METER
ENVIRONMENT

HOW TO COLLECT SAMPLES FOR THERMAL ANALYSIS

There are two major factors that can be changed during sample collection and delivery that affect the thermal properties (conductivity, resistivity, heat capacity) of soil and other porous materials like grout, FTB, and concrete. These are the water content and the compaction (or bulk density) of the material. As porous materials dry, the thermal conductivity and heat capacity decreases substantially, and the thermal resistivity (rho) can increase by a factor of five or more. Similarly, if the bulk density of a low-strength porous material is decreased (e.g., a soil sample that is unconfined and loosened during shipping), then the thermal conductivity and heat capacity decrease, while the thermal resistivity will increase substantially. It is, therefore, imperative that these two quantities be preserved during sample collection and shipment if the measured thermal properties are to reflect the thermal properties found in the field.

Note that soil water content is a highly dynamic property and changes seasonally, daily, and even hourly in many soils. The water content at which the sample is collected may not adequately reflect the water content that will be present after the engineering project is completed. Thus, it is always recommended to create a thermal dryout curve that characterizes the thermal properties over the full range of water content levels that could be found in that soil.

SOIL SAMPLING RECOMMENDATIONS

A Shelby tube or equivalent thin-walled tube should be driven into the soil and removed with an intact soil core inside. Minimum sample dimensions for a typical ASTM D5334 thermal resistivity test are 4.5 inches (11 cm) length and 1.5 inches (3.8 cm) diameter. Note that a 2-inch, or larger, diameter is better.

To preserve moisture, the ends of the tube should be capped or otherwise sealed and taped after the sample is collected. See picture below for an example of the preferred shipping method. Note that for a thermal dryout curve, the ends do not need to be sealed because the water content will be manipulated in the lab.

