Australian Government | WATER RATING

Water efficiency labelling for instantaneous gas water heaters

2008

The Water Efficiency Labelling and Standards (WELS) scheme is an Australian Government initiative in partnership with state and territory governments.

Prepared by Aleksander Szann, Access Product Information Consultants, for the Department of the Environment, Water, Heritage and the Arts in 2008.

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Water Efficiency Labelling and Standards Regulator
Water Efficiency Labelling and Standards scheme
Department of Agriculture and Water Resources
Postal address GPO Box 858 Canberra ACT 2601
Telephone 1800 372 746 (local calls) +61 2 6272 5232 (international)
Email wels@agriculture.gov.au
Web agriculture.gov.au

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Summary

Currently, instantaneous gas water heaters account for about 30-40 per cent of the gas hot water market compared with 60-70 per cent for traditional gas storage systems. However, the proportion of instantaneous gas water heaters being installed is growing, at the expense of storage type water heaters. This growth in instantaneous water heater installations is largely due to their versatility and to regulatory requirements that demand buildings be more energy efficient.

The bulk of instantaneous gas water heaters (IGWHs) are imported. There is a single manufacturer in Australia and some distributors have expressed interest in setting up manufacturing of these products locally.

The key current Australian Standard for instantaneous gas water heaters is AS4552:2005 *Gas fired water heaters for hot water supply and/or central heating*.

With regard to labelling, currently there is a total lack of water wastage data, and as such, it would not be possible to specify a water efficiency labelling program for these products. Before such a program could be implemented the following would be required:

- there would need to be an appropriate revision of AS 4552, which would clearly define a procedure for determining water wastage
- repeatability and reproducibility testing would need to be conducted to confirm that the water wastage test procedure in the revised AS 4552 is verifiable
- there would need to be an analysis of the quantity of water wasted by current products to ascertain appropriate star rating bands.

A revision of AS4552 is being prepared with the intent that a Minimum Energy Performance Standard (MEPS) will apply to IGWHs. Benefits are likely to also result from water efficiency labelling and a minimum water efficiency standard being introduced as soon as a suitable test procedure for determining water wastage has been developed. Bringing IGWHs into the Water Efficiency Labelling and Standards (WELS) Scheme may avoid IGWHs being designed to comply with only energy considerations, which could possibly have an adverse effect on water efficiency.

General

Instantaneous gas water heaters are also known as on-demand or continuous water heaters because these heaters provide hot water when a hot water tap is turned - on (i.e. when demanded), and because the water is constantly heated whilst the tap is left on, hot water is provided continuously. Unlike a storage water heater, which stores a set quantity of hot water, an instantaneous water heater cannot run out of hot water.

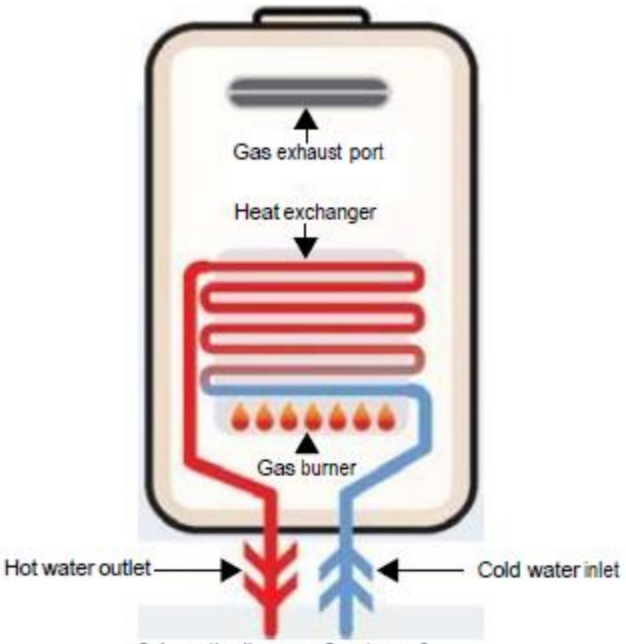
Generally, to minimise not only the waiting time before hot water is available at a tap outlet, but also to minimise the quantity of water that is wasted during this waiting time, water heaters should be installed as near as practical to a bathroom, kitchen or laundry. IGWHs are available for installation on the outside (external units) or the inside (internal units) of a building. Because of their relative small size and weight compared to storage water heater units, IGWHs are more adaptable to being installed in a location that would minimise the water flow distance between the water heater and outlet points.

Internal water heater units (which must be flued or suitably vented) can even be installed on a convenient internal wall such as that in the laundry.

