

NIOSH MANUAL OF SAMPLING DATA SHEETS

1977 EDITION

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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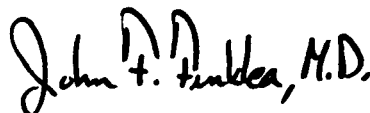
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FOREWORD

The National Institute for Occupational Safety and Health (NIOSH) is engaged in research to identify and evaluate hazards to the American working population. The results of this research are used to develop recommended criteria for the protection of all workers.

In the evaluation of health hazards from toxic and carcinogenic air contaminants, the sampling and analytical method is an important tool. For the industrial hygienist, the manual describes sampling methods for 245 substances. This manual is the only available compendium of such methods. Most of these methods have been recommended to the Occupational Safety and Health Administration (OSHA) for use in their compliance program. I am pleased that this publication makes these methods available for public use.



John F. Finklea, M.D.
Director, National Institute for
Occupational Safety and Health

PREFACE

NIOSH Sampling Data Sheets (SDS's) were originally written as guidelines for OSHA Compliance Safety and Health Officers. Each SDS recommends a sampling procedure for evaluating occupational exposure to toxic air contaminants. With the exception of asbestos and vinyl chloride, occupational exposure to these contaminants is regulated by 29 CFR 1910.1000. Occupational exposure to asbestos is regulated by 29 CFR 1910.1001, and occupational exposure to vinyl chloride is regulated by 29 CFR 1910.1017.

In the Contents, each SDS is identified by a SDS number. Many SDS numbers are prefixed by the letter "S." This identifies SDS's that were produced as part of the Standards Completion Program. After the Contents, the SDS's appear in numerical order. The SDS's prefixed by the letter "S" follow the other SDS's.

On each SDS, the number is followed by two digits after a decimal point. This number indicates the edition of the SDS and increases when significant changes are made in the SDS.

Each SDS is graded according to the quality and extent of the supporting data, as follows:

- A. Recommended - a sampling and analytical method which has been fully evaluated and successfully, collaboratively tested by a selected group of laboratories.
- B. Accepted - a sampling and analytical method which has been subjected to a thorough evaluation procedure in the NIOSH laboratory and is found to be acceptable.
- C. Tentative - a sampling method which is in wide use and which has been adopted or recommended by another Government agency or one of several professional societies.
- D. Operational - a sampling method which has been partially evaluated and shows promise of being found acceptable.
- E. Proposed - a new, untested sampling method.

A method classified as A, or recommended, is a sampling and analytical method that meets all the requirements for a class B method. In addition, this method has been successfully, collaboratively tested. During collaborative testing, ruggedization of the sampling and analytical methods is pursued. A limited number of sampling and analytical methods have been collaboratively tested because of the expense and NIOSH priorities on developing methods.

In order to grade a method as B, accepted, NIOSH must have fully evaluated the method and found it acceptable. Normally, this means that the method will be within $\pm 25\%$ of the true value over the range $1/2$ to 2 times the standard for 95% of the samples. Depending on the nature of the method and the nature of the contaminant, the method must meet additional specifications. For example, the sampling method must collect the contaminant efficiently. The samples must be stable for at least a week. The desorption efficiency of solid sorbents must exceed 0.75. These requirements are intended to make the method usable in the field. A method which meets these criteria in an artificially generated atmosphere stands a good chance of working in the field.

When a sampling and analytical method is recommended by another Federal Agency or a professional society, a Sampling Data Sheet may be written and classified as C, tentative. These methods have not been evaluated by NIOSH. NIOSH is merely adapting another, widely accepted method for its own use. Although the method is expected to be good, the method cannot be considered accepted or recommended until NIOSH establishes the method's accuracy and precision.

Two situations cause Sampling Data Sheets to be written and classified as D, operational. Many times a method has been partially evaluated and it shows potential of having an acceptable level of precision and accuracy. Other program needs or experimental problems may preclude the full development and evaluation of the method. In other cases, a method may have been fully evaluated and found not to meet the requirements for a class B method. Although this method has failed validation, it may have enough quality to be useful. In both situations, the preparation of SDS's reflects the fact that some methods are needed before acceptable methods can be fully developed and evaluated.

