Designation: D7203 − 11 (Reapproved 2017)

Standard Practice for Screening Trichloroethylene (TCE)-Contaminated Media Using a Heated Diode Sensor[1]

This standard is issued under the fixed designation D7203; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice describes procedures for screening media known to contain the halogenated volatile organic compound (HVOC), trichloroethylene (TCE). Procedure A is to be used for screening soil known to contain TCE and Procedure B is to be used for screening water known to contain TCE.

1.1.1 Both Procedures A and B involve measuring the TCE concentration in the headspace above a sample using a heated diode sensor device. From this measurement, an estimated concentration of TCE in the sample can be determined. Any TCE remaining in the sample is not measured. Any other HVOC present in the sample will be reported as TCE.

1.2 Procedure A can also be used for screening the headspace above a soil suspected of containing HVOC contamination to indicate the presence or absence of HVOC contamination in the soil. Procedure B can also be used for screening the headspace above a water suspected of containing HVOC contamination to indicate the presence or absence of HVOC contamination in the water. For both procedures, any HVOC contamination remaining in the soil or water is not detected by this practice.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3.1 *Exception*—Certain inch-pound units are provided for information only.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—The diode sensor is heated to temperatures ranging between approximately 600 and 1000 °C (see 6.1.5) and as a result could be a source of ignition.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D4547 Guide for Sampling Waste and Soils for Volatile Organic Compounds

D5681 Terminology for Waste and Waste Management

3. Terminology

3.1 *Definitions*—For definitions of terms used in this screening practice, refer to Terminology D5681.

4. Summary of Practice

4.1 *Procedure A*—To estimate the concentration of TCE in a soil known to contain TCE contamination, a sample of the soil is added to a glass jar having an open-top cap with a PTFE-bonded silicone septum. At the time of screening, the temperature of the soil in the jar should be approximately 50 to 120 °F (10 to 49 °C). The soil in the jar is shaken and allowed to settle for 10 min, so the TCE can partition into the headspace above the soil. After 10 min, the TCE concentration in the headspace is measured using a heated diode sensor device, which gives a numerical voltage reading. The voltage reading from the device is converted to a mg/m^3 value of TCE in the headspace in the container. Using this value, an estimated concentration of TCE in the soil in mg/Kg can be calculated. Any TCE remaining in the soil sample is not measured by this practice. Any other HVOC present in the soil will be reported as TCE.

4.1.1 To use Procedure A to screen a soil suspected of containing HVOC contamination, a sample of the soil is added to a glass jar having an open-top cap with a PTFE-bonded silicone septum. At the time of screening, the temperature of

[1] This practice is under the jurisdiction of ASTM Committee D34 on Waste Management and is the direct responsibility of Subcommittee D34.01.05 on Screening Methods.

Current edition approved Sept. 1, 2017. Published September 2017. Originally approved in 2005. Last previous edition approved in 2011 as D7203 – 11. DOI: 10.1520/D7203-11R17.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards*volume information, refer to the standard's Document Summary page on the ASTM website.

the soil in the jar should be approximately 50 to 120 °F (10 to 49 °C). The soil in the jar is shaken and allowed to settle for 10 min, so the HVOC can partition into the headspace above the soil. After 10 min, the heated diode sensor device is used to screen the headspace in the container. The numerical voltage reading from the device indicates the presence or absence of HVOC contamination in the soil. Any HVOC contamination remaining in the soil is not detected by this procedure.

4.2 *Procedure B*—To estimate the concentration of TCE in water known to contain TCE contamination, a sample of the water is added to a glass jar having an open-top cap with a PTFE-bonded silicone septum. At the time of screening, the temperature of the water in the jar should be approximately 50 to 120 °F (10 to 49 °C). The water in the jar is shaken, allowed to settle for 1 min, shaken again, and allowed to settle for 1 min, so the TCE can partition into the headspace above the water. After the sample is allowed to settle for the second time, the TCE concentration in the headspace is measured using a heated diode sensor device, which gives a numerical voltage reading. The voltage reading from the device is converted to a mg/m^3 value of TCE in the headspace in the container. Using this value, an estimated concentration of TCE in the water in mg/L can be calculated. Any TCE remaining in the water sample is not measured by this procedure. Any other HVOC present in the water will be reported as TCE.

