Designation: D 4844 – 88 (Reapproved 1998)

Standard Guide for Air Monitoring at Waste Management Facilities for Worker Protection[1]

This standard is issued under the fixed designation D 4844; 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 guide is intended to provide a standardized approach for establishing and carrying out an air monitoring program to protect workers at waste management facilities. This guide may apply to routine operations at an active treatment, storage, or disposal site or the extraordinary conditions that can be encountered in opening and cleaning up a remedial action site.

1.2 Any user of this guide must understand that it is impossible to predict all the difficulties that could develop at a waste management facility due to hazardous airborne emissions. Although air contaminant measurements obtained in accordance with this guide may indicate acceptable or tolerable levels of toxic agents are present, care and judgment must still be exercised before concluding that all atmospheric contaminants at the site are under control.

2. Referenced Documents

2.1 *ASTM Standards:*

D 1356 Terminology Relating to Atmospheric Sampling and Analysis[2]

D 1357 Practice for Planning the Sampling of the Ambient Atmosphere[2]

D 1605 Practices for Sampling Atmospheres for Analysis of Gases and Vapors[2]

D 3614 Guide for Evaluating Laboratories Engaged in Sampling and Analysis of Atmospheres and Emissions[2]

D 4687 Guide for General Planning of Waste Sampling[3]

E 548 Guide for General Criteria Used for Evaluating Laboratory Competence[4]

2.2 *Federal Standards:*

OSHA Analytical Methods Manual[5]

NIOSH Manual for Analytical Methods[6]

OSHA, 29 CFR Part 1910 Hazardous Waste Operations and Emergency Response; Interim Final Rule, December 1986[7]

3. Terminology

3.1 *Definitions:*

3.1.1 *General*—Terminology commonly used in air monitoring can be found in Terminology D 1356.

3.2 *Descriptions of Terms Specific to This Standard:*

3.2.1 *operating site*—an operating site is a location or facility where waste is treated, stored, or disposed as part of an on-going operation.

3.2.2 *remedial action site*—a remedial action site is a location or facility that may pose a threat to human health and the environment.

4. Summary of Guide

4.1 The procedures described in this guide address safety considerations, acute health hazards, and chronic health hazards due to airborne hazardous materials.

4.2 Monitoring concepts are described for cleanup operations at remedial action sites as well as routine activities at operational waste management sites.

5. Significance and Use

5.1 The techniques of air monitoring are many and varied. This guide is intended to describe the standard approaches that are used in designing an air monitoring program to protect waste management site workers.

5.2 When entering a remedial action site to initiate an investigation or a cleanup operation, operating personnel may be faced with the extreme hazards of fire, explosion, and acute or chronic health hazards. A thorough safety and health program, including a site-specific safety and health plan, must be in place to direct worker activity. Details for such plans can be found in the OSHA Interim Final Rule for Hazardous Waste Operations and Emergency Response and Refs **(1, 2)**.[8] Air monitoring is an integral part of such a program. This guide describes equipment and sampling procedures which can be used to evaluate the airborne hazard potential so as to gain and maintain control over the situation at the site.

---

[1] This guide is under the jurisdiction of ASTM Committee D34 on Waste Management and is the direct responsibility of Subcommittee D34.01.01 on Planning for Sampling.

Current edition approved Oct. 6, 1988. Published February 1989.

[2] *Annual Book of ASTM Standards*, Vol 11.03.

[3] *Annual Book of ASTM Standards*, Vol 11.04.

[4] *Annual Book of ASTM Standards*, Vol 14.02.

[5] 1985 manual available from Occupational Safety and Health Administration, OSHA Analytical Laboratory, Salt Lake City, UT.

[6] Third edition manual, February 1984, available from the National Institute of Occupational Safety and Health, (NIOSH), Cincinnati, OH.

[7] Available from the Superintendent of Documents, Government Printing Office, Washington, DC, 20401.

[8] The boldface numbers in parentheses refer to the list of references at the end of this guide.

5.3 Upon obtaining readings at the site, a decision must be made as to whether conditions are under control or not. That decision will depend on the nature of the contaminants (toxicity, reactivity, volatility, etc.), the extent (area affected, number of workers, etc.) of the problem and the level of worker protection available. Since all such parameters will be site specific, the necessary decision-making is beyond the range of this guide.

5.4 This guide does not include monitoring sites containing radioactive materials, nor does it cover general safety aspects, such as access to emergency equipment or medical support of emergency needs. These items should be covered in a safety and health plan.

