

for Temperature Measurement.¹ Measurement of water temperature shall be to an accuracy corresponding to 1.0% or less of the temperature rise with the exception of heat pump pool heaters, for which the accuracy shall correspond to 0.03°C (0.05°F) or less of the temperature rise.

6.3 Pressure. Pressure-measuring instruments shall have errors no greater than the following:

- a. Gas: ±25 Pa (0.1 in. of water)
- b. Oil: ±3.4 kPa (0.5 psi)
- c. Atmospheric: ±33.8 Pa (0.01 in. Hg)
- d. Water: ±6.9 kPa (1.0 psi)

6.4 Draft. Draft gauges shall have an accuracy of ±1.2 Pa (0.005 in. of water). Minimum divisions on the draft gauge shall be 1.2 Pa (0.005 in. of water).

6.5 Mass. Measuring instruments shall have an accuracy sufficient to ensure an error no greater than 1.0% of the total mass measured.

6.6 Time. Timing instruments shall have an error no greater than ±0.5 s/h.

6.7 Electrical Instruments

6.7.1 Electrical Measurements. Electrical measurements shall be made with indicating or integrating instruments.

6.7.2 Instruments. Instruments used for measuring the electrical input to heaters or other apparatus furnishing heat loads shall be accurate to ±1.0% of the quantity measured. Instruments used for measuring the electrical input to fan motors, compressor motors, or other equipment accessories shall be accurate to ±1% of the measured value for heat pump pool heaters and for other tested equipment shall be accurate to ±2.0% of the measured value.

6.7.3 Voltages. Voltages shall be measured with instruments that are accurate to ±1% of the quantity measured and shall be measured at the equipment terminals.

6.8 Higher Heating Value. Devices used to measure the higher heating value of either natural gas, propane, or fuel oil shall have an error no greater than ±1.0%.

6.9 Water Flow. A flowmeter may be used instead of a tank and scale for determining water flow rate and quantity. Conversion to mass of water, where required, shall be based upon the specific volume listed in the *ASHRAE Handbook—Fundamentals*, Chapter 6, Table 3,² for the temperature of the water metered. Water flowmeters shall have an error no greater than 1% of measured value. Concurrent water meter calibration, as described in Informative Appendix B, may be conducted as an alternative to calculation based on specific volume.

6.10 Combustion Products. Instruments used to measure the concentration of carbon dioxide shall have an error no greater than ±2.5% of the reading.

6.11 Smoke. Smoke-measuring instruments shall comply with requirements for smoke meters as outlined in ASTM-

D2156, *Test Method for Smoke Density in the Flue Gases from Burning Distillate Fuels*.³

7. APPARATUS

7.1 Test Platform. The equipment to be tested shall be installed in the test room in accordance with the manufacturer's installation instructions using recommended installation procedures and accessories. In all cases, the manufacturer's recommendations with respect to distances from adjacent walls shall be followed. For a pool heater not approved for installation on combustible flooring, suitable noncombustible material shall be placed under it.

7.2 Water Piping. Water piping shall be installed according to the manufacturer's recommendations. Unions may be used to facilitate installation and removal of the piping arrangements.

Any piping components or insulation supplied with the pool heater shall be included. Install a pressure gauge in the water supply line.

When required for conduct of this test, an optional recirculating loop of minimum length and a pump shall be provided as shown in Figure 1b. If the optional recirculation loop is used in the test, it shall be insulated with insulation having an R-value of 0.7 m²·K/W (4 h·ft²·°F/Btu). The recirculation pump electricity consumption shall be measured.

7.3 Thermocouple Locations

7.3.1 Water Pipe. Install thermocouples or temperature-measuring devices as illustrated in Figures 1a or 1b as appropriate. The junction of the thermocouples shall not extend more than 0.15 m (6 in.) into the pipe from the appropriate outlet of the tee.