Occasionally, NIOSH needs a Sampling Data Sheet immediately. The literature is reviewed, professional judgement is used to select the most appropriate method, and the Sampling Data Sheet is written and graded as E: a new, untested method. This procedure is used only when a method is needed immediately. Although these methods frequently lack good, supporting data, these methods are included in the manual because the distribution of these Sampling Data Sheets cannot be controlled once they leave the Measurements Systems Section. By grading a method as E, misconceptions about the method's quality should be prevented.

Although grades do not appear on some of the SDS's produced under the Standards Completion Program (the "S" numbered SDS's), these methods meet the requirements for a grade B method and are considered as such.

ABSTRACT

This manual is a collection of Sampling Data Sheets (SDS). Each SDS is intended as a guideline for evaluating compliance with a standard that regulates occupational exposure to air contaminants. The SDS's are graded according to the quality and extent of the supporting data.

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Cobalt, Metal Fume and Dust	16
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March 12, 1974

Substance:

Carbon Monoxide

Standard:

29 CFR 1910.93(b), Table G-1 of October 18, 1972

8-hour time-weighted average: 50 ppm

Sampling Equipment:

- (1) CO meter, (Portable, direct-reading) - Follow manufacturer's directions. (Primary Method)
- (2) Certified or NIOSH approved detector tubes and a hand operated pump (not rubber bulb type) may be used for compliance purposes. (Secondary Method)

Analytical Procedure:

- (1) Principle of detection of direct-reading instrument depends on the particular instrument used. Follow manufacturer's instructions.
- (2) Detector tubes are read for length of stain, strokes of pump are noted, and appropriate corrections are made for pressure (or altitude above 5,000 feet (1,500 m). The tubes are not to be used when below 0 degrees F (-18°C) or above 125 degrees F (52°C).

Sampling Period:

- (1) Depends on portable instrument used.
- (2) Detector tubes: direct-reading, length-of-stain detector tubes (certified or NIOSH approved) may be used for compliance purposes, if at least one sample per hour is taken per exposed worker or close group of workers. In an 8-hour day more frequent sampling per hour is preferred, especially for exposures over 50 ppm. Eight different samplings, one per hour, is considered the minimum acceptable number.

Sampling Data Sheet

#2.02

Class C

September 4, 1975

Substance:

Asbestos

Standard:

8-hour time-weighted average: 5 fibers greater than 5 micrometers long per cubic centimeter. After July 1, 1976, this standard is reduced to 2 fibers per cubic centimeter.

Ceiling: 10 fibers greater than 5 micrometers long per cubic centimeter.

Reference: 29 CFR 1910.93a

Analytical Method:

The fibers are collected on filters and counted under a microscope. The filters are mounted on a clean slide and cleared. The fibers are counted with a microscope using 400-450 magnification and phase contrast microscopy.

Sampling Equipment:

Personal Sampler Pump: A calibrated pump whose flow rate can be determined to an accuracy of $\pm 5\%$. The pump must be calibrated with a representative filter and filter holder in line.

Filter Holder: 3-piece, 37-mm filter holder and back-up pad.

Filter: 0.8-micrometer pore size mixed cellulose membrane filter.

Sample Size:

The recommended volume of air sampled depends on the asbestos fiber concentration and the microscope used to count the fibers. If more than 20 fibers are present in a single field, too much sample has been collected for an accurate count. To minimize counting error, the average number of fibers counted per field depends upon the microscope's field area, which is usually between 0.003 and 0.007 mm², and the asbestos concentration. The following table estimates recommended sampling times at the recommended flow rate of 1.5 lpm:

Recommended Sampling Time in Minutes

Microscope Field Area (mm ²)	.003	.005	.007
Suspected Concentration 10 fibers/cc	57	34	24
5	75	68	48
2	95	85	85

Sampling Procedure:

1. Assemble the filter and three-piece filter holder and close firmly to insure that the center ring seals the edge of the filter. Examine the filter holder for a good filter seal. If the filter holder will not seal tightly, discard it.
2. Attach the filter holder to the sampling pump with a 1/4 inch diameter, 3-foot piece of tubing, and an adaptor. The adaptor is used to provide a tight connection between the filter holder and tubing.
3. Remove the face cap from the filter holder and clip the filter holder to the worker's lapel. The filter's open face should be pointed down.
4. Turn the pump on and begin sample collection. Periodically check the pump's flow rate and readjust it if necessary.
5. Terminate sampling at the predetermined time and note the sample's flow rate, collection time, ambient temperature, and pressure. If a pressure reading is unavailable, record the elevation.
6. Place the face cap back in the filter holder and place the small plugs in both the inlet and outlet of the filter holder.
7. With each batch of samples, submit one filter subjected to exactly the same handling except that no air is drawn through it. Label it as a blank.

