

CHAPTER 12
VACUUM SAMPLERS

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Table of Contents		Page
I.	Introduction	12-1
II.	Sampling Equipment	12-1
	A. Vacuum Bottle	12-1
	B. Vacutainer	12-2
	C. Bistable	12-3
III.	Sampling Procedures - Ambient Air	12-3
	A. Vacuum Bottle	12-3
	B. Vacutainer	12-5
	C. Bistable	12-7
IV.	Sampling Procedures - Inaccessible Areas	12-9
V.	Post-Inspection Procedures	12-9
	A. Health Field Notes	12-9
	B. Submit Samples for Analysis	12-9
	C. Documentation and Recordkeeping	12-11
	Figure 12-1. 50 mL Vacuum Bottle	12-2
	Figure 12-2. 10 mL Vacutainer, Plunger, and Sealed Sample	12-2
	Figure 12-3. Bistable	12-3
	Figure 12-4. 50 mL Vacuum Bottle with Sample Seal	12-4
	Figure 12-5. Taking a 10 mL Vacutainer Sample	12-6
	Figure 12-6. Taking a Bistable Sample	12-7
	Figure 12-7. Bistable with Sample Seal	12-8

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Chapter 12

VACUUM SAMPLERS

I. Introduction

Vacuum samplers are used primarily to determine the concentration of methane (CH₄) generated underground in a 24-hour period. This data is used to determine the frequency of required inspections according to Section 103 of the Act and 30 CFR Part 57 Subpart T. Vacuum samplers are not to be routinely used to test for air quality. Direct-reading instruments (electronic direct-read instruments or detector tubes) should be used to determine methane (CH₄), oxygen (O₂), carbon monoxide (CO), and carbon dioxide (CO₂) concentrations to enable rapid response to identified hazards. However, if direct-reading instruments are not available, or if unusual circumstances warrant their use, vacuum samplers may be used for air quality samples. The MSHA Laboratory should be contacted for expedited sample analysis. There are three types of vacuum samplers: vacuum bottles (50 mL), vacutainers (10 mL), and bistables (or “crickets”). Vacuum bottles and vacutainers are single-use, small glass containers, which are vacuum-sealed by the manufacturer, while the bistable is a reusable metal container. Vacuum bottles, vacutainers, or bistables can be used to sample either ambient air or air from inaccessible areas such as behind seals and in drilled holes. A pump assembly is required if sampling air from inaccessible areas.

II. Sampling Equipment

Vacuum samplers and mailing containers are available from the MSHA National Air & Dust Laboratory (Mount Hope, WV). Bistables are available from the MSHA Denver Laboratory.

A. Vacuum Bottle

The 50 mL vacuum bottle is a cylindrical glass bottle with a long narrow tip used to sample for methane (CH₄), oxygen (O₂), carbon dioxide (CO₂), and carbon monoxide (CO). The bottle is sealed while under vacuum, and the tip is scored for easy breaking (refer to Figure 12-1). Air is drawn into the bottle when the tip is broken off. Vacuum bottles are labeled with a pre-printed sample identification number and come with a wax filled cap and a mailing container. The cap has an indefinite shelf life as long as the wax plug remains present and pliable. The bottle itself has an indefinite shelf life as long as it remains intact. Vacuum bottle samples need to be shipped within 14 days of sampling and should be submitted as soon as possible.



Figure 12-1. 50 mL Vacuum Bottle

B. Vacutainer

A vacutainer is a small 10 mL glass evacuated tube sealed with a rubber stopper, similar in shape to a test tube, and used for CH₄, O₂, and CO₂. Vacutainers are **not** intended for CO sampling. Vacutainers are prepared in-house exclusively for MSHA use (refer to Figure 12-2), and come pre-labeled with a sample identification number, a plunger, and a Styrofoam packing mailer. Samples collected in vacutainers should be shipped overnight to the MSHA Laboratory (Pittsburgh), so that the time from collection to analysis does not exceed 7 days. Alert the Laboratory that samples are being sent.



Figure 12-2. 10 mL Vacutainer, Plunger, and Sealed Sample

Note: Do not use commercially available over-the-counter vacutainers from medical supply sources.

