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U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 8

STANDARD OPERATING PROCEDURE (SOP)
FOR VIDEO EXPOSURE MONITORING OF ACTIVITIES
POTENTIALLY ASSOCIATED WITH EXPOSURE TO ASBESTOS IN AIR

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REVISION LOG

Revision Date	Reason for Revision
02/28/01	--
03/13/01	Provide greater detail for aerosol monitoring and video production

PROCEDURAL SECTION

1.0 Scope and Applicability

This Standard Operating Procedure (SOP) provides a standardized method for conducting Video Exposure Monitoring of people who are engaged in activities that may lead to exposure to asbestos fibers or other airborne particulate material in air. The method is generally applicable to any routine or special activity being investigated.

2.0 Summary of Method

Video Exposure Monitoring (VEM) is an exposure assessment technique developed by the National Institute for Occupational Safety and Health, Engineering Control Technology Branch (NIOSH 1992). The method allows for the identification and quantitation of worker exposures for specific job tasks. Through this technique, occupational exposures to a variety of contaminants can be more fully characterized than is possible with integrated sampling techniques such as sorbent tubes or filters. In addition to identifying critical tasks contributing to the workers' exposures, the exposure data and work activity video recording can be combined to fully illustrate the impact that these tasks have. The collection and analysis of exposure data using the Video Exposure Monitoring technique requires three major components: 1) a suitable direct reading instrument for measuring and recording exposure concentrations; 2) a video recording system (camcorder) for documenting work activities; and 3) a computer system with video overlay capabilities for analyzing and combining the two different types of data. The overall goal of the Video Exposure Monitoring technique is to determine how a worker's activities affect his or her exposure to hazardous compounds or conditions. The production of the video recording, showing the graphical representation of the exposure concentration, helps to communicate these results. By knowing what job element and activities are contributing most to the worker's exposure, appropriate controls can be implemented to adequately protect the worker.

3.0 Health and Safety Warnings

Asbestos fibers are hazardous to human health when inhaled. Exposure to excessive levels may increase the risk of lung cancer, mesothelioma, and asbestosis. All personnel engaged in VEM of persons engaged in activities that may release asbestos fibers into air must have adequate health and safety training and must wear an appropriate level of personal protective equipment (PPE) as specified in the Health and Safety Plan.

4.0 Cautions

None, refer to Section 3.0.

5.0 Interferences

None.

6.0 Personnel Qualifications

Field personnel engaged in VEM must be trained in the proper use of the direct-reading exposure monitor as well as the video and lighting equipment, and must have adequate health and safety training.

7.0 Apparatus and Equipment

Video Camera

The work activities being monitored using the Video Exposure Monitoring technique are recorded using off-the-shelf video recording equipment such as consumer quality camcorders. Professional quality video recording systems will result in better quality video images; these enhancements are not critical to the success of the technique. The one requirement for the video recording system, both consumer and professional quality, is the ability to display an on-screen clock or time with a resolution of at least one second. This clock or timer display must be recorded on the video tape with the work activity images. To ease the collection of the work activity data, the video camera should be mounted on a tripod if possible. It is also helpful to have a video camera with an LCD display. This allows the camera operator to control what is being recorded without looking into the viewfinder.

Lighting Source

The lighting of the general scene may be ambient light or any other suitable light source that allows clear visualization of the activities of the person being monitored. The light source used for Tyndall lighting may be any high intensity light, preferably with a narrow beam with low divergence.

Direct Reading Exposure Monitor

For aerosols such as asbestos fibers or other airborne dusts, direct reading measurement of exposure is made with a light scattering aerosol photometer. These devices measure the aerosol concentration based upon the amount of light scattered by the aerosol in the sensing chamber of the instrument. For this study, the HazDust II Real-time Personal Dust Monitor, Model HD-

1002 (Environmental Devices Corporation, Haverhill, MA) will be used to measure exposure concentrations. This instrument can be configured with various sampling heads to sample for inhalable, thoracic and respirable aerosols. It contains an internal sampling pump and can be outfitted to collect filter samples for post-collection calibration. The HazDust II is calibrated for Arizona Road Dust, with the instrument output relative to this standard. The monitor has a data logging system for recording the real-time data. This data logging system can then be downloaded to a personal computer for storage and analysis.