4.2.1 To use Procedure B to screen water suspected of containing HVOC contamination, a sample of the water is added to a glass jar having an open-top cap with a PTFE-bonded silicone septum. At the time of screening, the temperature of the water in the jar should be approximately 50 to 120 °F (10 to 49 °C). The water in the jar is shaken, allowed to settle for 1 min, shaken again, and allowed to settle for 1 min, so the TCE can partition into the headspace above the water. After the sample is allowed to settle for the second time, the heated diode sensor device is used to screen the headspace in the container. The numerical voltage reading from the device indicates the presence or absence of HVOC contamination in the water. Any HVOC contamination remaining in the water is not detected by this procedure.

5. Significance and Use

5.1 The heated diode sensor device used in this practice is selective for HVOCs. Other electronegative compounds, such as alcohols, ketones, nitrates, and sulfides, may cause a positive interference with the performance of the heated diode sensor to detect HVOCs, but to do so, they must be present at much higher concentrations than the HVOCs.

NOTE 2—For volatile organic compound (VOC) screening purposes, a flame ionization detector (FID) selectively responds to flammable VOCs; a photoionization detector (PID) selectively responds to VOCs having a double bond; and a heated diode sensor selectively responds to halogenated VOCs.

5.2 This practice can be used for screening media known to contain TCE to estimate the concentration of TCE in the media. Procedure A is to be used for screening soil known to contain TCE and Procedure B is to be used for screening water known to contain TCE. Both Procedures A and B involve measuring the TCE concentration in the headspace above a sample. From this measurement, an estimated concentration of TCE in the sample can be determined. Any TCE remaining in the sample is not measured by this practice. Any other HVOC present in the sample will be reported as TCE.

5.3 This practice can also be used for screening the headspace above a soil or water suspected of containing HVOC contamination to indicate the presence or absence of HVOC contamination in the soil (Procedure A) or water (Procedure B). Any HVOC contamination remaining in the sample is not detected by this practice.

5.4 *Detection Limit*—The detection limit of the heated diode sensor for TCE is 0.1 mg/m^3 in air, based on a signal-to-noise ratio of 2. For a 25-g TCE-contaminated soil sample in a 250-mL container, the detection limit of Procedure A for TCE is 0.001 mg/Kg, assuming complete partitioning of TCE into the headspace. For a 25-g TCE-contaminated water sample in a 250-mL container, the detection limit of Procedure B for TCE is 0.001 mg/L, assuming complete partitioning of TCE into the headspace.

5.5 This practice can be used to screen moist soil samples and water samples. Water vapor does not interfere with the performance of the heated diode sensor.

5.6 Hydrocarbon fuels, including fuels containing aromatic compounds, such as gasoline, are not detected by the practice.

6. Apparatus

6.1 *Procedures A and B:*

6.1.1 *Glass Jars,* 250-mL (8-oz), approximately 14 cm (5½ in.) tall, with open-top caps having PTFE-bonded silicone septa.

6.1.2 *Scale,* capable of weighing to 0.1 g.

6.1.3 *Thermometer,* with temperature given in divisions of 0.1 °C

6.1.4 *Barometer,* such that pressure in atmospheres can be determined to 0.001 atm.

6.1.5 *Heated Diode Sensor Device,* a device having a diode sensor that is heated between temperatures ranging from approximately 600 to 1000 °C generating an alkali metal vapor stream that selectively reacts with halogens present in HVOC molecules, creating ionized product species that cause a current to flow between a cathode and an anode. The numerical output from the sensor in volts is proportional to a microamp current from the diode and ranges from 0.001 to 20 V with a resolution of 0.001 V. The HVOC molecules in the headspace above the sample are drawn through a probe to the heated diode sensor by a pump in the device. The heated diode sensor device should have a needle attached to the probe of the device so the septum in the cap of the sample jar can be pierced and the needle can be inserted into the headspace above the sample. This needle must be designed to allow make-up air to enter the sample jar from the top so that back pressure will not build up within the jar. Back pressure in the jar will change the air flow rate of the device and in turn affect the voltage reading.