C. Bistable

A bistable or “cricket” is a specialized vacuum sampler consisting of two thin circular metal plates welded together, with a threaded sample port soldered to the edge. (Refer to Figure 12-3). It is used to sample for CO, CH₄, O₂, CO₂ and other gases. A threaded metal cap and a small lead ball are provided to seal the port opening once the sample has been collected. To use this sampling method, the inspector must carry an adequate supply of bistables, extra caps, extra lead balls, and extra sample labels. Send bistables to the Denver Technical Support Laboratory for analysis.

Caution: Bistables come with two different size stems and caps, which are not to be interchanged. The long stems require long caps and the short stems require short caps. In either case, the use of lead balls is essential to ensure an airtight seal.

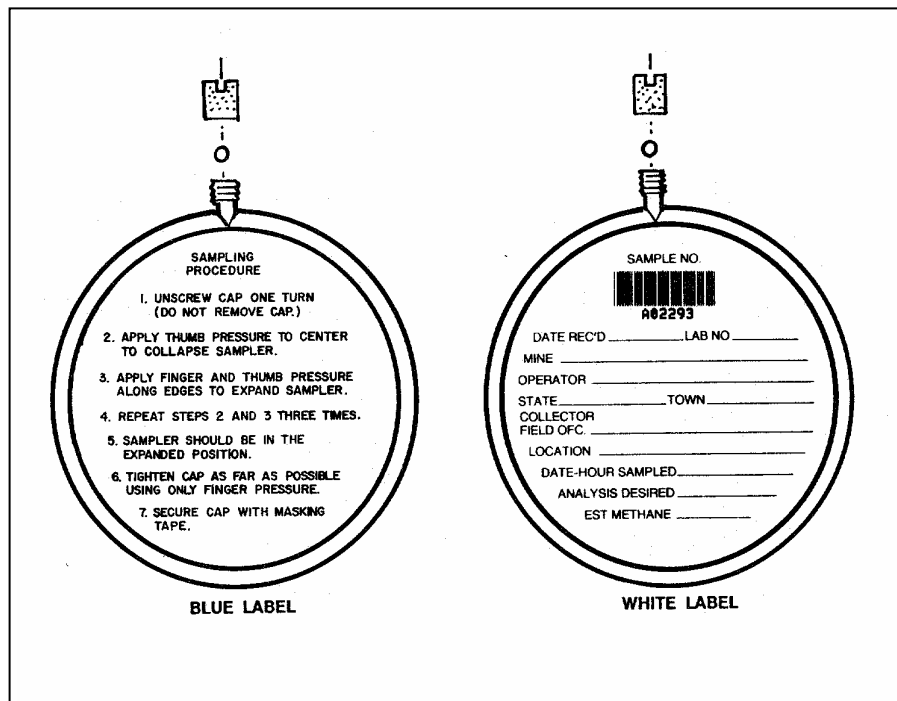


Figure 12-3.

Bistable

III. Sampling Procedures - Ambient Air**A. Vacuum bottle**

- 1.** Keep the wax caps in an inside pocket of your clothing or hold them in your hands so that the wax remains pliable.
- 2.** Select the location to be sampled.
- 3.** Collect the sample.
 - a.** Break the glass tip off the bottle neck at the scored location. Wear safety glasses for protection against flying glass particles, hold the bottle at waist level and use a glove or handkerchief while breaking to protect fingers. Be careful to dispose of any waste or broken glass particles.
 - b.** Hold the bottle away from your body for a minimum of one minute. Be sure to hold the bottle away from your breathing zone to avoid contaminating the sample.
 - c.** Seal the bottle using a wax-filled cap which has been adequately warmed. Apply firm, steady pressure to the cap until the bottle neck is filled along its length with wax. When the wax has been warmed sufficiently, the wax will flow smoothly and quickly into the bottle neck, forming a good seal and preserving the sample long enough to complete the analysis.
 - d.** Apply a sample seal to ensure the sample against tampering, as illustrated in Figure 12-4.



Figure 12-4. 50 mL Vacuum Bottle with Sample Seal

- e. Record the bottle number, time, and location sampled on the back side of the Health Field Notes (refer to Chapter 21, Section V). In addition, record:
- Location of sample;
 - Miners present and equipment operating in the area;
 - General description of controls (e.g., ventilation) in use and whether or not they seem adequate;
 - Potential sources of exposure, a general description of these sources, number of persons affected, and possible additional control measures;
 - Any other samples taken and the results, if available (e.g., noise, detector tubes, organic vapor badges); and
 - Environmental conditions (such as temperature and humidity).
- f. Avoid storing the sample where elevated temperatures may occur. If the wax plug were to melt, the sample would become contaminated.
- g. Send the bottle and Request for Laboratory Analysis form (refer to Chapter 21, Section VII) together in a packing container to the MSHA Laboratory for analysis.

