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# Heated water systems — Calculation of energy consumption

AS/NZS 4234:2021

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Australian Building Codes Board
Australian Industry Group
Australian Institute of Refrigeration Air Conditioning and Heating
Clean Energy Council
Consumer Electronics Suppliers Association
CSIRO
Energy Efficiency & Conservation Authority of New Zealand
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Australian/New Zealand Standard™

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# Preface

This Standard was prepared by the Joint Standards Australia/New Zealand Committee CS-028, Solar Heating and Cooling, to supersede AS/NZS 4234—2008.

The objective of this document is to provide methodologies to quantify the energy consumption of heated liquid systems and calculate energy savings relative to reference heaters.

Changes to the previous edition are as follows:

(a) Additional water heating technologies based on PV water heating, variable speed heat pumps and commercial applications are included

(b) The reference water heater systems used to quantify energy savings have been updated to current MEPS requirements; the main change being the increase from 3 star to 4 star for the gas reference water heater.

(c) The typical meteorology year weather records have also been updated.

(d) References to third-party software have been removed.

(e) New requirements for assessing the suitability of software packages for the application of this document.

The performance evaluation procedure defined in this document has been designed to provide a means of evaluating the annual task performance of heated water systems.

Testing of solar and heat pump water heating systems under outdoor conditions is 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 document 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 a simulation program. Performance criteria are specified for simulation programs that can be used to implement the requirements of this document.

Typical meteorological year weather data files for Australia are now based on Bureau of Meteorology satellite data from 1990 to 2016. The new weather data records indicate higher solar radiation levels in Zones 1 and 4 and higher ambient temperatures in all zones compared to the terrestrial weather data (1967 to 1987) used in previous versions of this document.

NOTE Weather data files for five Australia climate zones and two New Zealand climate zones are supplied with the purchase of this document.

The weather data files for the five climate zones in Australia are supplied free of charge to users of the document by Exemplary Energy Partners. For users of the document wishing to use weather data for other sites, additional weather data files can be obtained from www.exemplary.com.au/solar_climate_data/solar-radiation-data.php

This document evaluates the performance of water heating technologies such as Solar Thermal Collectors, Heat pumps, photovoltaic arrays, thermal storage tanks (which can incorporate integral gas or electric resistance element boosting) and in-line supplementary heating utilizing gas or electric energy sources.

The terms “normative” and “informative” are used in Standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

Where *shall* is used in this Standard, this indicates that a requirement is to be followed strictly in order to conform to the Standard. Where *should* is used, it is to be interpreted as a recommendation; a recommendation is not required to be followed in order to conform to the Standard.

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## Section 1 Scope and general

### 1.1 Scope

This document sets out a method for evaluating the annual energy performance of water heaters using a combination of test results for component performance and mathematical models to determine the standardized annual supplementary energy use.

This document may be used for both domestic and commercial systems, including recirculated hot water systems. For commercial applications, the systems modelled may deliver heat through fluids other than water.

The procedures may be used for solar and heat pump water heaters (HPWHs) with or without integral gas or electric boosting and may be coupled to conventional storage or instantaneous water heater(s) when used as solar pre-heater(s). Solar energy sources considered are —

(a) solar irradiance which is used in solar thermal collector applications;

(b) photovoltaic array applications; and

(c) air-sourced heat that is used for heat pump applications.

The calculations in this document also cover the displaced purchased energy relative to reference water heaters.

NOTE Solar and solar-boosted HPWH types not covered in this document may be tested under AS 2984 to obtain an annual performance assessment.

This document does not include product design or operation requirements, however for the purpose of rating it does specify minimum savings and water temperature delivery requirements used to select simulated thermal load size.

### 1.2 Application

The procedure in this document uses mathematical models to assess annual water heating systems; hence the application of the procedure is restricted by the availability of suitable mathematical models. The analysis required by this document is based on numerical simulation of water heaters powered by conventional electrical and gas energy, solar energy and heat pumps.

The numerical simulation model shall use the weather data, hot water load levels, electrical load data and modelling requirements specified in this document.

The operating conditions and product configurations to be used for evaluating the annual energy performance of a water heater are defined in this document.

This document may be used for evaluating the following water heaters:

(a) Electric and gas storage water heaters.

(b) Electric and gas instantaneous water heaters.

(c) Solar water heater systems with a combination of any of the following:

  (i) Flat plate, concentrating or evacuated tubular solar collectors.

  (ii) Photovoltaic arrays.

  (iii) Thermosiphon or pumped fluid circulation through the solar collectors.

(iv) Collector loop heat exchangers in a thermosiphon loop.

(v) Horizontal or vertical water storage tanks.

(vi) Storage tanks with single or multiple electric element(s).

(vii) Storage tanks with internal gas boosting.

(viii) Storage tanks with heat pump boosting.

(ix) 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.

(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.

Other water heater configurations incorporating the above components may also be modelled.

NOTE 1 If it is not possible to model the product using a simulation program, then the product may be rated using AS 2984.

NOTE 2 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 5125.1:2014 or AS 2984) may assist in developing a simulation program to assess its accuracy.

## 1.3 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document:

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 3498, *Safety and public health requirements for plumbing products — Water heaters and hot-water storage tanks*

AS 4552, *Gas fired water heaters for hot water supply and/or central heating*

AS/NZS 2535.1, *Test methods for solar collectors, Part 1: Thermal performance of glazed liquid heating collectors including pressure drop (ISO 9806-1:1994, MOD)*

AS/NZS 2712, *Solar and heat pump water heaters—Design and construction*

AS/NZS 4692.1, *Electric water heaters, Part 1: Energy consumption, performance and general requirements*

AS/NZS 4692.2, *Electric water heaters, Part 2: Minimum Energy Performance Standard (MEPS) requirements and energy labelling*

AS/NZS 5033:2014, *Installation and safety requirements for photovoltaic (PV) arrays*