

**STANDARD OPERATING PROCEDURES FOR THE OPERATION OF
GEOPROBE MODEL 5400
U.S. GEOLOGICAL SURVEY, ILLINOIS WATER SCIENCE CENTER**

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SCOPE

This document provides basic application, operation, and safety guidelines for use of the GEOPROBE Model 5400 hydraulic-sampling system (GEOPROBE). The guidelines apply to use of the sampling system in evaluating subsurface environmental conditions. The document is intended to serve as the Standard Operating Procedure (SOP) for the GEOPROBE when used as a site assessment tool. This SOP is intended to supplement the manufacturer's guidelines on equipment use (as presented in equipment and operation manuals). Therefore, it is necessary for the operator to be thoroughly familiar with both the manufacturer's guidelines and this document before attempting to use the GEOPROBE.

GEOPROBE APPLICATIONS

The GEOPROBE was designed to allow a convenient, cost effective and safe method for collecting soil and ground-water samples, measuring water levels, and conducting soil-gas surveys. The hydraulic unit with percussion hammer is capable of exerting 18,000 pounds (lbs.) of downward force; the weight of the vehicle contributes the majority of the force. The unit is capable of 25,000 lbs. of retractive force.

The GEOPROBE is equipped with specialized tools. Each tool is best suited to certain types of physical settings and subsurface conditions. The tool type and physical conditions of the sampling site determine the effective investigative depth. To assure that use of the GEOPROBE is the most effective investigative technique, prior research as to the soil conditions and stratigraphy beneath a site is imperative.

Specialized equipment, the primary applications and depths are briefly outlined below.

Well Points: Best suited for sandy conditions and particularly applicable in alluvial soils; very poor performance in clays. Maximum installation depth under ideal conditions is about 100 feet (ft). The small internal diameter of the drive rods, requires use of a thin-line bailer that extracts only about 20 milliliters per sample; a peristaltic pump that limits sampling depth to about 30 ft and extracts water using negative pressure; or a thin-line bladder pump that extracts small sample volumes (about 100-200 milliliters per minute) using positive displacement, and is typically constructed of parts composed of stainless steel and Teflon.

Sampling Tubes: Best performance in silt/clay; poor results in sand, and ineffective in gravel-rich sediments.

Soil Gas: Best performance in sand/silt; poor performance in clayey soils. Ideal subsurface conditions will provide effective investigative depth of up to 40 ft.

PRINCIPLE OF OPERATION

The GEOPROBE is a hydraulically powered hammer/ram sampling device. The unit is designed so that the weight of the vehicle provides the majority of downward force. The hydraulics, with the aid of a percussion hammer and the weight of the vehicle, push 4-ft lengths of specially modified 1.25-inch (in.) to 2.125-in. outside diameter (OD), hardened steel rod into the ground. The rod is advanced to depth by adding 4-ft lengths of rod until the target sampling depth is reached. The steel rod has been specially modified for specific types of sample collection. A carbide-tipped drill bit also is available, and allows penetration of up to 15 in. of concrete.

GEOPROBE EQUIPMENT

A GEOPROBE unit has the following primary equipment.

- * Utility vehicle with the GEOPROBE model 5400 mounted;
Ford F-450 with dual rear axle
- * Hardened steel rod, 4-ft long, 1.25 in. OD, 0.625 in. ID
- * Hardened steel rod, 4-ft long, 2.25-in. OD, 1.5-in. ID
- * Rod puller system
- * Large-bore sampler
- * Macro-core sampler
- * Anvil
- * Carbide-tipped drill bit, 2-ft long
- * Well screen (wire-wound and mill-slotted)
- * Bailer
- * Peristaltic pump

* Polyethylene and/or Tygon tubing

* Water tank, 60 gallon

* High-pressure cold-water washer, 2,500 lbs. per square inch (PSI)

* 3-5 gallon gasoline container

Various accessory tools are required for GEOPROBE operation. These include wrenches in a variety of sizes, a vice, screwdrivers, various hammers, pliers, and wire cutters.

GEOPROBE SAFETY

No one should attempt to operate the GEOPROBE without having first received training provided by the manufacturer or trained operator approved by the Illinois Water Science Center Director or his designee. Operators must review the Drilling Safety Guide (International Drilling Federation, 1991) and the Illinois Water Science Center (ILWSC) Job Drilling Hazards Analysis-Geoprobe (ILWSC internal web site), and Illinois Water Science Center Safety Plan (ILWSC internal web site) with respect to all safety issues applicable to the use of the GEOPROBE. An Annual Vehicle Safety Inspection must have been completed for the GEOPROBE within the previous 364 days before use on any Science Center projects.

Before drilling begins, a review of the drilling site for underground and overhead utilities must be completed. The review includes inspection of the drilling site and contact with the Illinois utility locator service, JULIE, or its equivalent in other States. Guidelines and contact information for JULIE can be found on the Illinois Water Science Center Internal Web site (Safety). The GEOPROBE vehicle should be equipped with a first aid kit and the operators should have the telephone number and be familiar with the route to the nearest hospital. The operators must have received USGS-approved first-aid and CPR training within the previous 3 and 1 years, respectively. The buddy system will always be employed during GEOPROBE operations. Information regarding the GEOPROBE site will be documented in the attached form (Site Safety Record for GEOPROBE Sampling Sites). One copy of the form will be filed in the GEOPROBE vehicle during active site investigations; one copy will be filed with the Illinois Water Science Center Safety Officer.

Operator/drivers must have current licenses with appropriate class to operate the size and weight of the vehicle (standard class license is required). Operator/drivers must have attended the USGS-required Defensive Driving Course within the past 3 years.