6.1.6 *Tedlar Bags,* 1 L in volume and having a stainless steel valve with a nipple fitting that can be opened and closed.

6.1.7 *Gas Regulators,* for use with the TCE standard gas cylinders (see 7.1). Each regulator should have a short length, about 1¼ in., of ¼-in. inner diameter fluoroelastomer tubing attached to the nipple fitting.

6.2 *Procedure A:*

6.2.1 *Metal or Rigid Plastic Coring Tools,* designed for collecting and transferring a 25-g soil VOC sample (see Guide D4547 and 8.1.1).

7. Reagents and Materials

7.1 *TCE Standard Gas Cylinders*—These are transportable cylinders containing certified concentrations of TCE in air pressurized to about 320 psi. If the practice is being used to screen a TCE-contaminated media to estimate the concentration of TCE in the media, two concentrations of TCE are required. One concentration is 220 ± 10 vapor part per million (ppmv) TCE in air. This is the high concentration TCE standard gas. The other concentration is 22 ± 1 ppmv TCE in air, which is the mid concentration TCE standard gas. These concentrations correlate with the upper and mid range of sensor response for the device. A 220 ppmv TCE standard gas at 25 °C corresponds to about 890 mg/m^3 TCE in air at 0.75 atm of pressure and to about 1200 mg/m^3 TCE in air at 1 atm of pressure. A 22 ppmv TCE standard gas at 25 °C corresponds to about 90 mg/m^3 TCE in air at 0.75 atm of pressure and to about 120 mg/m^3 TCE in air at 1 atm of pressure. See Note 3 and Note 4. If the practice is being used to screen a media suspected of containing HVOC contamination to indicate the presence or absence of HVOC contamination, only the high concentration TCE standard gas, 220 ± 10 ppmv TCE in air, is required.

NOTE 3—For HVOC concentrations in air that are greater than 10 mg/m^3, the current that is generated by the reaction between the halogen and the alkali metal vapor when the sensor is exposed to the HVOC is a function of the log of the concentration of the halogen in air. The log of 890 is 2.9, and the log of 1200 is 3.1, showing that the log values of these concentrations vary only slightly. Similarly, the log of 90 is 1.9, and the log of 120 is 2.1. These values show that the log of the TCE concentration in air varies only slightly at different elevations (atmosphere of pressure).

NOTE 4—The mg/m^3 concentrations of the TCE in the standard gas cylinders can be calculated using the ppmv concentrations of TCE in the cylinders, the atmospheric pressure, the temperature, and Eq 5 and Eq 6, which are given in 13.6 or Eq 20 and Eq 21, which are given in 18.6.

7.1.1 Transportation of the TCE gas cylinders must comply with current Department of Transportation (DOT) regulations.

8. Sample Collection and Preparation

8.1 *Procedure A:*

8.1.1 Collect a soil sample of approximately 25 g using a metal or rigid plastic coring tool. See Guide D4547 for recommended devices. If the sample will be stored in the coring tool prior to screening, it should be collected using a coring tool designed for sample storage as described in Guide D4547 and should be stored as specified in Guide D4547.

8.1.2 Pre-weigh a 250-mL glass jar with an open-top cap having a PTFE-bonded silicone septum. Record the mass of the jar with the cap to ±0.1 g.

8.1.3 Extrude the soil sample from the coring tool into the pre-weighed 250-mL glass jar and immediately seal the jar making sure that there are no soil particles on the sealing surfaces.

8.1.4 Weigh the jar-plus-soil sample and record the mass of the jar-plus-soil sample to ±0.1 g.

8.1.5 Determine the mass of soil added to the jar, and record the mass of the soil sample to ±0.1 g.

8.1.6 The temperature of the soil in the sample jar should be approximately 50 to 120 °F (10 to 49 °C) prior to screening the sample using the heated diode sensor, so that HVOC partitioning into the headspace above the sample will occur (see Note 5). The sample jar should not be opened to determine the soil temperature. The ambient temperature where the screening is to be performed should be in the range of 50 to 120 °F (10 to 49 °C) (see Note 6), and the soil sample should be allowed to come to approximately that temperature prior to screening (Section 12).

