

## Instructions Collecting Samples For Thermal Analysis

### Introduction

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 decrease 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 loosens 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. It is therefore 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

- 1) A Shelby tube or equivalent thin-walled tube should be driven into the soil and removed with an intact soil core inside.
- 2) 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" or larger diameter is better.

- 3) 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.
- 4) 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



### Grout Sampling Recommendations

- 1) 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" or larger diameter is better.
- 2) 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 that you contact Decagon before pouring concrete samples to obtain pilot pins (pictured below). Pilot pins are coated with petroleum grease/jelly and inserted into the un-cured material. Once the material is cured, they can easily be removed, leaving an appropriate sized hole for the measurement needle.

a. We recommend at least three pilot pins per sample.

b. If you can't get in touch with Decagon for pilot pins, you can use wire or tubing with outside diameter between 0.096 and 0.100 inches (2.44 – 2.54 mm).

3) 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 Decagon.



For more information concerning collecting soil samples for thermal analysis, contact us at [thermal@decagon.com](mailto:thermal@decagon.com) or call 509-332-5599.