ANSI/ASHRAE Standard 118.1-2003

ASHRAE STANDARD

Method of Testing for Rating Commercial Gas, Electric, and Oil Service Water Heating Equipment

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Approved American National Standard

ANSI

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.

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(This foreword is not part of this standard but is included for information only.)

FOREWORD

This test procedure is a revision of ANSI/ASHRAE Standard 118.1-1993, Method of Testing for Rating Commercial Gas, Electric, and Oil Water Heaters. Major changes are the addition of procedures to test heat pump water heaters and coverage of water-heating equipment with continuously operating pumps. Various smaller changes were made to improve the clarity and consistency of the standard.

This update was initiated by Technical Committee 6.6, Service Water Heating, after a review by members of the committee. The document was developed following ASHRAE procedures for updating standards.

1. PURPOSE

The purpose of this standard is to provide test procedures for rating directly heated commercial-service water-heating equipment.

2. SCOPE

2.1 This standard provides test procedures for determining the efficiency and hot water delivery capability of the water-heating equipment to which it applies.

2.2 This standard applies to electric resistance, electric air-source heat pump, gas-fired, and oil-fired water-heating equipment, including hot water supply boilers with input ratings less than 12,500,000 Btu/h (3660 kW) and greater than:

Electric Resistance	12 kW
Electric Heat Pump	6 kW (including all 3 phase regardless of input)
Gas-Fired	75,000 Btu/h (22 kW) (see Section 2.3)
Oil-Fired	105,000 Btu/h (31 kW)

2.3 This standard does not apply to gas-fired service water-heating equipment that meets all of the following:

(a) has a storage capacity of less than two gallons,

(b) is designated to deliver water at a controlled temperature of less than 180°F (82°C), and

(c) has an input rating less than 200,000 Btu/h (59 kW).

3. DEFINITIONS AND SYMBOLS

3.1 Definitions

boiler, hot water supply: a boiler used to heat water for purposes other than space heating.

cutout: the time when a thermostat has acted to reduce the energy or fuel input to the heating elements or burners under its control to a minimum.

heating cycle: the period of operation including prepurge, primary heat-producing energy flow, and postpurge.

heat pump water heater: a device using the vapor compression cycle to transfer heat from a low-temperature source to a higher temperature sink for the purpose of heating potable water, including all necessary ancillary equipment fans, blowers, pumps, storage tanks, piping, and controls.

input rating: the rating that appears on the water heater's rating plate, expressed in kW or Btu/h, as appropriate.

mean tank temperature: the mean of the water temperatures determined using the water-heating equipment tank thermocouple described in Section 7.3.1.

service water heating: heating water for purposes other than space heating or pool heating.

3.2 Symbols

C_{fg} = volume conversion factor, 7.48055 gal/ft^3 (1 000 L/m^3)

C_{ge} = conversion factor from kWh to Btu = 3,412 Btu/kWh

COP_h = the average coefficient of performance for heat pump water heaters: a dimensionless ratio of useful water-heating energy output to input energy

C_p = specific heat of water at 140°F (60°C) in Btu/(lb·°F) = 1.00 Btu/(lb·°F) [4 184 J/kg·°C]

C_{pg} = nominal specific heat of water, 8.25 Btu/(gal·°F) [1.15 kW/m^3·K]

C_s = correction factor applied to gas if it is not at standard temperature and pressure (see Appendix A)

C_{WJ} = conversion of electric power = 3 600 000 J/kWh

EB = energy balance: the heat pump water heater overall energy balance calculated in Section 9.4.3, Btu/h

Eg_{min} = equivalent gallons (liters) per hour, continuous

E_t = thermal efficiency as calculated in Section 10.2.1

E_{tp} = thermal efficiency during reduced input as calculated in Section 10.2.2

FR = flow rate: the water flow rate established at full input rating in Section 8.7, gal/min (L/min)

FR_a = flow rate average of FR for the duration of the thermal efficiency test in Section 9.1.1, gal/min (L/min)

FR_h = flow rate: the water flow rate during the heat pump water heater water heating mode test, Type IV, in Section 9.4.4, gal/min (L/min)

FR_{min} = water flow rate established at minimum input rating in Section 8.7.2, gal/min (L/min)

FR_p = tested flow rate at partial input: the average of FR_{min} for the duration of the thermal efficiency test in Section 9.1.2, gal/min (L/min)

H = actual higher heating value for the test gas, Btu/ft^3 (kJ/m^3)

H_o = actual higher heating value for the test fuel oil, Btu/lb (kJ/kg)

I = full input rating for water-heating equipment in Btu/h (kW). For electric water-heating equipment, the tested input rating, kW