NOTE 5—The temperature at which the screening is performed may affect the HVOC concentration in the headspace. For example, the vapor pressure of TCE at 120 °F (49 °C) is about seven times greater than the vapor pressure of TCE at 50 °F (10 °C). Therefore, more TCE would be expected in the headspace at higher temperatures.

NOTE 6—The ambient temperature where the screening is to be performed will be recorded as specified in 11.3

8.2 *Procedure B:*

8.2.1 Mark a 250-mL glass jar having an open-top cap containing a PTFE-bonded silicone septum to show the filling level to give approximately 25 g of water in the jar. Pre-weigh the marked 250-mL jar with its cap. Record the mass of the jar with the cap to ±0.1 g.

8.2.2 Collect a water sample of approximately 25 g directly into the pre-weighed glass jar and immediately seal the jar making sure that the sealing surfaces are clean.

8.2.3 Weigh the jar-plus-water sample and record the mass of the jar-plus-water sample to ±0.1 g.

8.2.4 Determine the mass of water added to the jar, and record the mass of the water sample to ±0.1 g.

8.2.5 The temperature of the water in the sample jar should be approximately 50 to 120 °F (10 to 49 °C) prior to screening the sample using the heated diode sensor, so that HVOC partitioning into the headspace above the sample will occur (see Note 5). The sample jar should not be opened to determine the water temperature. The ambient temperature where the screening is to be performed should be in the range of 50 to 120 °F (10 to 49 °C) (see Note 6), and the water sample should be allowed to come to approximately that temperature prior to screening (Section 17).

9. Operation of the Heated Diode Sensor Device

9.1 The heated diode sensor device used to perform this practice should be calibrated and operated according to the manufacturer's instructions.

9.2 After a sample or standard gas has been screened using the heated diode sensor device, the voltage reading of the device must be allowed to return to zero, indicating that the sensor has been flushed with intake air so that any contamination from the previous sample or standard gas has been removed from the system.

10. Preparation of Tedlar Bags Containing the TCE Standard Gases

10.1 If the practice is being used to screen a TCE-contaminated soil or water to estimate the concentration of TCE in the soil or water, a 1-L Tedlar bag containing each of the TCE standard gases (7.1) should be prepared. If the practice is being used to screen a soil or water suspected of containing HVOC contamination to indicate the presence or absence of HVOC contamination, a 1-L Tedlar bag containing the high concentration TCE standard gas, 220 ± 10 ppmv TCE in air, (7.1) should be prepared.

10.1.1 To prepare a Tedlar bag containing the TCE standard gas, attach a regulator (see 6.1.7) to the TCE standard gas cylinder.

10.1.2 Open the valve on a 1-L Tedlar bag. Press the bag against a flat, hard surface to make sure the bag is empty.

10.1.3 With the valve on the Tedlar bag in the open position, attach the bag to the regulator by connecting the nipple fitting on the valve with the tubing on the regulator. Carefully fill the Tedlar bag with the standard gas. Remove the bag from the regulator. With the valve on the Tedlar bag in the open position, once again press the bag against a flat, hard surface to empty the bag. After the bag has been flushed with the standard gas, it should be refilled with the standard gas, as described above, and the valve on the bag should be closed.

11. Heated Diode Sensor Device Calibration Check and Voltage Measurement of TCE Standard Gases

11.1 After the heated diode sensor device has been calibrated (see 9.1), open the valve on the Tedlar bag containing the high concentration TCE standard gas and connect the nipple fitting on the bag to the probe of the heated diode sensor device. The device is calibrated if the voltage reading for the high concentration TCE standard gas is between 9 and 12 V. If the voltage reading is 9 V or less or 12 V or greater, the device should be re-calibrated until the reading for the high concentration TCE standard gas is between 9 and 12 V. Record this voltage reading from the device for the high concentration TCE standard gas as $V_{HighTCEStd}$.