Continuous flow systems are generally more energy efficient because these systems do not store any hot water and as such they do not suffer from heat losses due to the stored hot water. Further, because of such features as hydro-mechanical and electronic ignition, continuous flow systems do not need to suffer from stand-by heat energy losses as they can do away with pilot lights which are necessary on storage systems.

The mode of operation

Schematic diagram of gas instantaneous water heater



Schematic diagram: Courtesy of Robert Bosch (Australia) Pty Ltd

The mode of operation of an IGWH is such that when a hot water outlet (such as a tap) is turned on, cold water from the supply flows through the water heater, and initiates gas to flow to a gas burner. Because of the need to quickly heat flowing water, the capacity of a burner in a continuous flow water heater is as much as four times the capacity of the burner in a storage system. In new generation IGWHs, the burner is ignited by a hydro-mechanical mechanism or electronically. Older units incorporate pilot lights similar to that used in storage water heaters.

A heat exchanger is positioned in close proximity to and above the gas burner so that when the burner is ignited heat is directed onto, and transferred to, the heat exchanger. To maximise heat transfer from the exchanger to the flowing water, the cold water pipe is designed to zigzag through the heat exchanger. The exchanger is typically made from copper but may have components made from titanium or even aluminium.

The heated water then proceeds to the outlet that was initially turned on.

Hot exhaust gases resulting from the combustion of the supply gas escape through an exhaust port (external units) or a flue (internal units).

On older models of water heater, the water temperature varied depending on the water flow. The more cold water that flowed through the heat exchanger, the lower the temperature of the heated water. On modern models, the temperature of the water at the outlet of the unit can be controlled by the temperature setting on the unit. The temperature control varies from a basic mechanical control to more advanced models that utilise sophisticated electronic controls. These newer models provide for remote control of water temperature at specific locations via temperature selector pads that are connected back to the IGWH. Some IGWHs allow for a number of temperature selector pads to be installed around the home to enable users to separately control the water temperature in the kitchen, the laundry and in the bathroom, where a lower temperature could be set to avoid the risk of scalding.

Capacity of an IGWH

As an IGWH does not store any heated water, its capacity or size is defined in term of its flow rate, which is expressed in litres per minute. The capacity as defined by industry is the unit's ability to raise the temperature of the water by 25 °C from ambient, and to provide hot water at the raised temperature continuously up to the claimed flow rate. For example, if the ambient water temperature is 10 °C, the IGWH should be able to continuously produce hot water (at the claimed flow rate) at a temperature of 35 °C. If however, a number of hot water taps are turned on at the same time and the flow rate of the hot water drawn exceeds that of the rated capacity of the IGWH, the temperature of the hot water from each of the outlets will of course be reduced. Also, if the hot water tap is only partially turned on, so that the water drawn through the IGWH is less then the unit's specified minimum flow rate (about 2.5 L/min for electronic systems or 3.5 L/min for hydro-mechanical systems), ignition will not be initiated and consequently there will be no heating of the water.

IGWHs are available in flow rate capacities that range from around 10 L/min to more than 30 L/min. The most commonly installed unit is around the 26 L/min capacity as this is considered to be sufficient to supply hot water to a two or three bathroom home.

Choosing the appropriate capacity of IGWH

As IGWHs supply hot water continuously and cannot run out of hot water (unlike a storage water heater), the appropriate capacity of an IGWH depends more on the number of hot water outlets in a home, rather than the number of people in a household.

Since the flow rate capacity is qualified by the heater being able to raise the temperature of the cold water by 25 °C from ambient, the climatic region where the water heater is to be installed is important. For colder regions, a greater flow rate capacity of water heater should be selected because hotter water would be drawn to accommodate the cooler ambient temperatures.

Table 1 indicates a typical capacity of water heater suggested by industry.

Table 1 Suggested capacities

Flow rate (25 °C temp rise) L/min	No. of bathrooms Moderate climate	No. of bathrooms Cool climate
18	1	1
20	2	2
24	2.5	2
26	3	2.5
32	4	3

IGWH models

Available IGWH models include those suitable for connection to natural gas or LPG (propane, butane or universal gas) supplies.

Although most models are primarily designed for outside installation there are still a number of models suitable for inside installation. Internal models are primarily used in laundries and must be flued or suitably vented.

The cost of an IGWH ranges from about $700 for a basic unit to about $2000 for a more sophisticated unit and around $3000 for the latest unit that incorporates a hot water recirculating system designed to eliminate water wastage and provide hot water instantly to all tap outlets.