Computer System

A personal computer system is used for several different purposes. First, the HazDust II monitor downloads its data to the computer through an RS232 port. The downloading procedure is controlled by the HazComm software supplied with the HazDust II monitor. Once the data are downloaded to the computer, the data can be evaluated and analyzed to determine the contribution of the workers' activities to the overall exposure. This analysis is typically done using a spreadsheet program such as Excel (Microsoft Corp., Redmond, WA). The computer system is also used to combine the video recording of the work activities with the exposure data. The computer is outfitted with a video overlay system which will overlay a graphical representation of the exposure onto the work activity video image. The overlay system to be used in this study is the DeltaScan GL (Vine Micros, Ltd., Margate, Kent, UK). This is an external computer device that interfaces to the computer through the VGA video port. The computer display resolution should be set to 800x600 for proper operation of the DeltaScan. A special computer program has been developed to read the data from the direct reading instrument, and display the data as a graphical representation of the exposure concentration. This program, VEM 3.0, creates the graphical image that is overlaid onto the work activity video by the DeltaScan device.

Filter Cassettes

All samples will be collected on conductive filter holders consisting of 37-mm diameter, three piece filter cassettes. The cassette shall be pre-loaded with a mixed cellulose ester (MCE) filter with pore size 0.8 μ m.

To reduce contamination and to hold the cassette tightly together, seal the crease between the cassette base and the cowl with a shrink band or adhesive tape. If particle deposition on the inside of the cowl is observed, it may be necessary to ground the cowl to reduce static charge. This is done by attaching one end of a length of flexible wire to the plastic cowl with a hose clamp and attaching the other end of the wire to a suitable ground (e.g., a cold water pipe).

Sample Labels

A pre-printed sheet of sample labels (2 identical labels per sample number) is required. One label should be attached to the filter cassette before the sample collection period begins, and the matching label should be attached to the field log book that records relevant data on the sample being collected.

Field Log Book

A field log book is required to record relevant information regarding the VEM activity (e.g., location, time, activity being recorded, unusual conditions or problems, etc.).

8.0 Instrument Preparation/Calibration

Video Camera

Ensure that the video camera has adequate battery power to record for length of time sufficient to document the activity being investigated. Ensure that a fresh video tape is loaded into the camera for each new activity being recorded.

Direct Reading Exposure Monitor

The HazDust II monitor is factory-calibrated. For field operation, the monitor needs to be zeroed, the calibration span checked with a reference scatter, and the sampling pump calibrated. This should be performed at the start of a sampling day, as well as periodically throughout the day (every 2-4 hours). The HazDust II should be zeroed before checking the span or the pump flow rate. A empty filter cassette is connected to the sensor housing, and the pump tube is connected to the cassette. The thoracic sampling inlet is inserted into the sensor housing, and the zero filter is inserted into the sampling inlet. The zeroing procedure of the HazDust II is then started according to the operation manual. Following zeroing, the calibration span of the HazDust II should be checked. The pump tubing is removed from the filter cassette, and the thoracic inlet is removed from the sensor housing. The reference scatter is inserted into the sensor housing and the HazDust II is started with the sampling time set to 1 second. The readout of the instrument should match the "k" value on the reference scatter. Details of this procedure are given in the operation manual of the HazDust II. Next, the pump on the HazDust II should be calibrated. A filter cassette of the same type being used during data collection should be connected to the sensor housing, and the pump tubing connected to the filter cassette. The thoracic sampling inlet is inserted into the sampling head, and the tubing from the calibrator is connected to the inlet. The instrument sample time is set to 1 second and sampling is started. The pump flow rate should be set to 2.0 l/min, and is set by adjusting a potentiometer on the bottom of the HazDust II. Once the flow rate is adjusted properly, instrument sampling is stopped, the calibrator tube is removed, and the inhalable inlet is inserted into the thoracic inlet.

The final items to set on the HazDust II are the sampling inlet and date and time. Details of these procedures are given in the operation manual of the HazDust II monitor. The inlet type used for this study is the inhalable inlet. The internal clock of the HazDust must be synchronized with the clock or time on the video camera system. Synchronizing the clocks allows specific work activities to be matched with the associated exposures. IT IS VITAL THAT THE CLOCKS BE SYNCHRONIZED. FAILURE TO DO SO WILL RESULT IN THE DATA OF MARGINAL VALUE. The clocks are synchronized manually, which with practice, will allow the clocks to be set to within one second of each other.

