INSTALLATION PROCEDURE
FOR PERMANENT SUB-SLAB PROBES

1.0 PURPOSE AND SCOPE

The purpose of this document is to detail the design and installation procedures of one example of a permanent sub-slab probe in the support of VI investigations. This type of probe can be utilized for the temporal repeatable collection of air samples from beneath the slab of buildings and for monitoring the effectiveness of a system for the mitigation of VI. Alternative design and installation procedures are acceptable.

2.0 HEALTH AND SAFETY

Prior to penetrating the subsurface, a check for the presence of utilities must be performed. Contact the local utility companies (gas, water, sewer, electric, phone) via the New Jersey One Call system (1-800-272-1000) to mark the location of utilities coming into the building from the outside. The utilities can then be traced into the building for their location. If needed, a plumber and/or electrician may be consulted to assist in identifying the location of utilities inside the building.

3.0 LOCATIONS AND QUANTITY OF SUB-SLAB PROBES

The quantity and locations of the permanent sub-slab probes will be dependent upon the objectives of the data that is required. Permanent sub-slab probes can be used for the collection of soil gas samples from the sub-slab atmosphere or for the collection of physical measurement data to monitor the effectiveness of a mitigation system.

This type of probe should be used for the collection of analytical data when several rounds of data will be required from the subsurface from a building. This will prevent variability in data from sample location and/or probe installation. The number of probes required will be dependent upon the size of the building and site specific characteristics.

The quantity of sub-slab probes to support the effectiveness of a mitigation system will be site specific based on the results of the communication test data during system installation. At a minimum, four probes are recommended on each side or corner of a building. Further information can be found in Section 6.3.2.5 of the VIT Guidance.

4.0 SUB-SLAB PROBE CONSTRUCTION

The recommended material for construction for the sub-slab probe is 316 stainless steel Swagelock® compression fittings. This material has the durability for long term use and is non-reactive to VOCs. No specialized fittings are required to connect to the probe. The ¼" NPT threads make connecting to the probe easy with common pipe fittings. This probe construction is slightly larger than other permanent probe constructions from ¼" connectors, ¼" caps and others found in the literature. Field experience has shown that those designs are not as durable due to the probe easily breaking loose in the concrete seal from over-tightening of fittings. The parts list for the sub-slab probe is as follows:

a. SS-400-7-4 - Female connector (tapered thread) ¼" tube x x1/4" NPT.

b. SS-401-PC – ¼" Tube fitting port connector.
c. *4534K12 (McMaster-Carr) Flush mount-high pressure steel thread hex socket plug, ¼" pipe, PTFE coated, ¼" Hex, 13/32 length

The construction dimensions of this probe will allow the inlet of the probe to be located within the building slab. This helps prevent the clogging of the probe with sub-slab material.

5.0 SUB-SLAB PROBE INSTALLATION

The sub-slab probe is quickly and easily installed with standard tools. The following is a list of tools and materials required for the installation:

a. rotary hammer drill with 1-1/4" diameter x 10" long spline-shank masonry bit
b. hammer drill with ¼" diameter x 12"-18" long masonry bit
c. extension cords
d. shop vacuum
e. quick drying cement or hydraulic cement with mixing cup and water
f. non VOC clay (pottery clay)
g. paper towels
h. duct tape
i. distilled water
j. carpet knife
k. sub-slab probe

5.1 Installation Procedures

5.1.1 Select the location for the permanent sub-slab probe based on the objectives of the phase of work, presence or potential presence of obstructions and input from the building owner.

5.1.2 If a floor covering is drilled through for the placement of the probe, future plans of the replacement or repair of the covering should be made in advance.

If carpeting is present, a "flap" can be cut into the carpet for access to the slab. This "flap" can then be pushed back into place when work is competed. If a sheet flooring product is present, a section can be removed to allow drilling and used for replacement after decommissioning. For tile flooring, a replacement tile or section of flooring should be obtained for installation after the probe is decommissioned.

5.1.3 Using a hammer and chisel, chip an "X" in the concrete as a starting point for drilling to prevent the bit from "wandering" off the desired target location.

5.1.4 Determine the desired depth of the probe body and mark this length on the 1-1/4" masonry bit by wrapping with duct tape with an "ear". The "ear" will act as a depth gauge. When duct tape "ear" it hits the slab, the bit is at the appropriate depth. The desired depth of the hole will be dependent if the probe is to be flush with the floor or slightly countersunk to the floor.

5.1.5 Use the rotary hammer drill with the 1-1/4" bit to advance the outer hole to the proper depth and vacuum out the cuttings.

