STANDARD OPERATING PROCEDURE – BER-34

PROCEDURES FOR SAMPLING AND ANALYSIS OF SUBSLAB AIR SAMPLES

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1.0 INTRODUCTION

The objective of this Standard Operating Procedure (SOP) is to describe the equipment and techniques for the installation of subslab sampling ports, collection of subslab vapor samples and subsequent analysis to assess and quantify volatile organic compound (VOC) concentrations in vapor directly below the foundation of a building.

2.0 SAMPLING EQUIPMENT

Subslab vapor samples can be collected in several ways depending on the analytical methodology selected for the project. Samples for onsite analysis may be collected with polyethylene or glass syringes equipped with a three-way valve or with a Tedlar bag. Samples for offsite analysis are collected in stainless-steel Summa canisters, typically with a volume of 1-liter or less.

Subslab vapor samples may be collected as grab samples or as time-integrated samples. Time integrated samples are collected using a Summa canister equipped with a pre-calibrated flow controller and an in-line particulate filter. If an appropriate flow controller is not available from the laboratory, care must be taken to open the canister valve slowly and the sample is collected over several minutes to limit the chance of short-circuiting. Subslab vapor samples should not be collected at a rate greater than 200 milliliters per minute (mL/min) (e.g., 1-liter sample should be collected over a period of 5 minutes). Canisters will be cleaned and certified by the laboratory as per EPA Method TO-14A or TO-15 specifications. The sampling team should consider requesting extra canisters and flow controllers from the laboratory due to the potential for equipment failure.

Prior to sampling, a vacuum gauge is used to measure and record the initial Summa canister vacuum pressure. The initial canister pressure should be between -26 inches of mercury (”Hg) and -30”Hg. If the initial pressure is less than -26”Hg, the canister should be rejected and returned to the laboratory. A post-sampling vacuum measurement is also recorded to ensure that a full sample is collected.

Permanent sampling ports are typically constructed of stainless steel or brass and are generally ¼-inch or less in diameter. Swagelok® fittings are used for airtight connections at the sampling port and canister. KDHE commonly installs permanent sampling ports using a small length of ¼ in. nylon or Teflon tubing attached to a ¼ in. Swagelok® tube fitting. A ¼ in. flush seating stainless steel or brass pipe plug is used to seal the port between sampling events (Figure 1). Temporary or semi-permanent sampling ports may be constructed of stainless-steel,

Figure 1. Typical subslab port

Teflon, or nylon tubing, ¼ in. or less in diameter. Sample tubing cannot be reused.

3.0 SAMPLING PORT INSTALLATION

A minimum of one subslab sample should be collected per building of interest. For larger buildings, one subslab sample should be collected per 1,500 ft^2 to 2,000 ft^2. Prior approval for installation of subslab sampling ports must be obtained from the property owner. Attempts should be made to install the ports at locations that are inconspicuous, such as under carpeting in a corner away from footings, under floor tiles, in unfinished areas, and out of direct visibility. Sampling ports should not be installed directly above any utilities. When drilling through the slab, care should be exercised as to not penetrate the materials below the slab. If the basement has bearing walls that require footings under the slab, multiple sampling ports may be needed to account for spatial variability.

Figure 2. Drilled hole for subslab port

A rotary hammer is used to drill into the concrete. The installation requires two masonry bits, 1 ¼ in. to 1 ½ in. for the outer hole and 5/8 in. to ½ in. bit for the inner hole (Figure 2). The larger bit is used to make a hole that is approximately one inch deep and the smaller bit is used to complete the hole through the slab.

After the hole is drilled, the concrete dust and debris should be removed by vacuuming the hole thoroughly. Once the hole is completed and cleaned, the sampling port can be installed flush with the surface of the concrete. For permanent installations, a neat cement mixture is used to seal the sampling port in place (Figure 3). The neat cement is Portland cement with about 1-3% of bentonite powder added. The concrete mixture should be allowed to cure for at least 24 hours prior to being disturbed. Teflon tape is used to seal the threaded pipe plug in place. For temporary or semi-permanent installations, non-VOC and non-shrinking modeling clay may be used to seal the inert tubing within the slab. Prior to sampling, at least 30 minutes of time should elapse following installation of a temporary or semi-permanent port to allow for the subsurface conditions to equilibrate. Subslab sampling ports should never be installed in slabs that may come into contact with a high water table.