Table 2 lists all the IGWHs with their voluntary energy efficiency star ratings that were on the July 2007 register of the Australian Gas Association.

Table 2 Registered instantaneous gas water heaters (AGA, July 2007)

Manufacturer	Brand	Model	Number of models on AGA Register Internal	Number of models on AGA Register External	Star rating
Aqua-Max Pty Ltd	Aquamax	Continuum 20 & 24		2	5.0
Douglas & Company	Douglas	Internal Balanced Flue #	1	-	4
Dux Manufacturing Ltd	Dux	Endurance 20i	2	-	5.3
Dux Manufacturing Ltd	Dux	Endurance GK models	-	3	5.3 - 5.8

Manufacturer	Brand	Model	Number of models on AGA Register Internal	Number of models on AGA Register External	Star rating
Dux Manufacturing Ltd	Dux	Endurance (Mains pressure models)	-	5	5.1 - 5.3
Morcraft Industries Pty Ltd	Heatmaster	250 IBF #	1	-	4.0
Paloma Industries Ltd (Rheem Aust Pty Ltd is Aust agent)	Everhot	27XXXX models	-	8	5.2 - 5.3
Paloma Industries Ltd (Rheem Aust Pty Ltd is Aust agent)	Paloma	PH models	-	4	5.2 - 5.3
Paloma Industries Ltd (Rheem Aust Pty Ltd is Aust agent)	Rheem	Integrity	-	21	5.2 - 5.3
Paloma Industries Ltd (Rheem Aust Pty Ltd is Aust agent)	Solarhart	101432XX models	-	6	5.2 - 5.3
Primo –Tech Pty Ltd (W.A. Manufacturer)	Merlin	600E	-	1	5.3
Rinnai Australia Pty Ltd	Rinnai	REU-V models	-	1 4 25	4.8 5.6 - 5.7 5.0 - 5.6
Rinnai Australia Pty Ltd	Rinnai	Enviro Smart		1	6.0
Robert Bosch (Australia) Pty Ltd	Bosch	Commercial #	1	1	4.8
Robert Bosch (Australia) Pty Ltd	Bosch	Commercial 32Q #	-	1	4.8
Robert Bosch (Australia) Pty Ltd	Bosch	Highflow	-	4	5.0 - 5.5
Robert Bosch (Australia) Pty Ltd	Bosch	Highflow 70 Series	-	3	5.5 - 5.6
Robert Bosch (Australia) Pty Ltd	Bosch	W125K…T #	1	-	3.7
Robert Bosch (Australia) Pty Ltd	Bosch	WR250 models #	2	-	4.5
Robert Bosch (Australia) Pty Ltd	Bosch	WR325 models #	2	-	4.8
Robert Bosch (Australia) Pty Ltd	Bosch	WR400 models #	3	-	2.9 - 4.6
Robert Bosch (Australia) Pty Ltd	Bosch	10 H	-	2	5.1
Robert Bosch (Australia) Pty Ltd	Bosch	13 H #	-	2	4.6
Robert Bosch (Australia) Pty Ltd	Bosch	16 H	-	2	5.0
Robert Bosch (Australia) Pty Ltd	Bosch	Kleenheat Gas 600 #	-	1	4.5

Manufacturer	Brand	Model	Number of models on AGA Register Internal	Number of models on AGA Register External	Star rating
Robert Bosch (Australia) Pty Ltd	Bosch	Water Wizard 600 #	-	1	4.5
Robert Bosch (Australia) Pty Ltd	Bosch	Water Wizard 780 #	-	1	3.9
Robert Bosch (Australia) Pty Ltd	Bosch	Water Wizard 900 #	*	*	4.2
Takagi Industrial Co Ltd	Edwards	Comfort	-	4	5.4 - 5.5
Takagi Industrial Co Ltd	Edwards	Chromagen	-	4	5.4 - 5.5
-	-	Total number of models	18	102	-
-	-	Total number of models with star ratings < 5.0	12	7	-

*unable to confirm market status
# indicates product not likely to meet minimum energy performance standards

Labelling

The existing voluntary gas star energy rating scheme is industry sponsored, and since 1985 it has been administered by the Australian Gas Association (AGA). The Australian Standard AS 4552 forms the foundation for product compliance.

The scheme rates gas water heaters based on their annual gas consumption when compared to the annual gas consumption of a reference water heater.

The reference model used for the scheme was a storage water heater with a capacity of 140 litres having a burner rated at 30MJ/hr. Under specified conditions the reference heater would consume 28 900 MJ of gas per year.