B. Vacutainer

Vacutainers are easier to use, store, and transport than vacuum bottles. In addition, they are less expensive to purchase than vacuum bottles.

1. Select the location to be sampled.
2. Collect the sample.
 - a. Push the vacutainer, stopper first, into the plunger until the needle in the plunger punctures the stopper, allowing the vacuum to be replaced with mine air. Refer to Figure 12-5. Note: Always handle this apparatus with care since it contains a sharp medical-grade needle. Hold the bottle away from your body and away from your breathing zone to avoid contaminating the sample.

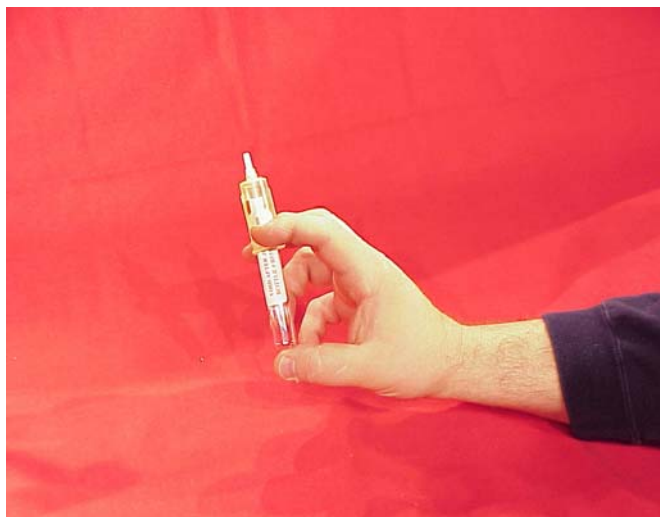


Figure 12-5. Taking a 10 mL Vacutainer Sample

- b. Withdraw the vacutainer from the plunger. The hole in the stopper made by the needle will automatically seal itself.
- c. Place a sample seal on the vacutainer as shown in Figure 12-2.
- d. Record the sample number, time, and location sampled on the back side of the Health Field Notes (refer to Chapter 21, Section V). In addition, record:

- Location;
 - Miners present and equipment operating in the area;
 - General description of controls in use (e.g., ventilation) and whether or not they seem adequate;
 - Potential sources of exposure, a general description of these sources, number of persons affected, and possible additional control measures;
 - Any other samples taken and the results, if available (e.g. noise, detector tubes, organic vapor badges); and
 - Environmental conditions (such as temperature, humidity, etc.).
- e. Ship the vacutainer and Request for Laboratory Analysis Form (refer to Chapter 21, Section VII) together in a packing container overnight to the MSHA Laboratory for analysis. Ship the vacutainer overnight.

C. Bistable

1. Select the location to be sampled.
2. Collect the sample.
 - a. Unscrew the bistable cap one turn. Do not remove the cap.
 - b. Holding the bistable in both hands as illustrated in Figure 12-6, apply thumb pressure to the two opposing edges of the bowed side so the two metal plates separate from one another. This will draw air through the sample port into the newly created space between the plates. Then, apply pressure to the center of the bistable disc with your thumbs to collapse the bistable and expel its contents. Repeat this process two or three times.