5.5 It is recommended that this guide be used in conjunction with Guide D 4687.

6. General Considerations

6.1 That aspect of science which routinely deals with the assessment of airborne hazards to workers is known as industrial hygiene. Professional industrial hygienists, besides measuring the concentration of contaminants in air, recommend means for controlling such airborne hazards, protecting workers, and demonstrating compliance with applicable laws and regulations. A certified industrial hygienist generally offers the optimum combination of background and credentials for recognizing, evaluating, and controlling workplace health hazards. If industrial hygiene staff support is not available on site, coverage can be obtained through the use of consultants and possibly through loss prevention insurance carriers. The remainder of this guide reflects the general thought process that an industrial hygiene professional would most likely go through in establishing an air monitoring program to protect workers at a waste management site.

6.2 *Establishing a Test Protocol*:

6.2.1 Various combinations of equipment and sampling techniques are used in work place air monitoring. The best monitoring program is one that combines accuracy with timely response in a cost effective manner.

6.2.2 The particular test protocol which is selected for an industrial hygiene study depends on the nature of the contaminants and the end purpose of the monitoring effort (that is, routine monitoring, searching for worst case exposure, looking for contaminant leaks in a process).[9]

6.3 *Selecting Specific Methods*:

6.3.1 The choice of sampling method is most often tied in with the analytical method. There may be no difference in the analytical work whether it is for a 15-min ceiling sample or a 7-h full day sample. If the analytical method has poor sensitivity, however, it may be necessary to increase the pump flow rate for the short duration sample to make certain that sufficient sample is collected. Such fine adjustments must be worked out between the sampling personnel and the laboratory personnel. Extensive guidance on the latest developments in air sampling technology is available in Refs **(3, 4)**.

6.3.2 A number of sources of information are available to describe general methodology. Practice D 1605 lists some of the classic methods that have been used when sampling for gases or vapors. The American Conference of Governmental Industrial Hygienists offers a publication, Ref **(5)**, that provides a review of newer equipment and methodology. The final combination of equipment and procedures is predicted on the precision, accuracy, and sensitivity needed to support the test protocol.

6.3.3 Once the goals and protocol for the sampling program have been set, specific sampling/analytical methods must be selected. Within the *Annual Book of ASTM Standards*, Volume 11.03 is dedicated to atmospheric analysis and to occupational health and safety issues. Some applicable methods from that reference are listed in Annex A1. Other sources of health and safety support include the NIOSH Manual of Analytical Methods and the OSHA Analytical Methods Manual. The specific equipment and sampling media for a particular set of airborne contaminants are selected from sources such as these.

7. Procedures

7.1 *Operating Site*:

7.1.1 The procedures described in this section apply to air monitoring activities at an operational waste treatment, storage, or disposal site. At an operating site, controls (work practices, engineering controls, and personal protective equipment) would be in place to minimize the exposure of workers to hazardous conditions. These are defined in the health and safety plan.

7.1.2 *Knowledge of Materials*—Knowledge of the materials arriving at or present at an operating site is critical to the design of a sampling plan. If hazardous wastes are arriving, be sure that they are listed on the manifest. The results of waste sample analyses will also help to identify contaminants of greatest concern in an incoming shipment. It is also likely that specific users of the disposal site will tend to be consistent in the types of wastes they send to the site based on the generating process and history of shipment. For example, paint manufacturers will most likely send mixtures of solvents, resins, and pigments, whereas plating firms will generally send alkaline sludge of heavy metal waste; and so on. Deviation from established patterns, however, is possible and should not be discounted in sampling plan design.

7.1.3 *Worker Sampling*:

7.1.3.1 Of all the different techniques for workplace air monitoring, personal sampling of the worker's breathing zone is paramount. While some workers may be quite sedentary in an operations trailer at a control panel, others may be out covering all areas of the work site. For this reason, the assessment must be capable of following the activity of the worker.

7.1.3.2 The first order of personal monitoring is long duration time-weighted-average (TWA) sampling. For an 8-h work shift, be sure that TWA samples are at a minimum of 7-h duration either as a single sample or a series of two or more samples. For any other work hour situation, the procedure is to sample for the duration of the shift less 1 h. For workers handling organic wastes (for example, vapor degreaser solvent waste) the program would call for charcoal tube sampling with

[9] Subcommittee E34.18 of ASTM Committee E34 on Occupational Health and Safety is developing a guide for industrial hygiene air monitoring programs titled "Standard Guide to Air Sampling Strategies for Worker and Workplace Protection.''

analysis for one or two of the chlorinated solvents most likely to be present in the waste. Such TWA monitoring, as well as the following information, would be repeated periodically to ensure that worker exposure is not increasing.

7.1.3.3 Another form of personal monitoring that would be carried out is for peak exposures. For example, 15-min ceiling samples might be taken while a set of containers was being opened to inspect or remove the contents. The same type of sampling might be done while pumping the contents of a truck into a holding tank. At these times, personal protective equipment (for example, respiratory protection) is often used to minimize worker exposure to vapors. Ceiling samples will help ensure that workers are using respirators having a high enough protection factor.