7.3.2 Flue Pipe. Thermocouple grids shall be constructed of equally spaced thermocouples wired in parallel in a test plane less than half the distance ($J/2$) to the point of dilution from the heater flue outlet perpendicular to the axis of the flue, vent, or venting system as part of the outdoor equipment as illustrated in Figure 2. The thermocouple leads shall be equalized in length before paralleling. If there is a possibility that the thermocouples could receive direct radiation from flame, install radiation shields on the flame side of the thermocouple only and position the shields so that they do not touch the thermocouple junctions. The thermocouples shall be the bead type having a wire size no greater than 0.50 mm (No. 24 American wire gauge).

7.3.3 Test Room

7.3.3.1 For Fossil Fuel and Electric Resistance Pool Heaters. Install a thermocouple in the test room with its junction shielded against radiation from the pool heater and position it at the vertical midpoint of the heater at a perpendicular distance of approximately 0.60 m (24 in.) from the surface of the pool heater jacket.

7.3.3.2 For Heat Pump Pool Heaters. An outdoor test room or space is required for testing heat pump pool heaters. This test room shall be of sufficient volume and shall circulate air in a manner such that it does not change the normal air

AIR TEMPERATURE AND WET - BULB MEASUREMENTS
PER SECTION 8.4

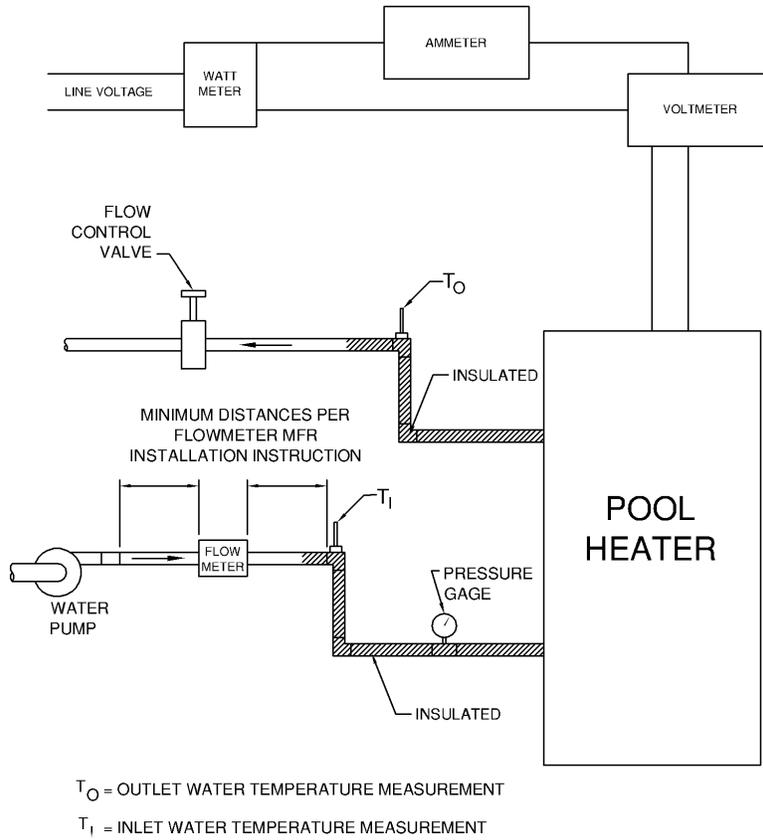
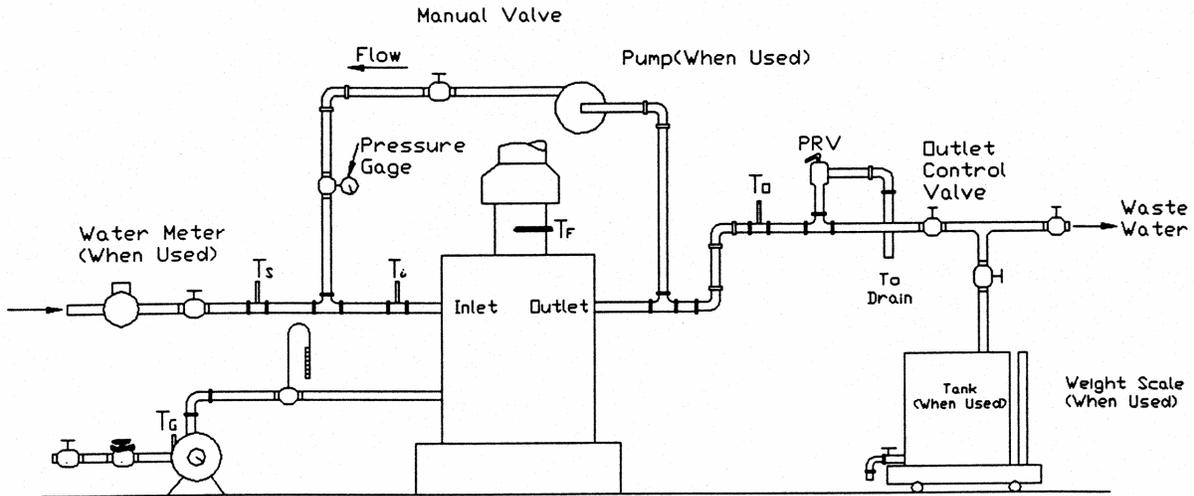