11.2 If the practice is being used to screen a TCE-contaminated soil or water to estimate the concentration of TCE in the soil or water, a voltage reading for the mid concentration TCE standard gas is required. This reading is made after it is determined that the heated diode sensor device is calibrated (11.1), the voltage reading from the device for the high concentration TCE standard gas ($V_{HighTCEStd}$) has been recorded, and the voltage reading of the heated diode sensor device has returned to zero. The valve on the Tedlar bag containing the mid concentration TCE standard gas (Section 10) should be opened and the nipple fitting on the bag should be connected to the probe of the heated diode sensor device. The voltage reading from the device for the mid concentration TCE standard gas should be recorded as $V_{MidTCEStd}$. If the practice is being used to screen a soil or water suspected of containing HVOC contamination to indicate the presence or absence of HVOC contamination, a voltage reading for the mid concentration TCE standard gas is not required.

11.3 If the practice is being used to screen a TCE-contaminated soil or water to estimate the concentration of TCE in the soil or water, record the temperature in °C to 0.1°C and pressure in atmospheres to 0.001 atm at the time that the voltage readings for the high concentration and mid concentration TCE standard gases are recorded. If the practice is being used to screen a soil or water suspected of containing HVOC contamination to indicate the presence or absence of HVOC contamination, record the temperature in °C to 0.1 °C at the time that the voltage reading for the high concentration TCE standard gas is recorded.

11.4 The voltage reading of the high concentration TCE standard gas should be checked after ten samples have been screened, or if the sensor is exposed to a sample that gives a voltage reading above the reading for the high concentration TCE standard gas, $V_{HighTCEStd}$, recorded in 11.1 (see Note 7). If during this check, the reading for the high concentration TCE standard gas is not within 10 % of the value recorded for the standard gas during the previous check, the device must be re-calibrated.

NOTE 7—If a sensor is exposed to a sample that gives a voltage reading above the reading for the high concentration TCE standard gas, $V_{HighTCEStd}$, indicating that the concentration of TCE in the headspace above the sample is greater than the TCE concentration in the high concentration standard gas, the sensor response may become unstable.

PROCEDURE A – SCREENING SOIL

12. Soil Screening

12.1 When the sample temperature is estimated to be 50 to 120 °F, (10 to 49 °C), shake the jar-plus-soil sample for at least 20 s. Allow the jar to sit for a minimum of 10 min for HVOC partitioning into the headspace above the soil sample.

12.2 After 10 min, insert the needle attached to the probe of the heated diode sensor device through the septum in the cap of the sample jar and into the headspace above the sample. The tip of the needle should be approximately 3 in. below the cap of the jar. The tip of the needle should never contact the surface of the soil. The voltage reading for the headspace above the soil sample should be recorded as V_s.

12.3 If the practice is being used to screen a soil suspected of containing HVOC contamination, the voltage reading for the headspace above the 25-g soil sample, V_s, determined in 12.2 can be used to indicate the presence or absence of HVOC contamination in the soil (see Note 8). If the practice is being used to screen a TCE-contaminated soil to estimate the concentration of TCE in the soil, the calculations provided in Section 13 should be performed.

NOTE 8—The voltage reading of a heated diode sensor device is specific to the particular device, the particular sensor, and the amount of use the sensor has encountered. For this reason, the voltage reading for a soil sample, V_s, can be used to indicate the presence or absence of HVOC contamination; however, to compare readings made during different screening episodes, the relative response values for the samples, R_s, (see 13.4) should be calculated and compared.

13. Calculations for Soil Screening

13.1 Data interpretation in this practice is based on the response characteristic of the particular sensor used in the device. Fig. 1 is a qualitative plot of the response, R, versus the base 10 log of the concentration of TCE in air, log C_H (mg/m^3). This figure shows three possible heated diode sensor response profiles for a concentration of 100 mg/m^3 TCE in air (log C_H = 2.00): R greater than 0.550 (profile 1); R equal to 0.550 (profile 2); and R less than 0.550 (profile 3). These profiles are specific to TCE and any heated diode sensor meeting the specifications given in 6.1.5.