9.0 Videotape Production

Lighting

Whenever possible, the activity will be videotaped using Tyndall lighting so that a direct visual indication of dust particle exposure can be observed. Use a high-powered narrow beam divergence spotlight in a relatively dark area. Aim the lightbeam across the area where dust will be generated. For best viewing results, videotape at an angle of 10° to 15° from the light source. Use some type of shielding to keep the light beam from interfering with video camera.

Data Collection

The HazDust monitor is fastened to the worker's waist by a belt, and the sampling head is clipped to the worker's collar near the breathing zone with the sampling inlet oriented downward. The sampling head should be fastened securely enough to prevent it from interfering with the work being performed. Data collect begins by starting the HazDust monitor and starting recording on the video camera system. When starting the HazDust II monitor, the sampling time should be set to 1 second. The video camera should be operated to ensure the worker's movements are recorded. It is recommended that the HazDust II monitor be downloaded frequently throughout the sampling day (i.e., every 1-2 hours). This prevents the loss of large quantities of data in the event of instrument failure. The HazDust II is downloaded to a personal computer through a download cable, using the HazComm software. This software saves the exposure data, and allows it to be imported into a spreadsheet program. Details for using this software are given in the HazDust II operation manual.

10.0 Data Analysis and Presentation

After the data have been downloaded and saved by the HazComm software, the data need to be analyzed. Working with the data in a spreadsheet program, activity variables are developed and coded into the dataset. The result is a set of exposure measurements with the corresponding activities. Before analyzing this dataset, the data need to be adjusted for the transportation lag

associated with the transport of the contaminant to the monitor's sensor. The actual source of a worker's exposure is usually at least 2-3 feet from the worker's breathing zone. If the contaminant is release into the air, it may take one to five seconds for the contaminant to reach the sensor and for the sensor to respond. This lag must be estimated by viewing the video recording and tracking the exposures in the data set. When an obvious release of a contaminant is detected on the video recording, the response of the monitor will be offset by the magnitude of the transportation lag. The data set can be adjusted for the transportation lag by moving the exposure data column up in the spreadsheet. For example, if the lag is three seconds, the entire column of exposure data would be moved up three rows, assuming a one second interval between readings. By adjusting for the transportation lag, the activity codes will be matched with the resultant exposure concentrations.

Analysis of the data collected can be very simple, or extremely complex. The NIOSH publication "Analyzing Workplace Exposure Using Direct Reading Instruments and Video Exposure Monitoring Techniques" provides several options for the analysis of this data. At the very least, these data should be analyzed to determine mean exposure concentrations by work activity. This way, the critical work activities contributing most to the worker's overall exposure can be determined.

After evaluating the dataset, portions of the exposure data can be overlaid onto the work activity video to highlight the results of the study. Segments to be overlaid should be kept short, 5 to 10 minutes in duration, and should be produced to demonstrate how specific activities affect the worker's exposure. The exposure data are presented graphically by the VEM 3.0 program, which reads the data copied from the spreadsheet, and displays the data in the form of a moving bar. When using the DeltaScan GL, this graphical representation of the exposure data is overlaid onto the work activity video, and recorded to a second video recording system. When properly synchronized with the exposure dataset, the work activity video will show how the worker's exposure changes with the activities being performed.

QUALITY CONTROL and QUALITY ASSURANCE

Pre-Project Filter ("Lot") Blanks

Before samples are collected, two cassettes from each filter lot of 100 cassettes should be randomly selected and submitted for analysis. The lot blanks will be analyzed for asbestos fibers and other mineralogic materials by the same method as will be used for field samples. The entire batch of cassettes should be rejected if any asbestos fiber is detected on any filter.

Field Blanks

Blank samples are used to determine if any contamination has occurred during sample handling. Prepare two blanks (from the sample lot used for field sampling) at each sampling location (residence). Filter blanks should be taken to a sampling location, prepared there, and remain at the sampling location as long as field samples are collected. Remove the caps on the filter cassette and hold the cassette open for about 30 seconds. Attach and secure a sample seal around each sample cassette in such a way as to assure that the end cap and base plug cannot be removed without destroying the seal. Tape the ends of the seal together since the seal is not long enough to be wrapped end-to-end. Initial and date the seal. Store blanks for shipment with the sample cassettes.

REFERENCES

NIOSH. 1992. Analyzing Workplace Exposures Using Direct Reading Instruments and Video Exposure Monitoring Techniques. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 92-104