

Thermal properties measurements in rock and concrete



With all sample types, it is necessary to allow the sensor needle to equilibrate with the sample and the surrounding environment. Temperature differences between the sensor, sample, and surroundings could give erroneous readings.

Sensor recommendations

For rock, masonry, cement, and concrete samples, METER recommends using the RK-3 or TR-3 sensors. If the material is hardened and needs to be drilled into to be sampled, then we recommend using the RK-3. The RK-3 sensor fits nicely into a pilot hole created by a 5/32" (3.97 mm) rotary hammer bit. However, if the sample can be poured, then the TR-3 can also be used if greased pilot pins are inserted into the sample before it cures. If the soil being measured is composed of large particles, then care should be taken to assure good contact between the needle and the material.

We do not recommend using the SH-3 sensor to make specific heat and diffusivity measurements in rock, stone, and concrete. The SH-3 can be used in concrete samples if the sensor is cast into the sample, however, this will make the sensor irretrievable.

Concrete and cement

The thermal properties of concrete are highly-dependent on its water content. As concrete cures, it consumes water in the curing process. This means that concrete that is not fully cured will have higher water content and lower resistivity than fully-cured concrete. Taking thermal measurements of a concrete sample that is still not fully cured could yield incorrect thermal properties readings. As a worst-case scenario, this could mean making design decisions based on incorrect information.

Concrete and grout sample collection

Concrete samples can be tested in-situ or can be poured and cured. The sample should be a minimum of 4.5" (11 cm) tall and 2" (5 cm) in diameter. If you will be sending a sample to METER for testing services, please be conscious of the weight of your sample.

Pilot pins can be inserted into the sample as it cures for use with the TR-3 sensor. Pins should be greased with petroleum jelly or thermal grease prior to insertion to make removal of the pins possible after the sample has cured. It is likely that pins that have not been greased will not be able to be removed from a cured sample. A minimum of three pins should be inserted into the sample to allow for multiple sampling points.

A minimum of two weeks of cure time should elapse before any thermal testing. Note that the moisture content will continue to change as the sample sets and that concrete can take months to fully cure. Only measurements from fully-cured samples should be used for design decisions.

Rock and stone samples

Pilot holes for the RK-3 sensor can be drilled into rock and stone samples using a 5/32" (3.97 mm) rotary hammer bit. We recommend using the RK-3 for all cured stone and rock samples.

Certain types of rock, like granite, will have a higher thermal conductivity and will require a large sample as to remove the possibility of boundary resistance. Ideally, natural stone samples can be tested *in situ* in a large sample.

Crushed rock and gravel samples composed of large granules should not be tested using the heated needle technique. It is likely that large air pockets will be present between the sensor needle and the sample, creating resistance errors in the reading.

See "[How to collect samples for thermal analysis](#)".

For more questions about testing, or collecting samples, please contact [METER](#) directly.

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