13.2 Calculate the relative response for the mid concentration TCE standard gas, $R_{MidTCEStd}$, using the voltage reading for the mid concentration TCE standard gas, $V_{MidTCEStd}$ (11.2), and the voltage reading for the high concentration TCE standard gas, $V_{HighTCEStd}$ (11.1), as shown in Eq 1.

$$R_{MidTCEStd} = V_{MidTCEStd}/V_{HighTCEStd} \quad (1)$$

13.3 The relative response, $R_{HighTCEStd}$, for the high concentration TCE in air standard gas is equal to 1.00, based on the calculation shown in Eq 2.

$$R_{HighTCEStd} = V_{HighTCEStd}/V_{HighTCEStd} = 1.00 \quad (2)$$

13.4 Calculate a relative response, R_s, for the sample using the voltage reading for the 25-g sample (V_s, 12.2) and the voltage reading for the high concentration TCE in air standard ($V_{HighTCEStd}$) as shown in Eq 3.

$$R_s = V_s/V_{HighTCEStd} \quad (3)$$

13.5 If R_s calculated in 13.4 is less than or equal to 1.00, go to 13.6 and continue the calculations. If R_s is greater than 1.00, the concentration of TCE in the headspace above the sample is greater than the TCE concentration in the high concentration standard gas. The concentration of TCE in mg/m^3 in the high concentration TCE standard gas should be calculated using Eq 5 shown in 13.6. Then the estimated concentration of TCE in the soil sample, C_s, mg/Kg, should be reported as the greater than value calculated using Eq 4.

$$C_s\text{, mg/Kg} > (C_{HighTCEStd}\text{, mg/m}^3)(\text{Vol of headspace in the container, L}) \quad (4)$$
$$/(\text{Kg of soil})(1000\ \text{L/m}^3)$$

where: $C_{HighTCEStd}$, mg/m^3, is the concentration of TCE in the high concentration standard gas, calculated using Eq 5 in 13.6;

Vol of headspace in the sample container, L, is 0.235 L for a 25.0-g sample in a 250-mL jar, assuming a soil density of 1.7 g/mL;

Mass of soil sample in Kg: for a 25.0-g sample, this is 0.025 Kg.

13.6 Calculate the concentration of TCE in mg/m^3 in the high concentration and mid concentration TCE in air standard gas cylinders using Eq 5 and Eq 6, respectively.

$$C_{HighTCEStd}\text{, mg/m}^3 = (\text{ppmv}_{HighTCEStd})\ (131.39\ \text{g/mol})\ (P)/(R)\ (T) \quad (5)$$

$$C_{MidTCEStd}\text{, } mg/m^3 = (\text{ppmv}_{MidTCEStd})\ (131.39\ \text{g/mol})\ (P)/(R)\ (T) \quad (6)$$

where:

$\text{ppmv}_{HighTCEStd}$ = the TCE concentration in the high concentration TCE standard gas in ppmv,
$\text{ppmv}_{MidTCEStd}$ = the TCE concentration in the mid concentration TCE standard gas in ppmv,
P = pressure in atmospheres (recorded in 11.3),
R = the gas constant, 0.082057 ppmv L atm/mol °K, and
T = temperature in °K (T °C + 273.15) (T °C recorded in 11.3).

13.7 To interpret the data, equations corresponding to specific line segments, such as those shown in Fig. 2 for concentrations of TCE in the headspace above the soil sample (C_H) ranging from greater than 10 to 1000 mg/m^3, and the line shown in Fig. 3 for concentrations of TCE in the headspace above the soil sample (C_H) ranging from 0 to 10 mg/m^3, are used depending on the relative response for the sample, R_s.

13.7.1 If the relative response, R_s, for the sample (calculated in 13.4) is equal to or between the relative response values, $R_{MidTCEStd}$ and $R_{HighTCEStd}$ (1.00) (Eq 1 and Eq 2, respectively),