Operator/drivers should know the vehicle dimensions and avoid all obstructions such as carports, canopies, low hanging wires, narrow alleys, etc. Operator/drivers should complete a standard vehicle safety check for brakes, lights, gauges, fluids, tires, battery charge, fuel amount, equipment secured, etc. prior to operating the vehicle. An inspection should be performed to assure all locks, latches, compartment doors, brakes, tie-downs and clips are in place prior to moving the vehicle or equipment. An abbreviated inspection should be completed each time the drill rig is moved from hole to hole on the drill site.

Manufacturer's recommendations should be followed in regard to which equipment and machinery must be stowed and secured prior to vehicle movement.

Safe operation of the GEOPROBE requires the use of the following safety equipment.

Tire blocks should be placed under the front wheels of the parked vehicle. The vehicle should not be parked on non-level ground that presents a risk of roll-over. Where parking on non-level ground is necessary, the vehicle shall preferably be positioned perpendicular to the sloping surface.

Park or position the machine to allow the wind to carry engine exhaust fumes away from the operator. Exhaust fumes from engines can be lethal. Have exhaust piping rerouted on the vehicle if exhaust fumes are a routine problem in the operating area. Be aware of reducing the amount of time the engine operates or idles. Break times, clearing, setting

up, planning times, and site meeting times may be occasions when the vehicle engines can be turned off. Increase the time and number of breaks if localized conditions such as high humidity, terrain gullies and depressions, or other conditions do not allow the diesel fumes to dissipate. Provide exhaust connections in vehicle service bays to draw the fumes to the outside of the building.

GEOPROBE personnel should don orange or fluorescent green safety vests (when on a roadway), hearing protection, steel-toed boots, hard hats, work gloves, and safety glasses.

The maximum height of the hydraulic press on the GEOPROBE is only 10 ft. Although the risk of shock associated with nearby power sources is less than that for conventional drilling equipment, the operators should be aware of potential sources and maintain proper clearance. No vehicle, extended probe, or load shall be permitted within a 50-ft radius of energized sources with nominal voltage below 50 kilovolts (kV). No vehicle, extended probe, or load shall be permitted within a 100-ft radius of energized sources with nominal voltage above 50 kV and below 300 kV. No work will occur during electrical storms.

Temporary power should be limited in use as much as practical. For example, daylight operations should be performed in lieu of nighttime operations requiring artificial lighting. Energized equipment should be protected by over-current and ground-fault devices. The equipment should be designed for outdoor and weatherproof conditions. When driven by

the GEOPROBE rig, use electrical equipment and tools that are compatible with the rig's electrical systems.

Powered equipment not part of the GEOPROBE should be positioned clear of the probing operations, so as not to produce tripping conditions, or be in the way of other possible damage. Cables used for transferring power from the source to the tool or item should be protected from damage.

Most equipment used with the GEOPROBE weighs less than 5 lbs. Although safety hazards are substantially less than those associated with conventional drilling equipment, operators should use similar safety practices, including proper working clearances (twice the height of the raised probe – 20 ft) and proper storage/housekeeping and handling of equipment, to prevent trip-and-fall, lifting, and dropping injuries.

Operating controls and gauges should be kept free of debris, grease, oil, etc. These devices should remain clear to operate, and should remain visible during operations. Periodic wipe downs and washes of controls and gauges should be included in the normal operating procedures. Noncombustible and nonflammable cleaners should be used when cleaning the vehicle and equipment.

Fuels, oils and chemicals should be stored in containers designed specifically for their use. Designated locations for storage of these items should be used on GEOPROBE. Quantities should be limited to those necessary to perform the GEOPROBE operations.

The high-pressure washer used with the GEOPROBE weighs about 50 lbs. and produces 2,000 PSI of water pressure. Ramps, a hydraulic lift, or two people such be used to place and remove the washer from GEOPROBE vehicle to prevent back injuries or injuries from dropping. When operating, the high-pressured spray should be directed toward equipment or the ground and not toward nearby persons. All fittings and hoses should be inspected for wear to prevent unexpected ruptures.

The high-pressure washer is powered by a 5.5-horsepower gasoline engine. To prevent exposure of the operator to toxic fumes or limited oxygen supplies, the fuel-storage tank on the washer shall not be filled in confined areas (garages, storage areas, etc.). To prevent burns while the engine is running or recently run and is hot, direct contact with the engine shall be avoided. To prevent fire or explosion, the fuel-storage tank shall not be filled while the engine is running or recently run and is hot. There shall be no open flames or smoking in areas where fuels are used or stored; ignitable materials shall be kept a safe distance away while the engine is running or recently run and is hot.

When using the GEOPROBE, all other appropriate safety guidelines should be applied. Guidelines could include those detailed in site-safety plans and OSHA standards for studies at hazardous-waste sites (including, in part, health and safety plans, medical monitoring, use of personal protective equipment, and site control measures), and for conditions of extreme cold or heat, electrical storms, biological hazards, etc.,

Attachment 1.

Site Safety Record for GEOPROBE Sampling Sites

(File 1 copy in GEOPROBE vehicle during site investigation;
File 1 copy with Illinois Water Science Center Safety Officer)

Date: _____

Operator: _____(print)

Operator: _____(signature)

Initial Vehicle Inspection Completed: _____Y / N

Site Name/Address:

City: _____ State: _____

On-Site Phone No. _____

Emergency Phone No. _____

Hospital Name: _____

Hospital Phone No. _____

Hospital Location: _____

Utility Representative Contacted: JULIE _____

Underground Utility Protection Service Phone No.: 1-800-892-0123 _____

Underground Utility Protection Service Order/Request Number: _____

Dates in transit: _____

Dates on-site: _____