

SPECIFICATIONS FOR DIRECT MEASUREMENT OF EARTH THERMAL CONDUCTIVITY TESTING

- Thermal conductivity test should be performed for 36 to 48 hours. The time may be shortened at the determination of the data interpreter using experience in the area.
- The heat rate (heat of rejection) is to be 15 to 25 watts per ft. (50 to 80 W/m) of borehole. These heat rates are the expected peak loads on the test borehole for an actual heat pump system. Heat rates should increase as the borehole diameter increases, as the borehole depth increases, and as the grout resistance increases. As the ratio of effective diameter of the heat rejection tubes to the borehole diameter increases the heat rate decreases.
- The standard deviation of input power is to be less than + 1.5 % of the average value and peaks less than + 10% or resulting temperature variation less than + 0.5°F (0.3°C).
- The accuracy of the temperature measurement and recording devices are to be +0.5°F (0.3°C). · The accuracy of the power transducer and recording device is to be +2% of the reading.
- Flow rates are to be in the range to provide a differential loop temperature of 6 to 12°F (3.5 to 7°C). This is the temperature differential for an actual heat pump system.
- A waiting period of five days is recommended for low-conductivity soils [$k < 1.0$ Btu/hr-ft-°F (1.7 W/m-°C)] after the ground loop has been installed, grouted, and filled with water before the thermal conductivity test is initiated. A delay of three days is recommended for higher conductivity formations [$k > 1.0$ Btu/hr-ft-°F (1.7 W/m-°C)].
- The initial ground temperature measurement is to be made at the end of the waiting period by direct insertion of a probe inside a liquid filled ground heat exchanger at three locations representing the average or by the measurement of temperature as the liquid exits the loop during the period immediately following start-up. Ewbank uses the exiting fluid temperature while pumping measurement and records at one second intervals.
- Data collection should be at least once every 10 minutes. Ewbank collects data points at one minute intervals and test duration is only limited by file size.
- All above ground piping is to be insulated with a minimum of 0.5 inch (1.25 cm) closed cell insulation or equivalent. Test rigs are to be enclosed in a sealed cabinet that is insulated with a minimum of 1.0-inch (2.5 cm) fiberglass insulation or equivalent.
- If retesting a bore is necessary, the loop temperature should be allowed to return to within 0.5°F (0.3°C) of the pretest initial ground temperature. This typically corresponds to a 10 to 12-day delay in mid to high conductivity formations and a 14-day delay in low conductivity formations if a complete 48-hour test has been conducted. Waiting periods will be proportionally reduced test terminations occurred after shorter periods.
- Any of the public domain software programs tested in conjunction with ASHRAE 1118-TRP, with the exception of the Line Source method that only ignores the first 0.08 hours of data, can be used to evaluate thermal conductivity. It is suggested that multiple programs be used to further enhance reported accuracy.
- A well completion report (driller's or lithologic log) is required to estimate the thermal diffusivity. No direct measurement methodology has been established for thermal diffusivity.
- Static water level in the formation should be noted and dry formations noted. Groundwater produced while drilling should be noted.
- Lost circulation zones and occurrence of natural gas should be noted.