Figure 1a Plumbing layout and location of water temperature measurements (heat pump pool heaters).



- T_s = Location for Temperature Measurement in Supply Water Line
- T_a = Location for Temperature Measurement in Outlet Water Line
- T_f = Location for Temperature Measurement in Flue
- T_g = Location for Temperature Measurement in Gas Line
- T_i = Location for Temperature Measurement in Inlet Water Line

Figure 1b Plumbing layout and location of water temperature measurements (gas, oil, and electric resistance pool heaters).

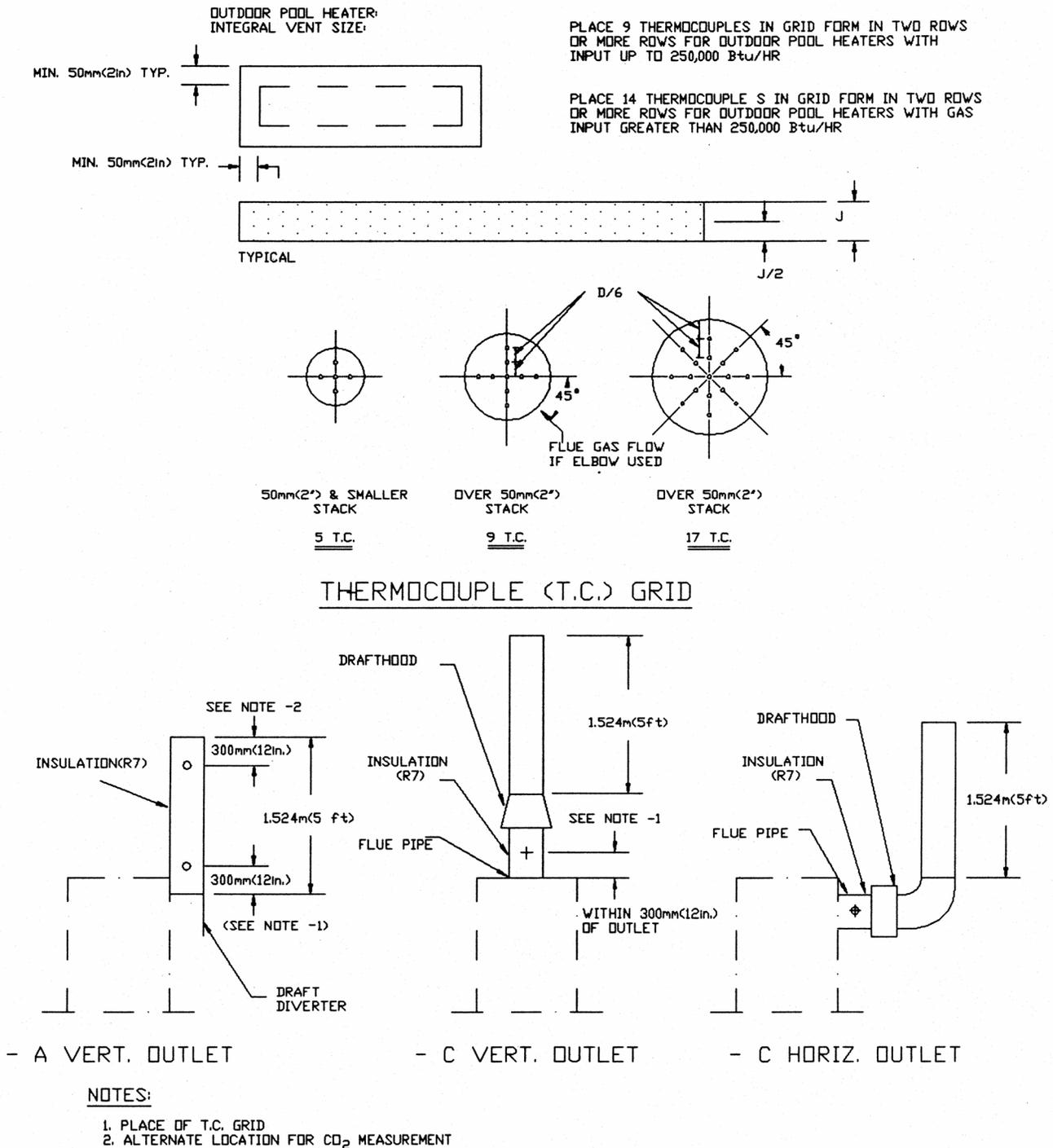


Figure 2 Flue configuration and thermocouple grid (gas pool heaters).

circulating pattern of the equipment under test. It shall be of dimensions such that the distance from any room surface to any equipment surface from which air is discharged is not less than 1.8 m (6 ft), and the distance from any other room surface to any other equipment surface is not less than 0.9 m (3 ft), with the exception of the floor. To facilitate more uniform air temperature surrounding the unit, it may be raised off the floor. The room-conditioning apparatus should handle air at a rate not less than 1.5 times the airflow rate of the equipment under test. The room-conditioning apparatus pref-

erably should take the air from the direction of the air discharge and return it at the desired conditions uniformly and at low velocities.

7.3.3.2.1 Outdoor Air Inlet Temperatures. Outdoor air inlet temperatures shall be measured at locations such that the following conditions are fulfilled:

- a. The measured temperatures shall be representative of the temperature surrounding the outdoor section and simulate the conditions encountered in an actual application.