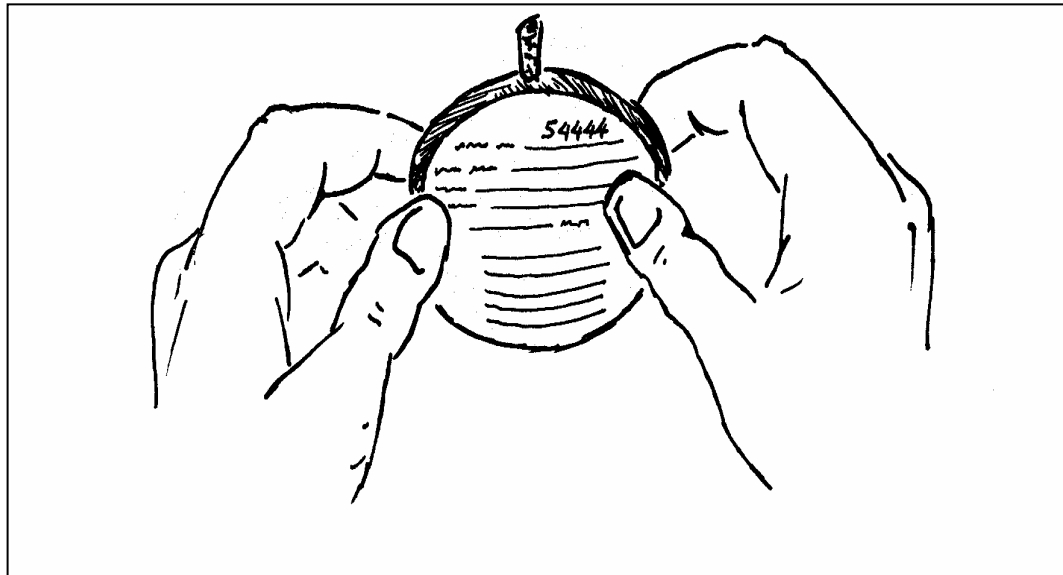


Figure 12-6. Taking a Bistable Sample

- c.** Tighten the cap using only finger pressure. Excessive tightening may not provide a gas-tight seal.
- d.** Check that the bistable is sealed by applying finger pressure to the center of the disc. If the unit collapses, the lead ball is missing or faulty or the cap is loose. Take off the cap and replace the lead ball. Repeat steps “a” through “c.” If the bistable still does not properly seal, use another bistable for the sample.
- e.** A cap guard may be used to prevent accidental loosening of the cap in transit. The cap guard consists of a short length of flexible hose which has been split halfway up each side. Push the cap guard down over the cap so that the split ends grip the bistable (refer to Figure 12-7).
- f.** Complete the label on the bistable, noting the mine name, operator's name, state and nearest town, collector's name and field office, sample location, date and time collected, analysis desired, and the estimated percent methane in the sample.
- g.** Place a sample seal over the tightened cap as illustrated in Figure 12-7.