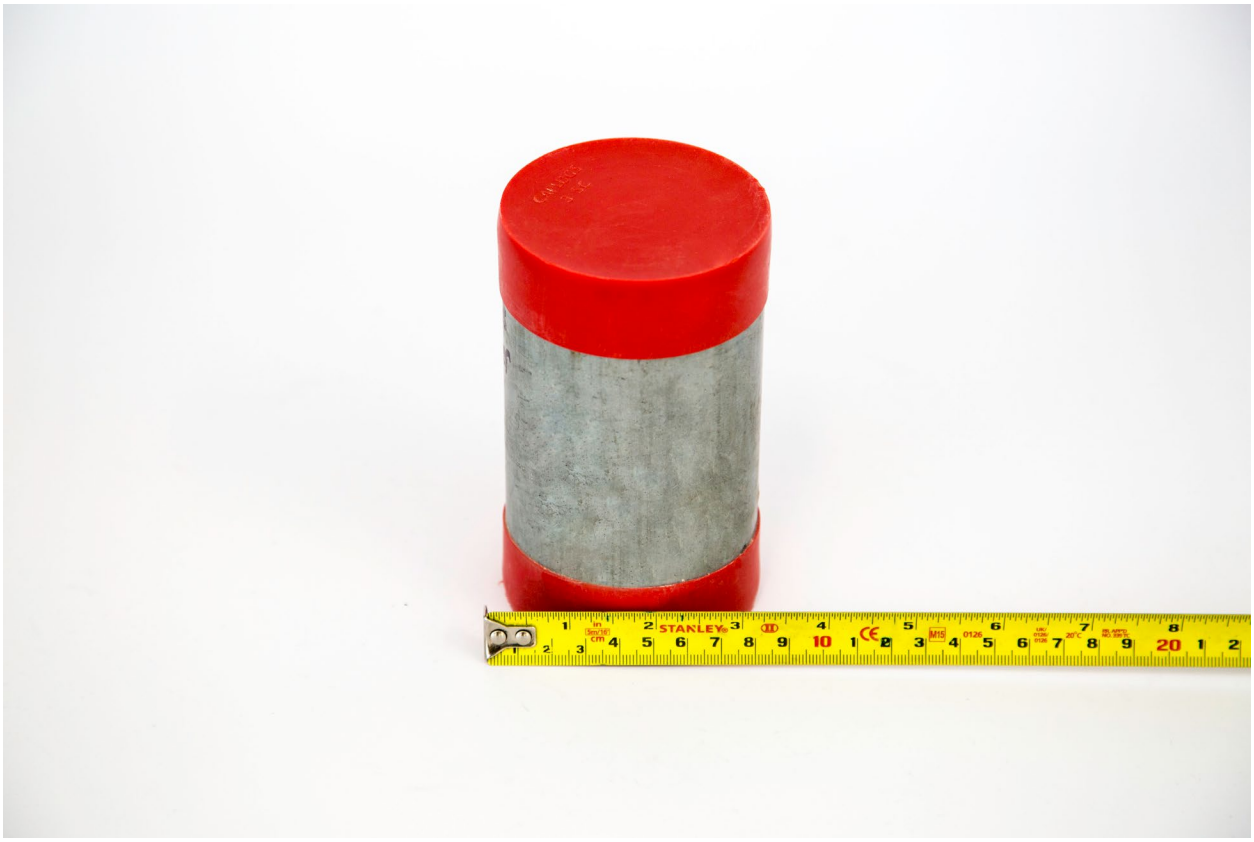

Figure 1. Preferred sample shipping method

GROUT SAMPLING RECOMMENDATIONS

Flowable grout samples can be sealed in any container with appropriate dimensions of at least 4.5 inches (11 cm) length and 1.5 inches (3.8 cm) diameter. Note that a 2-inch, or larger, diameter is better. The sample container should be filled completely with grout and sealed to prevent water loss.

CONCRETE/FTB SAMPLING RECOMMENDATIONS

1. Concrete or FTB can be cured in any container with appropriate dimensions of at least 4.5 inches (11 cm) length and 2 inches (5 cm) diameter. See picture below for a typical concrete sample container.

2. It is HIGHLY recommended to contact METER before pouring concrete samples to obtain pilot pins (pictured below).

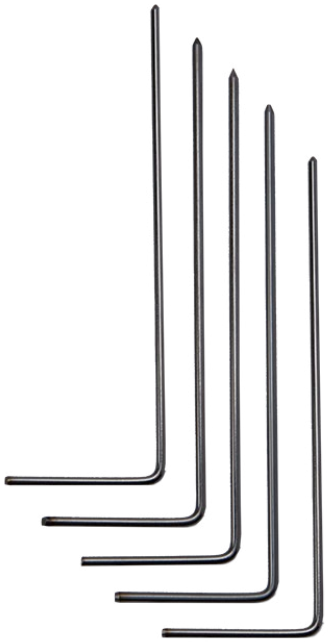

Figure 2. Pilot pins

3. Pilot pins are coated with petroleum grease/jelly and inserted into the uncured material at least 3/4 inch from the container wall. The spacing between pilot pins is not critical, but on typical 4-inch diameter samples, pilot pins can be conveniently spaced at least one inch from container walls and from adjacent pilot pins. Once the material is cured, they can easily be removed, leaving an appropriate-sized hole for the measurement needle. We recommend at least three pilot pins per sample. If you can't get in touch with METER for pilot pins, you can use wire or tubing with outside diameter of 0.096 inches (2.44 mm).

4. Various concrete/FTB mixes have different cure times, which affect the water content of the material. Please make sure that the material is fully cured before shipping to METER.