7.1.3.4 Ceiling samples might be the only form of monitoring for certain toxic agents. If waste acid pickling solution were to come in from a steel mill for neutralization, it might be appropriate to sample for hydrogen chloride. In that instance, only 15-min samples would be of interest, because that is how exposure to HCl is controlled by health/regulatory agencies.

7.1.3.5 New equipment has come into use to cover both TWA and peak sampling. Some personal dosimeters, worn by the employees, give an overall average exposure and also record the instantaneous exposures of the worker during the day. These units, which are read out on a portable computer, are generally good for only one particular contaminant, though all the different types are read using the same computer. These might be very useful in monitoring a heavy equipment operator for carbon monoxide or a waste treatment plant attendant for sulfur dioxide.

7.1.3.6 Another concept to be considered in both the monitoring and safety and health plans is the additive effect of certain substances. Paragraph 7.1.3.2 presented the concept of screening for only one or two solvents. When this is done, the eventual comparison with permissible exposure limits must be done using a safety factor. This safety factor is intended to take account of the possible effects of other similar compounds which are likely to be present, but are not measured routinely.

7.1.4 *Area Monitoring*:

7.1.4.1 A good complement to personal monitoring is fixed location area monitoring. This can be done with either sample collecting-type equipment, direct reading instruments, or specialized fixed-parameter monitors such as those described in 7.1.3.5. Area monitoring offers the advantage of potentially providing an early warning.

7.1.4.2 A combustible vapor meter in a solvent storage area can give warning before an employee must walk in to find a leak.

7.1.4.3 A carbon monoxide monitoring system around a pyrolyzer or incinerator can warn both the operator in the control room and workers in the loading area of a system upset.

7.1.4.4 An oxygen meter permanently mounted in a below ground pit can warn an employee of an oxygen deficient atmosphere before he enters the confined space.

7.1.4.5 Direct reading colorimetric tubes Ref **(6)**, offer a convenient means for obtaining a quick reading. Besides their suitability for qualitative checks (see Annex A2), they also provide reasonable quantitative estimates.

7.1.5 *Complex Exposure Potential*:

7.1.5.1 Although much of the sampling effort may involve monitoring for one or two particular contaminants on specific operations, there will be other times when the exposure potential is more complex. Examples of more complex monitoring might include: *1*) where a sludge is handled on site, and there is a chance of spillage and eventual spreading of the debris around the site by vehicular traffic and wind, dust samples will need to be analyzed periodically for heavy metals; *2*) where waste from a polymer plant (in particular one processing nitrile rubber or acrylonitrile butadiene styrene, (ABS) plastic) is handled on site, it may be necessary to devise a sampling protocol which looks for trace quantities of acrylonitrile in an atmosphere dominated by one or two less harmful organic vapors; *3*) where polychlorinated biphenyl, (PCB) vapor can be carried into the atmosphere by methane gas evolving from a closed site, Ref **(7)**, monitoring must cover these and perhaps other compounds; and *4*) where a wide range of similar compounds arise, such as in some organic wastes and landfill gas, the cumulative effect must be estimated rather than the potential effect of individual contaminants.

7.1.6 *Data Storage and Analysis*:

7.1.6.1 The various forms of air monitoring described in 7.1.3, 7.1.4, and 7.1.5 will result in the accumulation of a substantial amount of data by the site operator. The data need to be recorded and catalogued in a manner that provides for ready retrieval and comparison.

7.1.6.2 Store and retrieve data so that the level of airborne contamination can be reviewed over time. In this way seasonal or diurnal trends may be identified.

7.1.6.3 The site operator may want to determine if certain shipments or customers are sending waste material that is difficult to handle.

7.1.7 *Quantitative Considerations*:

7.1.7.1 The premise of most of the discussion of Section 7 is that the site operator has at least some working knowledge of the materials being handled. As stated previously, however, surprises can be expected.

7.1.7.2 An unexpected odor or phase separation may indicate an unknown is present in the waste material.

7.1.7.3 An abnormal reaction in a neutralization process may be a sign that an unexpected volatile is being emitted. Given this reality, even the best run waste site may have to analyze for unknowns in the work atmosphere. For the following reasons it is important to be aware of the qualitative aspects of air monitoring as they are described in 7.2.

7.2 *Remedial Action Site*:

7.2.1 The level of hazard that is found by air monitoring at a remedial action waste site can vary from relatively innocuous to very dangerous. The uncertainty associated with the types and composition of wastes present at these sites complicates virtually every aspect of site cleanup and monitoring. For these reasons a thorough site characterization must be made before work is started to provide data for a site-specific health and safety plan, including subsequent air monitoring requirements.

7.2.2 *Qualitative Assessment*:

7.2.2.1 From an operational viewpoint, a prime difference between a remedial action site and an operating site is the need