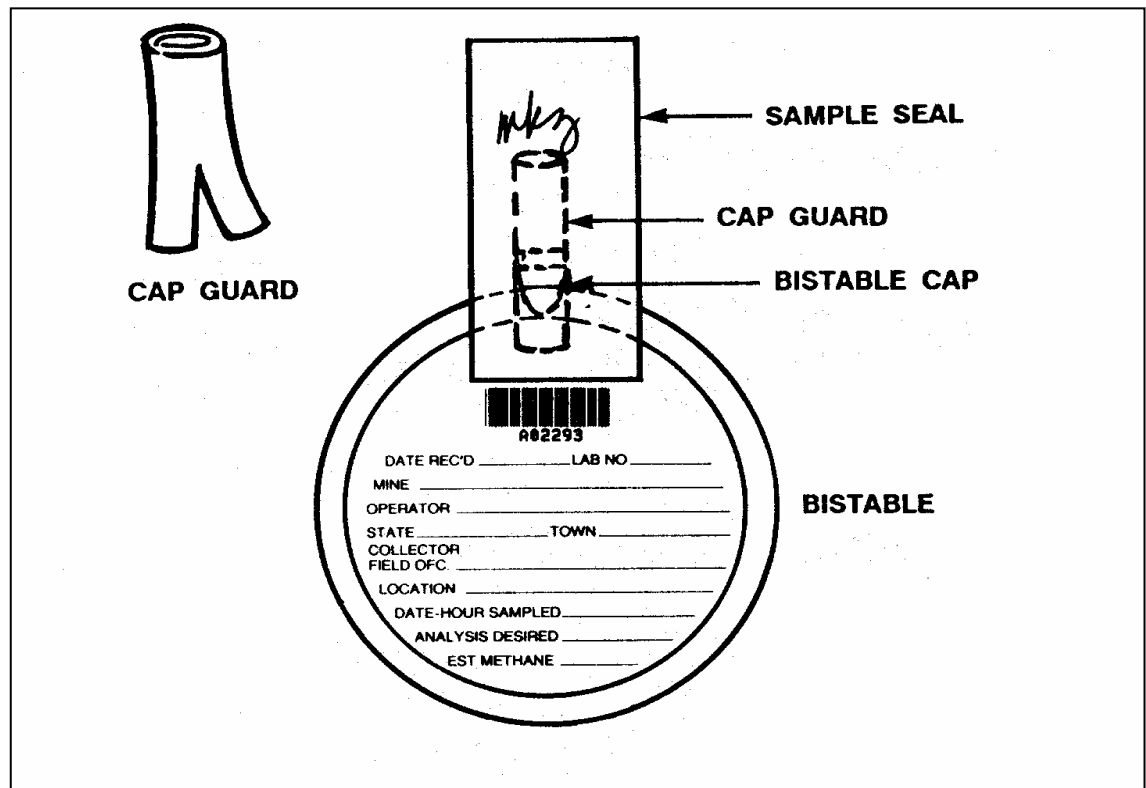


Figure 12-7. Bistable with Sample Seal

- h.** Record the bistable number, time, and location sampled on the back side of the Health Field Notes (refer to Chapter 21, Section V). In addition, record:
- Location;
 - Miners present and equipment operating in the area;
 - General description of controls in use (e.g., ventilation) and whether or not they seem adequate;
 - Potential sources of exposure, a general description of these sources, number of persons affected, and possible additional control measures;
 - Any other samples taken and the results, if available (e.g., noise, detector tubes, organic vapor badges); and
 - Environmental conditions (such as temperature, humidity, etc.).

- i. Send the bistable and Request for Laboratory Analysis form (refer to Chapter 21, Section VII) together in a packing container to the MSHA Laboratory for analysis.

IV. Sampling Procedures - Inaccessible Areas

In the unlikely event that samples must be taken remotely with a vacuum sampler, contact the district office for guidance. MSHA Technical Support has specialized equipment and trained personnel for sampling in remote areas.

V. Post-Inspection Procedures

A. Health Field Notes

Review Health Field Notes to see that all necessary information has been recorded.

B. Submit Samples for Analysis

Complete Request for Laboratory Analysis (RLA) forms (refer to Chapter 21, Section VII).

- Item 14. Field Sample No: Record the number printed on the sampler label (vacutainer and bistable) or sample card (vacuum bottle).
 - Item 16. Analysis Requested: State that you want a complete analysis, unless specific circumstances dictate otherwise. Use Sample Type “G” in Item 15.
 - Item 24. Sample Location: Identify if the sample is a “face” sample, a “return air” sample, a “sealed area” sample, etc., in addition to the specific physical location within the mine and Location Code.
1. Submit all vacuum samples for analysis as soon as possible after collecting. **Send them in the packing mailers that have been provided.**
 - Vacutainer samples must be shipped overnight.
 - Vacuum bottle and bistable samples must be sent no more than 14 days after sampling.

2. Submit vacuum bottle and vacutainer samples to the Pittsburgh Technical Support Laboratory or the MSHA Denver Laboratory (addresses are listed below).
3. Submit bistables to the MSHA Denver Laboratory (address is listed below.)

Technical Support Laboratory Addresses and Telephone Numbers

The addresses and telephone numbers of the Technical Support Laboratories are:

Pittsburgh, PA Laboratory

USDOL/MSHA
Pittsburgh Safety and Health Technology Center
PTAD Labs
Cochrans Mill Road, Bldg. 38
P.O. Box 18233
Pittsburgh, PA 15236

Telephone numbers: (412) 386-6984, FAX (412) 386-6154

Denver, CO Laboratory

USDOL/MSHA
Denver Federal Center
6th & Kipling
2nd Street, Building 25, Room 1828
Denver, Colorado 80225
or
P. O. Box 25367, Denver, CO 80225

Telephone numbers: (303) 231-5547 or 5548

Mount Hope, WV Laboratory

MSHA National Air & Dust Laboratory
100 Bluestone Road
Mount Hope, West Virginia 25880

Telephone number: (304) 877-3900

C. Documentation and Recordkeeping

1. Complete the Area Sample Data Summary (refer to Chapter 21, Section IX) if not provided by the Laboratory. Be sure that the concentration and exposure limit units of measurement are the same as those listed for the contaminant code (refer to Chapter 3).
2. Inspection reports should include: a copy of the Health Field Notes; the completed Area Sample Data Summary (ASDS); citation/orders; and any other supplemental information collected during the inspection.