ANSI/AHRI Standard 1400-2025 (I-P)

Performance Rating of Indirect Water Heaters

Approved American National Standard

ANSI

AHRI

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ICS Code: 91.140.65

Note:

This standard supersedes GAMA Testing Standard for Indirect-Fired Water Heater IWH-TS-1, March 2003 Edition.

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2025 Edition

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Origin and Development of AHRI Standard 1400

This is the initial publication.

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The Hydronic Systems STC is responsible for the development and maintenance of AHRI standards and guidelines pertaining to boilers, indirect water heaters, and other hydronic system components.

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PERFORMANCE RATING OF INDIRECT WATER HEATERS

Section 1. Purpose

1.1 *Purpose*. The purpose of this standard is to establish for Indirect Water Heaters: definitions; test requirements; rating requirements; minimum data requirements for Published Ratings; marking and nameplate data; and conformance conditions.

1.1.1 *Intent*. This standard is intended for the guidance of the industry, including manufacturers, designers, installers, contractors and users.

1.1.2 *Review and Amendment*. This standard is subject to review and amendment as technology advances.

Section 2. Scope

2.1 *Scope*. This standard applies to Indirect Water Heaters, having a total volume (potable plus heat source) less than or equal to 120 gallons, designed for installation with a hot water boiler or other external sources of heated water.

Section 3. Definitions

All terms in this document follow the standard industry definitions in the ASHRAE *Terminology* website unless otherwise defined in this section.

3.1 *Expressions of Provision*. Terms that provide clear distinctions between requirements, recommendations, permissions, options, and capabilities.

3.1.1 *"Can" or "cannot".* Express an option or capability.

3.1.2 *"May"*. Signifies a permission expressed by the document.

3.1.3 *"Must"*. Indication of unavoidable situations and does not mean that an external constraint referred to is a requirement of the document.

3.1.4 *"Shall" or "shall not"*. Indication of mandatory requirements to strictly conform to the standard and where deviation is not permitted.

3.1.5 *"Should" or "should not"*. Indication of recommendations rather than requirements. In the negative form, a recommendation is the expression of potential choices or courses of action that is not preferred but not prohibited.

3.2 *Standards-specific Definitions.*

3.2.1 *Indirect Instantaneous Water Heater*. A water heater consisting of a tank that contains hot water from an external source and a heat exchanger used to transfer heat from this stored water to the potable water.

3.2.2 *Indirect Storage Water Heater*. A water heater consisting of a potable hot water storage tank equipped with an internal or external heat exchanger used to transfer heat to the stored potable water from an external source.

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3.2.3 *Published Rating*. A statement of the assigned values of those performance characteristics, under stated Rating Conditions, where a unit can be chosen to fit the application. These values apply to all units of the same nominal size and type (identification) produced by the same manufacturer. This includes the rating of all performance characteristics shown on the unit or published in specifications, advertising or other literature controlled by the manufacturer, at stated Rating Conditions.

3.2.3.1 *Application Rating.* A rating based on tests performed at rating conditions other than Standard Rating Conditions.

3.2.3.2 *Standard Rating*. A rating based on tests performed at Standard Rating Conditions.

3.2.4 *Rating Conditions*. Any set of operating conditions under which a single level of performance results and which causes only that level of performance to occur.

3.2.4.1 *Standard Rating Condition*s. Rating Conditions used as the basis of comparison for performance characteristics.

Section 4. Test Requirements

Published Ratings shall be verified by tests conducted in accordance with the test method described in Appendix C and at the Rating Conditions in Section 5.

Section 5. Rating Requirements

5.1 *Standard Ratings*. Standard Ratings shall be established at the Standard Rating Conditions specified in Section 5.3.

5.2 *Verify Standard Ratings*. All Standard Ratings shall be verified by tests in accordance with Section 4.

5.2.1 *Values of Standard Ratings*.

1) Continuous draw shall be expressed in gal/h to the nearest 1 gal/h.
2) First draw shall be expressed in gal/h to the nearest 1 gal/h.
3) Heat source friction loss shall be expressed in ft w.c. to the nearest 0.1.
4) Standby loss shall be expressed in °F/h to the nearest 0.1.

5.2.2 *Indirect Water Heaters with Multiple Heat Exchangers*. Separate ratings shall be determined for each heat exchanger piping arrangement that are evaluated under this standard.

5.3 *Standard Rating Conditions*. The conditions of test for Standard Ratings shall be established at the Standard Rating Conditions specified in this section.

5.3.1 *Potable Inlet Water Temperature*. Potable inlet water temperature (T_i) shall be maintained at 58°F ± 2°F during all the draw tests.

5.3.2 *Potable Water Flow Rate*. Potable water flow rate (w) shall be adjusted to yield a nominal steady state 77°F differential between potable water outlet temperature and potable water inlet temperature, as measured over a period of 15 min and maintained within 0.25 gpm.

If a water heater is tested with a mixing valve, the potable water throttling valve or mixing valve, or both shall be adjusted to obtain the maximum potable water flow rate, where the above nominal steady state temperature differential can be maintained. If the mixing valve does not permit the above steady state temperature to be maintained at any potable water flow rate, the heater shall be tested without the mixing valve.