5. Compaction strongly affects thermal conductivity. Compact samples to the same density as the poured concrete or FTB.

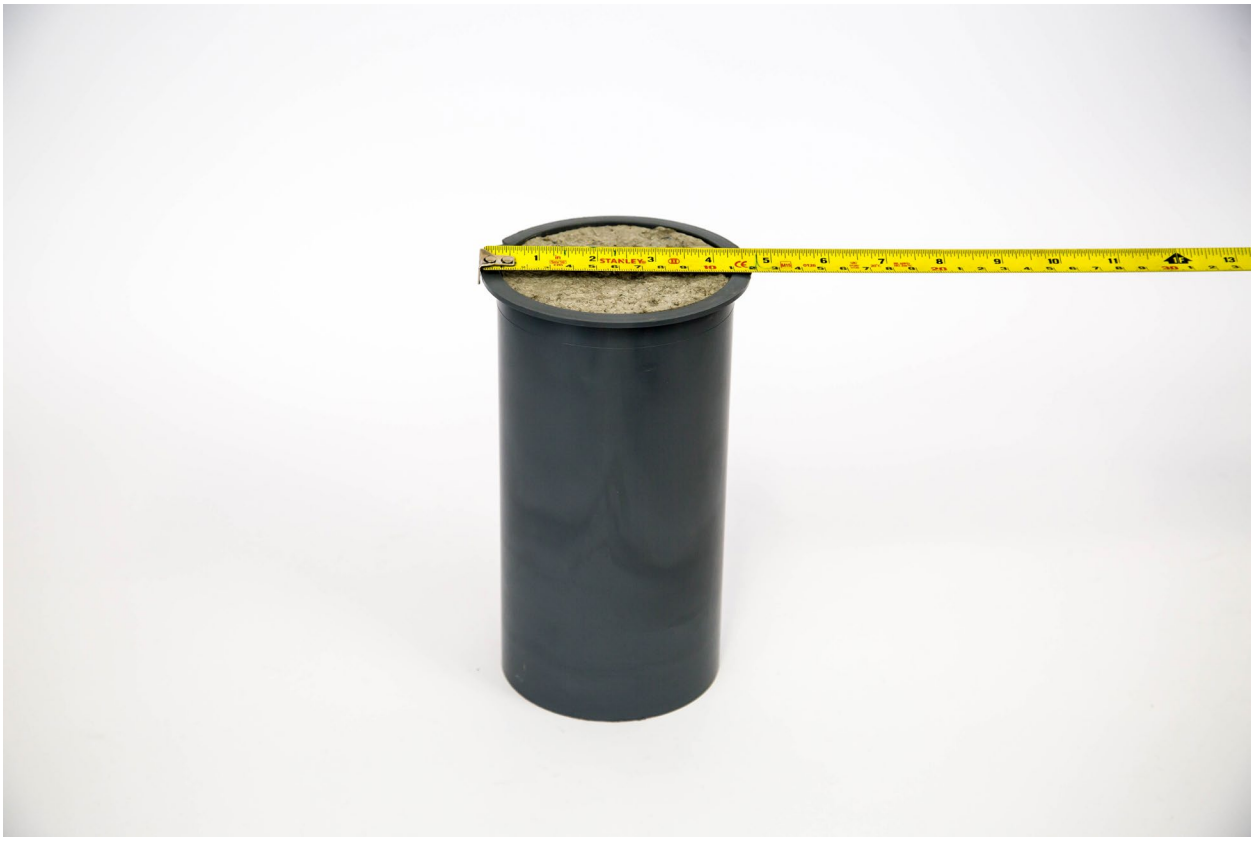

Figure 3. Typical concrete sample container

FLUID SAMPLE RECOMMENDATIONS

Fluid samples can be shipped in any durable, sealed container. We require a minimum of 50 mL of fluid material for testing. Please note that samples with low viscosity (kinematic viscosity < 5.5 X 10-7 m2/s) cannot be tested with the transient heated needle technique as the needle heating will cause free convection and invalidate the measurement. This viscosity level is approximately equivalent to water at 50 °C, so most aqueous solutions can be measured at room temperature. If the fluid sample contains chemical additives, please include the MSDS for the chemicals along with the sample shipment.

For more information concerning collecting soil samples for thermal analysis, contact METER.