Figure 3. Completed subslab port

4.0 SAMPLING PROCEDURES

Prior to sample collection, leak tests may be performed to evaluate whether a good seal is established in the sampling train and at the sampling port. Leak testing is most important when subslab materials have low permeability or if temporary or semi-permanent subslab ports are installed, as these factors may increase the likelihood of short-circuiting. There are two different types of leak tests that can be performed. Tracer testing involves the introduction of a gaseous tracer compound, such as helium, into a shroud covering the sampling apparatus. A portable gas monitoring device is used to maintain a reasonably steady concentration of tracer gas within the shroud. The tracer gas concentration in the shroud should be at least 10% or two orders of magnitude higher than the reporting limit of the field meter. Three line volumes are purged from the sampling train with a syringe and then field screened with the meter. If high concentrations (>10% of the starting concentration within the shroud) of the tracer gas are observed in a sample, connections in the sampling train are checked and/or the sampling port is re-installed. A shut-in test may be used alone or in conjunction with the tracer testing to check for leaks in the above ground fittings. This test involves assembling the sampling train and, leaving the canister valve in the closed position, applying a vacuum to the sampling line with a hand pump. A vacuum gauge, attached to the pump or connected to the line with a "T" fitting, is observed for at least one minute. If a loss of vacuum is observed, the fittings are adjusted until the vacuum does not noticeably dissipate.

Sampling of subslab vapor is done by removing or pulling air from the space directly below the slab. This can be done with a syringe for onsite analysis or a Summa canister for off-site analysis. For either method a sampling tube is attached to the subslab port and must be purged. Typically, three line volumes must be purged prior to sampling. The tubing volume is dependent on the length and inside diameter of the tubing. The approximate volume of the $^1/_4$-inch and $^1/_8$-inch outside diameter (or $^1/_8$-inch and $^1/_{16}$-inch inside diameter) tubing commonly used for vapor intrusion investigations are 2.41 milliliters per foot (mL/ft) and 0.60 mL/ft, respectively. The syringe can be fitted to ¼ in. tubing to purge three line volumes evacuated. If samples will be analyzed onsite, after purging, the syringe fitted with a three-way valve can be used to collect an additional 20-30 mL of air. Samples for laboratory analysis are collected from the sampling port into a one liter Summa canister through nylon or Teflon tubing attached with a Swagelok® male connector and two nut and ferrule sets (as shown in Figure 4). Subslab vapor samples should never be collected at a rate greater

Figure 4. Tubing for collecting subslab sample

than 200 ml/min. Sampling over several minutes (>5) will ensure a proper flow rate and allow enough time to fill the canister. After sampling is complete, close the canister valve and record the canister vacuum pressure. Do not over-tighten the valves or compression fittings.

Attach an identification tag that indicates the canister serial number, sample number, location, sample collection time and date to the canister for transport to the laboratory. The canisters will be shipped under proper chain-of-custody protocol. Canisters must be returned to the laboratory from which they were rented for analysis. Once sampling is completed, Teflon tape is applied to the plug and the sampling port is sealed.

5.0 SAMPLE ANALYSIS

Field analysis will be performed according to SOP BER-25 Mobile Laboratory. Detection limits for most compounds will be low enough to make decisions regarding vapor intrusion exposure estimates.

A number of analytical methods are available for analyzing air samples for VOCs. In general, the preferred laboratory analytical method is EPA Method TO-15 which uses gas chromatography/mass spectrometry (GC/MS) to identify and quantify target VOCs. The GC/MS utilized for EPA Method TO-15 is a more scientifically defensible detector scheme and is more desirable than the use of single or multiple specific detectors utilized in EPA Method TO-14A. The laboratory should be consulted prior to sampling to determine which analytical method is most appropriate to satisfy project data needs.

6.0 REFERENCES

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