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Heat source inlet water temperature (T_{ih}) shall be maintained at 180°F ± 2.5°F during all the draw tests.

Heat source water inlet temperature shall be maintained between 58°F and 80 °F during the heat source friction loss test.

Heat source water flow rate (w_h) shall be adjusted according to the manufacturer's published recommendations, or the nominal value shown in Table 1, whichever is less. The heat source water flow rate shall be maintained within 0.25 gpm of this flow rate throughout the conduct of the test.

Table 1 Heat Source Water Flow Rate Based on Heat Source Connection Tube Size

Nominal Connection Size, in	Maximum Nominal Flow Rate, gpm
0.5	4
0.75	8
1.0	14
1.25	21
1.50	28
2.0	48
2.5	75
3.0	106

Ambient air temperature (T_a) shall be maintained at 70°F ± 5°F during the standby loss test and 75°F ± 10°F during the continuous draw and first draw tests.

Section 6. Minimum Data Requirements for Published Ratings

As a minimum, Published Ratings shall include all Standard Ratings. All claims to ratings within the scope of this standard shall include the statement "Rated in accordance with AHRI Standard 1400". All claims to ratings outside the scope of this standard shall include the statement "Outside the scope of AHRI Standard 1400". Application Ratings within the scope of the standard shall include a statement of the conditions under which the ratings apply.

Section 7. Conformance Conditions

While conformance with this standard is voluntary, conformance shall not be claimed or implied for products or equipment within the standard's Purpose (Section 1) and Scope (Section 2) unless such product claims meet all of the requirements of the standard and all of the testing and rating requirements are measured and reported in complete compliance with the standard. Any product that has not met all the requirements of the standard shall not reference, state, or acknowledge the standard in any written, oral, or electronic communication.

Section 8. Nomenclature

All symbols and variables used in the standard are defined as shown in Table 2.

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Table 2 Nomenclature

Symbol	Title	Unit
A	Mean tank temperature at start of test	°F
B	The slope or decay rate of the mean tank temperature	°F/h
c_p	Specific heat of water	Btu lb °F
DR	Mean tank water temperature decay rate during standby test	°F/h
DR_u	Uncorrected mean tank water temperature decay rate during standby test	°F/h
L_{in}	Length of external heat source piping between pressure gauge port and the inlet to the indirect water heater	ft (minimum 6 in)
L_{out}	Length of external heat source piping between the indirect water outlet and the gauge port	ft (minimum 25 pipe diameters)
P_{iht}	Pressure at heat source inlet with flow	ft w.c.
P_{ihs}	Pressure at the heat source inlet with no flow	ft w.c.
P_{oht}	Pressure at the heat source outlet with flow	ft w.c.
P_{ohs}	Pressure at the heat source outlet with no flow	ft w.c.
dP_{eh}	Pressure drop of external heat source piping	ft w.c.
dP_h	Heat source friction loss	ft w.c.
Q	Standby heat loss from the Indirect Water Heater tank	Btu/h
Q_h	Heat exchanger heat input	Btu/h
T_a	Measured ambient air (room) temperature	°F
$T_{a,avg}$	Average ambient air (room) temperature	°F
T_i	Measured potable water inlet temperature	°F
$T_{i,avg}$	Average potable water inlet temperature	°F
T_{ih}	Inlet heat source water temperature to the Indirect Water Heater	°F
$T_{ih,avg}$	Average inlet heat source water temperature to the Indirect Water Heater	°F
T_o	Measured potable water outlet temperature	°F
$T_{o,avg}$	Average potable water outlet temperature	°F
T_{oh}	Outlet water temperature from Indirect Water Heater to heat source	°F

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Symbol	Title	Unit
$T_{oh,avg}$	Average outlet water temperature from Indirect Water Heater to heat source	°F
$T_{o,max}$	Maximum potable water outlet temperature during first draw test	°F
T_s	Mean tank temperature	°F
V	Potable water volume	gal
V_c	Volume of potable water drawn during continuous draw test	gal per 30 min
V_{cd}	Continuous draw rating	gph
V_d	Volume of potable water drawn during the first draw test	gal
V_{END}	Volume reading of potable water meter at end of first draw test	gal
V_f	First hour rating	gph
V_h	Heat source water volume	gal
V_t	Initial volume reading of potable meter reading at beginning of first draw test	gal
W	Water flow rate (potable) in Indirect Water Heater	gpm
w_h	Water flow rate (heat source) for Indirect Water Heater	gpm
$w_{h,avg}$	Average water flow rate (heat source) for Indirect Water Heater	gpm
w_{hf}	Heat source water flow during friction loss test	gpm
W_c	Total weight of potable water drawn during continuous draw test	lb per 30 min
W_d	Total weight of potable water drawn during first draw test	lb
W_p	Weight of tank when filled with potable water	lb
W_{ph}	Weight of tank when filled with potable and heat source water	lb
W_t	Dry weight of tank	lb
WT_{END}	Weight of weigh tank and potable water at end of first draw test	lb
WT_t	Initial weight of weigh tank at beginning of first draw test	lb
X	Time lapse in hours	h

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