- b. At the point of measurement, the temperature of air must not be affected by the air discharged from the outdoor section. This makes it mandatory that the temperatures be measured upstream of any recirculation produced.

It is intended that the specified test temperatures surrounding the outdoor section under test shall simulate as nearly as possible a normal installation operating at ambient air conditions identical with the specified test temperatures.

7.4 Flue Requirements

7.4.1 Gas-Fired Pool Heaters. For indoor units, a vertical 1.5 m (5 ft) length of flue pipe shall be connected to the flue gas outlet. If the outlet discharges horizontally, a suitable 90° elbow shall be installed first. For outdoor units, no modifications to the integral vent shall be made (and no vent pipe is needed). The flue gas sample shall be taken at the location shown in Figure 2 for indoor units and at the flue outlet for outdoor units.

Pool heaters designed for other than natural draft venting, or for a specific venting system, shall be installed with the venting arrangement specified in the manufacturer's instructions using the minimum lengths of vertical and horizontal vent pipe recommended by the manufacturer.

7.4.2 Oil-Fired Pool Heaters. On indoor units, a vertical 1.5 m (5 ft) length of vent pipe shall be connected to the flue gas outlet to establish the minimum draft at the flue collar as specified in the manufacturer's installation instructions. Additional stack height or a mechanical draft inducer may be used. If the outlet discharges horizontally, a suitable 90° elbow shall be installed first. For outdoor units, no modification to the integral vent shall be made (and no vent is needed). The flue gas sample shall be taken at the location shown in Figure 3 for indoor units and at the flue outlet for outdoor units.