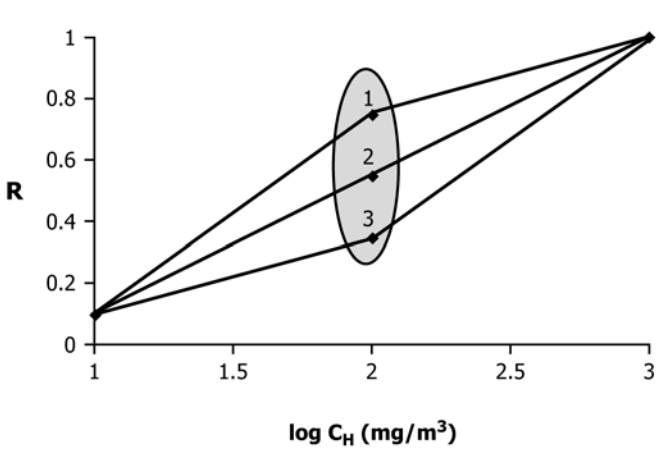

FIG. 1 Qualitative Heated Diode Sensor Response Profiles for TCE Headspace Concentrations (C_H) Ranging from Greater than 10 to 1000 mg/m^3 Showing Three Possible R Values for C_H = 100 mg/m^3 (log C_H = 2.00)

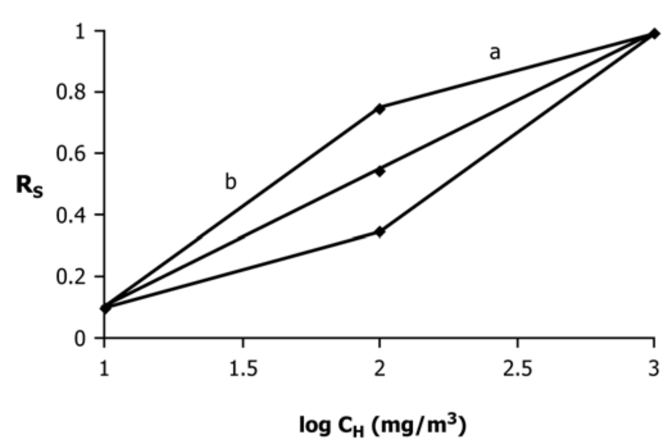

FIG. 2 Qualitative Heated Diode Sensor Response Profiles for Sample TCE Headspace Concentrations (C_H) Ranging from Greater than 10 to 1000 mg/m^3 Showing Specific Line Segments for TCE Concentrations Equal to or Between 100 and 1000 mg/m^3 (line segments a) and TCE Concentrations Between 10 and 100 mg/m^3 (line segments b)

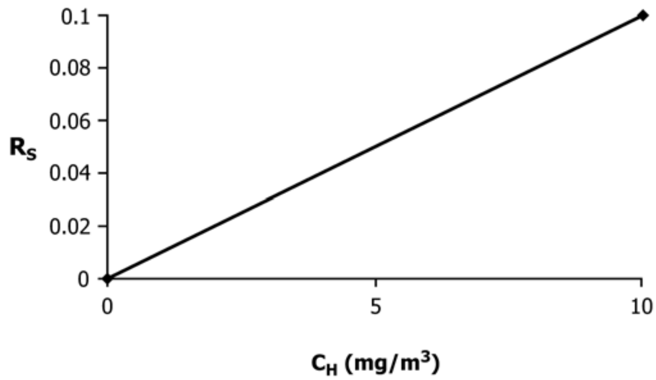

FIG. 3 Heated Diode Sensor Response Profile for Sample TCE Headspace Concentrations (C_H) Ranging from 0 to 10 mg/m^3

calculate the slope and *y* intercept of the line segment appropriate for the sample response (segments **a** shown in Fig. 2) using Eq 7 and Eq 8. Then calculate the base 10 log of the concentration of TCE in the headspace above the soil sample (log C_H) using Eq 9.

$$\text{slope, } m_a = (1.00 - R_{\text{MidTCEStd}})/(\log C_{\text{HighTCEStd}} - \log C_{\text{MidTCEStd}}) \quad (7)$$

$$y \text{ intercept, } b_a = 1.00 - [(m_a)(\log C_{\text{HighTCEStd}})] \quad (8)$$

$$\log C_H = (R_s/m_a) - (b_a/m_a) \quad (9)$$

13.7.2 If the relative response, R_s, for the sample (calculated in 13.4) is between $R_{\text{midTCEStd}}$ (Eq 1) and 0.100, calculate the slope and *y* intercept of the line segment appropriate for the sample response (segments **b** shown in Fig. 2) using Eq 10 and Eq 11. Then calculate the base 10 log of the concentration of TCE in the headspace above the soil sample (log C_H) using Eq 12.