5.1.6 Using the hammer drill with a ¼" bit, place the bit in the center of the1-1/4" hole and drill through the slab into the subsurface material by 3-6". A significant increase in the rate of penetration by the drill will indicate the bottom of the slab has been passed through.

5.1.7 Vacuum out the drill cuttings from in and around the hole. Test fit the probe in the hole so it is at the desired location. Alter the hole depth if required.

5.1.8 Dampen a paper towel with distilled water and wipe away the dust from the 1-1/4" hole and wet the sidewalls. Do not allow excess water on the towel go into the sub-surface.

5.1.9 With a small piece of duct tape, wrap it around the plug on the probe while covering the top of the probe. This will protect the threads of the probe and plug from cement during the installation.

5.1.10 Using a small piece of clay, roll it until it is in a thin "cigar" shape. Place the clay around the port connector at the ¼" nut. Insert the probe into the hole, the clay forms a seal between the two holes in the slab, not allowing cement into the smaller hole and the subsurface.

5.1.11 Mix a small amount of cement and pour into the annular space around the probe. Allow the cement to cure for the recommended time for curing by the manufacturer of the cement. After curing remove the tape from the probe and clean the surface of unwanted cement. Figure 1 is a schematic of the cross section of the permanent sub-slab probe installation that is countersunk to the slab.

5.2 Annular Seal Leak Check

After allowing the cement to cure, a leak check should be performed to ensure a competent annular seal of the probe. A leaking annular seal will result in inaccurate readings that are biased low for physical or analytical measurements.

Perform the annular seal leak check by placing a vacuum on the probe and placing a bead of water around the probe (if installed counter sunk to the slab). Watch for changes in the water level or, use a tracer gas (helium, isopropyl alcohol, nitrogen, carbon dioxide), hook up a DRI to the probe and check for a response to the tracer gas. These same techniques can be used during sampling of the sub-slab atmosphere. If a leak is discovered, the probe must be removed, re-installed and tested again for leaks.

5.3 Flow and Vacuum Check

A flow and vacuum check should be performed on the probe if there is the potential to use the probe to collect a sample from the sub-slab atmosphere for analysis. Obtaining a sample from a sub-slab probe with excessive vacuums can change the partitioning of vapors between pore water and the soil gas potentially biasing VOC concentrations high. In addition, the high vacuum may increase the risk of leakage between the sub-slab probe and the sample container.

The flow and vacuum check is performed by connecting a pump to the probe and running at a flow rate of 200 ml/min until the vacuum stabilizes. During this test the vacuum should also be

monitored. The investigator should be aware of potential portioning of VOCs from the sub-slab materials due to vacuum or flow rates.

6.0 Measurement of Sub-Slab Pressures

Measurement of sub-slab pressures (differential between the indoor air and sub-slab atmospheres) can be easily determined via the permanent sub-slab probe. A simple barb fitting connected to a digital micro-manometer capable of reading 0.001 inches of water can be used to determine the depressurization of the slab-slab atmosphere to monitor the effectiveness of a mitigation system.

7.0 Decommissioning

Once it is determined that monitoring of the sub-slab atmosphere is no longer required due to remediation of the contaminant source or other reason, the sub-slab probe can be removed. The probe can be removed by breaking the annular seal with a chisel or rotary hammer with a bull point. Once the probe is removed, seal the hole with concrete to the original level and replace the flooring that was removed during installation or glue the carpet "flap" to the floor.

The following sources were utilized in developing the installation procedures for sub-slab probes.

California Environmental Protection Agency. 2005. Guidance for the Evaluation and Migration of Subsurface Vapor Intrusion to Indoor Air. Department of Toxic Substances Control.

Hartman, B. 2004. Vapor Monitoring Wells/Implants. Standard Operating Procedures (vapor intrusion applications). H&P Mobile Geochemistry, Solana Beach, California

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Reynolds, Peter A. 2007. The Use of Tracer Gas in Soil Vapor Intrusion Studies. In Proceedings of the Annual International Conference on Soils, Sediments, Water and Energy, Volume 12, Article 39. The Berkeley Electronic Press.

U.S. Environmental Protection Agency (USEPA). 2006. Assessment of Vapor Intrusion in Homes near the Raymark Superfund Site Using Basement and Sub-Slab Air Samples. EPA/600/R-05/147, March 2006

U.S. Environmental Protection Agency (USEPA), Region 8. Not Dated. Draft-Standard Operating Procedures for Installation of Sub-Slab Vapor Probes and Sampling Using EPA Method TO-15 to Support Vapor Intrusion Investigations. (Accessed 2009).

FIGURE I
SUB-SLAB PROBE CONSTRUCTION