Pool heaters designed for other than natural draft venting, or for a specific venting system, shall be installed with the venting arrangement specified in the manufacturer's instructions using the minimum lengths of vertical and horizontal vent pipe recommended by the manufacturer.

7.4.3 Insulation Requirements. Insulation with an R-value of no less than 1.2 m²·K/W (7°F·ft²·h/Btu) shall be provided on the flue pipe and elbow (if installed) up to the plane where flue gas temperature is measured. For gas-fired heaters with draft hoods and for oil-fired heaters, there shall be no opening between the heater and point where the flue gas sample (for CO₂) is taken and the flue gas temperature is measured.

7.5 Fuel or Energy Consumption Measurement. Install one or more instruments that measure, as appropriate, the quantity and rate of electrical energy, natural gas, LP gas, and fuel oil consumed by the pool heater.

7.6 Water Supply. The water supply shall be capable of delivering water at the conditions specified in Section 8.3.

8. METHODS OF TESTING

8.1 General. The pool heater shall be installed and operated in accordance with the manufacturer's instructions unless

specifically required otherwise by the test method. The pool heater shall be equipped with the apparatus described in Section 7, and the instrumentation described in Section 6 shall be set up for obtaining and recording data, as necessary.

8.2 Energy Supply

8.2.1 Electrical Supply. Throughout the entire operating portion of each test, maintain the electrical supply voltage to within ±2% of appropriate standard voltage. Standard voltage shall be

- the highest voltage of the applicable range of 110–120, 200–208, 220–240, 254–277, 440–480, and 560–575 if the voltage rating specified on the nameplate of the pool heater is within one of these ranges or
- the voltage on the nameplate of the pool heater if the voltage is not within one of the ranges specified above.

8.2.2 Gas Supply. Maintain the appropriate gas supply at a pressure within the limits specified by the manufacturer on the nameplate of the pool heater. Record the higher heating value, H , in kJ/m³ (Btu/ft³) for the gas to be used in the test, and use this value for all calculations included herein.

8.2.3 Oil Supply. Record the actual higher heating value, H_o , in kJ/kg (Btu/lb) for the fuel oil used in the test, and use this value for all calculations included herein.

8.3 Water Supply. Water temperatures and flow rates shall be as shown in Table 1, and the flow rate shall be maintained throughout the test at ±2%.

8.4 Test Room Ambient Condition. For heat pump pool heaters, maintain the dry-bulb temperature at 27°C (80.6°F) and the wet-bulb temperature at 21.5°C (70.7°F) for high air temperature, mid-humidity (62% relative humidity) tests; maintain the dry-bulb temperature at 10.0°C (50.5°F) and the wet-bulb temperature at 5.5°C (41.9°F) for low air temperature, mid-humidity (50% relative humidity) tests. For tests of all other types of pool heaters, maintain the ambient air dry-bulb temperature of the test room at 24°C (75.2°F). Test tolerances shall be in accordance with Table 2.

8.5 Power Input Adjustment

8.5.1 Gas Pool Heater. Adjust the fuel rate to achieve input that is within ±2% of the rating specified by the manufacturer as measured 15 minutes after initiation of pool heater operation. If the pool heater is equipped with a gas equipment pressure regulator, the regulator outlet pressure shall be within 50 Pa (±0.2 in.) of the manufacturer's specified manifold pressure. Do not change the equipment pressure regulator setting after the input has been established.

8.5.2 Oil Pool Heater. Adjust the burner to obtain input that is within 2% of the manufacturer's specified power with the CO₂ reading in accordance with the manufacturer's instructions as measured 15 minutes after initiation of pool heater operation. The smoke density in the flue pipe shall not exceed number 1.³ The fuel pump pressure shall be within