$$\text{slope, } m_b = (R_{\text{MidTCEStd}} - 0.100)/(\log C_{\text{MidTCEStd}} - 1.00) \quad (10)$$

$$y \text{ intercept, } b_b = 0.100 - m_b \quad (11)$$

$$\log C_H = (R_s/m_b) - (b_b/m_b) \quad (12)$$

13.7.3 If the relative response, R_s, for the sample (calculated in 13.4) ranges from 0 to 0.100 (line shown in Fig. 3), calculate the concentration of TCE in the headspace above the soil sample (C_H) in mg/m^3 using Eq 13.

$$C_H = (R_s)(100) \quad (13)$$

13.7.4 If a log C_H value was determined in either 13.7.1 or 13.7.2, the concentration of TCE in the headspace above the soil sample (C_H) in mg/m^3 can be calculated using Eq 14.

$$C_H = 10^{logCH} \quad (14)$$

13.8 Using the C_H value calculated in either 13.7.3 or 13.7.4, the estimated concentration of TCE in the soil sample, C_s, in mg/Kg, can be calculated using Eq 15.

$$C_s, \text{ mg/Kg} = (C_H, \text{ mg/m}^3)(\text{Vol of headspace in the container, L}) \quad (15)$$
$$/(\text{Kg of soil})(1000 \text{ L/m}^3)$$

where: C_H, mg/m^3, is the concentration of TCE in the headspace above the soil sample determined in 13.7.3 or in 13.7.4;

Vol of headspace in the sample container, *L*, is 0.235 L for a 25.0-g sample in a 250-mL jar, assuming a soil density of 1.7 g/mL;

Mass of soil sample in Kg: for a 25.0-g sample, this is 0.025 Kg.

14. Record

14.1 Record the following information:

14.1.1 Mass of the empty 250-mL sample jar with the cap, g,

14.1.2 Mass of the sample jar with cap-plus-soil sample, g,

14.1.3 Mass of the soil sample, g,

14.1.4 Voltage reading for the high concentration TCE standard gas, $V_{\text{HighTCEStd}}$,

14.1.5 Voltage reading for the mid concentration TCE standard gas, $V_{\text{MidTCEStd}}$ (see Note 9),

14.1.6 Temperature in °C and pressure in atmospheres at the time that the voltage readings for the mid concentration and high concentration TCE standard gases are recorded (see Note 9), and

14.1.7 Voltage reading for the headspace above the 25-g soil sample, V_s.

NOTE 9—If the practice is being used to screen a soil suspected of containing HVOC contamination to indicate the presence or absence of HVOC contamination in the soil, a reading for the mid concentration TCE standard gas, $V_{\text{MidTCEStd}}$, and a pressure reading at the time that the voltage reading for the high concentration TCE standard gas is recorded are not required.

15. Report

15.1 If the practice is used to screen soil known to contain TCE to estimate the concentration of TCE in the soil, report the estimated TCE concentration in mg/Kg to two significant figures. Any other HVOC present in the soil will be reported as TCE.

15.2 If the practice is used for screening soil to indicate the presence or absence of HVOC contamination, report the voltage reading recorded for the soil and the indicated presence or absence of HVOC contamination. To compare heated diode sensor readings made during different screening episodes, the relative response values for the samples (R_s) should be reported (see Note 8).

16. Precision and Bias

16.1 No information is presented about either the precision or bias of Practice D7203 for measuring TCE or HVOCs since the test result is nonquantitative. However, data have been generated to provide information on the performance of the procedure to screen soil collected at a TCE-contaminated site. The screening procedure was evaluated based on a comparison of the screening data with data generated from analysis of samples collected side-by-side from the same location and analyzed in the laboratory using gas chromatography/mass spectrometry (GC/MS). These data[3] are shown in Appendix X1.

[3] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D34-1017. Contact ASTM Customer Service at service@astm.org.