

## **Application Note: SHIPPING OF SOIL SAMPLES**

It seems like everyone involved in underground construction has the misconception that samples cannot be shipped long distances or by common courier. This has led to unnecessary practices in some cases and inadequate shipping procedures in other cases. This application note summarizes GeoTesting Express' experience and recommendations for shipping geotechnical samples.

Samples taken for tests that involve remolding of the soil can be shipped without concern for sample disturbance. This includes tests to determine gradation, Atterberg limits, moisture-density, moisture content, organic content, percent fines, classification, durability, and mix design. It also includes all mechanical property tests (strength, compressibility, permeability) to be performed on samples that will be remolded and compacted in the laboratory to specified conditions.

Samples obtained from stockpiles, borrow areas and disturbed areas can be shipped without concern for sample disturbance. Samples obtained by grab samplers, drill cuttings, auger returns, drive samplers, or a STP sampler are already highly disturbed and can be shipped without concern for sample disturbance due to the shipping method.

Samples described above are considered disturbed samples. They can be placed into bags, jars, buckets, or boxes for shipping. Glass jars should be bagged and surrounded with protective material to prevent breakage. Wet bulk samples should be placed in a strong plastic bag that is tied and that bag placed into a second bag that is tied to prevent leakage. If shipped by courier, all plastic bags should be placed in a strong cardboard box, a wooden box, or a cooler. All samples requiring determination of moisture content should be preserved in airtight containers such as jars with sealed lids or double sealed plastic bags as soon as the sample is taken and the sample kept out of direct sunlight.

Sample disturbance due to shipping becomes a concern when one wishes to test soils in their natural undisturbed state using samples taken with techniques that minimize disturbance caused by the sampling process. This includes thin-walled tube samples, vibra-core samples, block samples, core barrel samples of weakly cemented materials, and formed samples containing cementaceous materials within a few days of casting. The defining reference for preparing and shipping undisturbed soil samples to minimize sample disturbance is M.J. Hvorslev (1949) "Subsurface Exploration and Sampling of Soils for Civil Engineering Purposes." Report on a Research Project of the Committee on Sampling and Testing, Soil Mechanics and Foundations Division, ASCE. Mr. Hvorslev set the key requirements for shipping undisturbed tube samples as: (1) protect them from freezing, (2) protect them from vibrations to extent possible, and (3) maintain samples in an upright position.

ASTM developed a Standard Practice for preserving and transporting soil samples (ASTM D 4220). This standard divides soil samples into four groups:

- |                |   |
|----------------|---|
| <i>Group A</i> | <i>Samples for which only general visual identification is necessary.</i>   |
| <i>Group B</i> | <i>Samples for which only water content and classification tests, compaction and relative density and bulk samples that will be remolded or compacted for testing is necessary.</i> |
| <i>Group C</i> | <i>Intact, naturally formed or field fabricated samples for density determinations or for mechanical property testing to determine strength, compressibility or permeability.</i>   |
| <i>Group D</i> | <i>Samples that are fragile and highly sensitive which are to be used for the tests defined in Group C.</i>   |

Group A samples may be transported in any container by any means of transportation that protects the sample against spillage and loss. Group B samples should be placed in sealed, moisture-proof containers packaged to prevent breakage and spillage and shipped by convenient transport. Group C samples must be packed and shipped to protect against vibration, shock, extreme heat and freezing. These samples should be packaged in the same orientation in which they were sampled and encased in cushioning material with a minimum thickness of 1 inch around the sample and two inches on the bottom. Protection against heat or cold should be provided, if necessary. Group D samples should be handled like group C samples with the loading, transporting and unloading of shipping containers supervised by a qualified person as much as possible.

GeoTesting Express has developed a special container for shipping up to three thin wall tube samples. The container meets all the requirements of ASTM D 4220, is reusable, is of relatively lightweight and is easy to dismantle and reassemble. It is designed to maximize the likelihood that the container will be kept upright at all times. A handle on the top keeps the container from being positioned upside down. Its round shape discourages couriers from placing it on its side because it would roll around in their truck. The outside is clearly labeled with markings to indicate the up direction and fragile contents. The internal insulating materials incorporate high tech energy absorption materials developed by NASA for aircraft passenger seats and wheelchair seating. More information on this container is provided in GTX-SOP-S100 available at our web site: <http://www.geotesting.com>.



Block samples of undisturbed materials usually fall into Groups C and D of ASTM D 4220. For transport, they should be wrapped in several layers of plastic wrap. We then do multiple wraps of the sample at all orientations with plastic electrical tape slightly stretched to impart a small amount of compression into the sample. This should be sealed with wax, or if the sample will be received by the lab within 3 days, placed into a heavy plastic bag containing several moist towels or rags. This bag should be tightly sealed and placed into a second heavy plastic bag containing several moist towels or rags and is tightly sealed. The bagged sample should then be placed into a wooden box or cooler and surrounded with a minimum of one inch of cushioning material (sawdust, rubber, polystyrene, kitty litter, or plastic foam). The box should be filled with material to prevent the sample from shifting around inside the box during transport.

Saturated loose silts and sands, very weak clays and highly structured weak materials may require extra special provisions for packaging and shipping. GeoTesting Express can help with these situations. We have successfully shipped undisturbed samples of saturated silt and fine sand from Japan to Boston for cyclic triaxial testing. Our results were similar to those obtained on duplicate samples hand transported and tested by a Japanese lab. Undisturbed samples are routinely shipped internationally by large design firms working in underdeveloped nations. Our experience shows that undisturbed samples can be shipped anywhere by international courier as long as the appropriate packaging and handling procedures are applied.