files) are supplied with this Standard. The operating conditions and product configurations to be used for evaluating the energy performance of a water heater are also defined in this Standard.

This Standard may be applied to the following water heaters:

(a) Electric and gas storage water heaters.

(b) Electric and gas instantaneous heaters.

(c) Solar water heaters with—

  (i) flat plate, concentrating or evacuated tubular solar collectors;

  (ii) thermosiphon or pumped fluid circulation through the solar collectors;

  (iii) collector loop heat exchangers in a thermosiphon loop;

  (iv) horizontal or vertical water storage tanks;

  (v) storage tanks with single or dual electric element(s);

  (vi) storage tanks with internal gas boosting; and

  (vii) storage tanks with delivery side heat exchangers.

(d) Solar preheaters in series with electric or gas storage or instantaneous boosters.

(e) Solar boosted heat pump water heaters with—

(i) solar collectors acting as the refrigerant evaporator;

(ii) water cooled condenser; and

(iii) in-tank electric booster.

A3 (f) Air-source heat pump water heaters with—

(i) internal tank condensers;

(ii) external wrap-around, or in-wall embedded tank condensers; and

(iii) external condensers, circulating water into one or more tanks.

Example deck files for the following systems are provided with this Standard.

(A) Thermosiphon solar water heaters with in-tank supplementary boosting.

(B) Pumped solar water heaters with in-tank supplementary boosting.

(C) Thermosiphon solar pre-heater in series with an instantaneous gas booster.

(D) Pumped solar pre-heater in series with an instantaneous gas booster.

(E) Electric storage water heater.

(F) Gas storage water heater.

(G) Gas instantaneous water heater.

A3 (H) Integral air source heat pump with wrap-around tank condenser.

(I) Stand-alone air source heat pump.

NOTE: Sample decks are suitable for modelling both flat plate and evacuated tube collectors.

Other water heater configurations incorporating the above components may also be modelled. If it is not possible to model the product using the TRNSYS software then the product may be rated using AS 2984.

A3 NOTE: In some instances, test data produced through physical test procedures that measure the performance of a system when it delivers hot water (e.g. AS/NZS 5125 Appendix G; AS 2984) may assist in TRNSYS model development and to assess the accuracy of some TRNSYS inputs and some simulation outputs.

1.3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

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AS

2984 Solar water heaters—Method of test for thermal performance—Outdoor test method

3498 Authorization requirements for plumbing products—Water heaters and hot-water storage tanks

4552 Gas fired fuel water heaters for hot water supply and/or central heating

AS/NZS

2535 Test methods for solar collectors

2535.1 Part 1: Thermal performance of glazed liquid heating collectors including pressure drop (ISO 9806-1:1994, MOD)

2712 Solar and heat pump water heaters—Design and construction

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4692 Electric water heaters
4692.1 Part 1: Energy consumption, performance and general requirements
A3 4692.2 Part 2: Minimum Energy Performance Standard (MEPS) requirements and energy labelling

A1 5125 Heat pump water heaters—Performance assessment
5125.1 Part 1: Air source heat pump water heaters

NZS
A1 A3 4218 Thermal insulation—Housing and small buildings
4606 Storage water heaters

ISO
A3 9806 Solar energy—Solar thermal collectors—Test methods

ASHRAE
23-93 Methods of testing for rating positive displacement refrigerant compressors and condensing units

A3 EN
12975 Thermal solar systems and components—Solar collectors
12975-2 Part 2: Test methods

1.4 DEFINITIONS

For the purpose of this Standard, the definitions below apply.

1.4.1 Absorber

Device within a collector for absorbing radiant energy and transferring this energy as heat into a fluid.

1.4.2 Auxiliary equipment

Those parts of a solar or heat pump water heater system that use purchased electrical energy, other than resistive heating units or heat pump package (compressor and integral controls, pumps and fans).

1.4.3 Collector

Device containing an absorber and intended for installation either as a unit or as part of an array of units.

1.4.4 Collector aperture

The net area available for transmission of solar radiation through the outer air/cover interface; for unglazed collectors, the net plan area of the absorber. The aperture width for different collector types is illustrated in AS/NZS 2535.1.

1.4.5 Collector inclination

Angle between aperture surface of the collector and the horizontal.

1.4.6 Container

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

1.4.7 Dual elements

Electric elements at different levels in the tank. Each element may be connected to a different electric supply or be operated under local control.

1.4.8 Electricity supply options

1.4.8.1 *Continuous*

Continuously available electricity supply.

1.4.8.2 *Limited time of supply*

Electric supply available at limited times, as follows:

(a) *Night rate* Electricity supply at restricted night hours. (See Appendices A and B for typical availability times.)

(b) *Extended off-peak* Electricity supply during extended hours. (See Appendices A and B for typical availability times.)

1.4.9 Evacuated tubular collector

Evacuated collector employing transparent tubing (usually glass) with an evacuated space between the tube wall and the absorber. The absorber may consist of an inner tube or another shape, with means for removal of the thermal energy.

1.4.10 Heat pump water heater

A water heater using vapour compression cycle and incorporating a compressor, an evaporator and a condenser that delivers heat to the water either directly or indirectly.

1.4.10.1 *Heat pump water heater—solar boosted*

A heat pump water heater with an evaporator collecting energy from latent and sensible heat of the atmosphere and solar radiation.

1.4.10.2 *Heat pump water heater—air source*

A heat pump water heater with an evaporator collecting energy from latent and sensible heat of the atmosphere.

1.4.11 Incidence angle

Angle between the direct radiation and the outward normal from the plane considered (e.g., from the collector aperture).

1.4.12 Irradiance

Power density of radiation incident on a surface, i.e. the quotient of the radiant flux incident on the surface and the area of that surface, or the rate at which radiant energy is incident on a surface per unit area of the surface (Unit: W/m^2).

1.4.13 Irradiation

The incident energy per unit area of a surface, found by integration of irradiance over a specified time interval, often an hour or a day (Unit: MJ/m^2 per specified time interval).

1.4.14 Load

Amount of thermal energy drawn from the system as hot water. Energy is computed relative to the cold-water inlet temperature.

1.4.15 One-shot boosting

Operation of a supplementary heat source for one heating cycle. The heater is returned to normal control after one heating cycle

1.4.16 Packaged system

A system with a fixed configuration, sold as a ready-to-install kit containing all system components.