The rating steps are based on a seven per cent linear reduction of the maximum 28 900 MJ gas consumed.

The maximum gas consumed per annum (in megajoules per year) for each of the star ratings is indicated in Table 3.

Table 3 AGA ratings

Star rating	Maximum gas consumption (MJ/yr)	% Gas consumption (from reference)
1	28 900	93 - 100%
2	26 880	86 - 92.9%
3	24 850	79 - 85.9%
4	22 830	72 - 78.9%
5	20 810	65 - 71.9%
6	18 790	Less than 65%

For the purposes of water efficiency labelling, the revision must also include appropriate tests for determining the quantity of water wasted by an appliance during the warm-up period.

Energy considerations

Each time an IGWH is turned on, heat energy is required to heat flowing water from ambient to the set temperature.

The energy required to achieve this includes:

- the energy required to ignite the burner, which should include the energy of a pilot light or the electrical energy (including any stand-by electrical energy) if the product has electronic ignition
- the initial heat energy (commonly referred to as start-up energy) required to heat not only the water flowing through the pipe, but all the associated components (e.g. the heat exchanger, the pipework etc) within the heater itself
- the heat energy required to maintain the appropriate temperature of the water flowing to the tap outlet.

Water considerations

As cold water has to flow through an IGWH to initiate the ignition of the burner, then be heated from ambient to the required temperature, and then be delivered to the tap outlet, it necessarily means that there is a certain quantity of water (wastage) that flows out the tap before the water is considered usable[*].

The water that is wasted comprises:

- the initial static water that was between the IGWH and the tap outlet before the tap was turned on
- the water that flows during the start-up period of the IGWH until the water at the heater is heated from ambient to the set temperature
- the hot water flowing from the IGWH that is initially cooled by the water pipe between the IGWH and the tap outlet, until the temperatures of the hot water and water pipe stabilise.

The above wastage becomes multiplied with each separate start-up from the same tap and even further accentuated when a number of users draw hot water from different taps at the same time.

A study of four IGWHs, conducted by Mechlab at the University of NSW, found that the daily water wastage under AS 4552 conditions of 19 events varied from 35-70 L/day. The water wastage of a storage heater under the same test conditions was only 4-5 L/day.

The study also found that under some test conditions, electronically controlled IGWHs were subject to large fluctuations in performance during delivery of water at high temperatures. Under certain

[*] Not all of the water will be wasted, as some end-uses (such as for bathtub filling or washing machines) will retain and use initial, below-temperature flows. For the purposes of the study, all wastage is assumed to go to drain.

conditions of high delivery temperatures these water heaters wasted water in the range of 170-250 L/day.

For WELS labelling of IGWH's to be feasible, available units would need to have a substantial spread of water efficiencies. As can be seen from Table 2, the energy efficiencies of currently registered IGWHs range from 3.7 to 6.0, however, from this investigation it was clear that the least energy efficient models were already being taken off the market. Indeed, as indicated previously it is possible that only models with a rating of 5-6 may remain.

A full assessment of the feasibility and value of WELS labelling, including a possible water rating range, will not be possible until data on actual water wastage is collected.

As the revision of AS4552 is being prepared with the intent that Minimum Energy Performance Standards (MEPS) will apply to IGWHs, it is sensible to conduct further assessments of the feasibility and value of WELS labelling and minimum standards for these products. The introduction of MEPS and WELS for IGWHs would provide manufacturers and distributors with complete compliance conditions. This is important as it would avoid IGWHs being designed to comply with only energy requirements, which could possibly adversely affect their water efficiency.

Recommendations for addressing water labelling concerns

Before it is possible to propose a suitable rating program for the purposes of water efficiency labelling, the following issues will need to be considered:

1) The revision of AS4552 must include appropriate tests for determining the quantity of water wasted by an appliance.

   In this regard it is suggested that:

   - the reference heater be updated to reflect the performance of products currently on the marketplace
   - the water wastage issues for both instantaneous and stored water heaters should have common water set-up conditions and final achievement goals (i.e. tested to the same conditions of water temperature at the inlet and outlet)
   - the development of the test procedures concerning water issues should include representatives from WELS and water utilities (e.g. Water Services Association of Australia).

   This last suggestion is included because the revision of AS 4552, currently being undertaken, has no such representation of water interests.

2) The repeatability and reproducibility of the test procedure for determining the water efficiency of a product should be verified.

3) An analysis of water wastage of the current instantaneous water heaters on the marketplace would need to be conducted.

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