Special Considerations:

1. A high fiber count on blank filters reduces the accuracy and precision of the method.

Data Sheet #2.02

2. The filters on which the samples are collected and the blank filters should all come from the same batch since the background dust count will vary from batch to batch.

Shipping Instructions:

Ship in a container designed to prevent damage during transit.

References:

Leidel, N., "Optimum Sampling Times for Airborne Asbestos Fibers,"
TR-72, NIOSH Engineering Branch, November 1972, 6 pp.

September 5, 1975

Substance:

Crystalline Silica

Standard:

Form	8-Hour time-weighted average
Quartz (respirable):	$\frac{10 \text{ mg/m}^3}{\% \text{ SiO}_2 + 2}$
Cristabolite:	One half the value for quartz
Tridymite:	One half the value for quartz

Reference: 29 CFR 1910.93

Analytical Method:

The samples are collected on preweighed filters. After collection the filters are reweighed. The percent free silica is determined by using a colormetric wet chemical method. The minimum detectable amount by this method is 0.1 mg/filter. The relative presence of the different species of free silica can be determined by x-ray diffraction.

Sampling Equipment:

Pump: A calibrated personal sampler pump whose flow rate can be determined to an accuracy of $\pm 5\%$. Since the standard is written on respirable dust, the pump must have a pulsation dampener and be part of a unit certified under 30 CFR 74. The pump must have been calibrated with an assembled respirable dust sampling head in place.

Filter Holder: A 2-piece, 37-mm filter holder held together by tape or shrinking band.

Filter: A 37-mm, 5-micrometer pore size polyvinyl chloride filter. These filters must be hydrophobic, silica free, and preweighed to at least the nearest 0.01 mg. The filter is mounted on a cellulose back-up pad.

Data Sheet #3.02

Cyclone: 10-mm nylon cyclone is used to separate respirable from nonrespirable dust. Its outlet is connected to the filter holder inlet.

Sampling Head Assembly: This device must hold the filter holder and cyclone together so that air enters only at the cyclone inlet.

Sample Size:

A maximum of 5 milligrams and a minimum of 0.5 milligrams of total particulate should be collected. A direct-reading mass monitor can be helpful in establishing sample volume. Because the respirable dust is being sampled, a sample flow rate of 1.7 liters per minute must be maintained.

Sampling Procedure:

1. Assemble the filter, back-up pad, and two-piece filter cassette and close firmly to insure that the face cap seals against the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. This filter holder should be held together by tape or a shrinking band.
2. Assemble the filter holder, cyclone, and sampling head. The sampling head rigidly holds together the cyclone and filter holder. The air outlet of this assembly is connected to the pump by a flexible piece of tubing.
3. Clip the sampling head to the worker's lapel.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the ambient temperature and pressure. If ambient pressure is not available, record the elevation. If the personal sampler pump is used, position the middle of the rotameter ball to the proper calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists in the air, the pump flow rate should be checked and readjusted as needed. If unable to readjust, terminate sampling.
5. After sampling, place small plugs back in cassette's inlet and outlet.
6. Blank: With each batch of samples submit one filter which is subjected to exactly the same handling as for the samples, except that no air is drawn through it. Label this as a blank.

Data Sheet #3.02

Special Considerations:

1. Filters stored in filter holders molded from Tenite plastic, which is a cellulose-acetate-butyrate, have shown weight gains. Therefore, the filter holder must not be molded from Tenite plastic.
2. The filter used must be free of silica. The Gelman VM-1 Filters are unacceptable because of a high background silica.
3. The 10-mm nylon cyclone interior must be inspected before use. The cyclone must be cleared before use to prevent reentrainment of collected dust. If the interior of the cyclone is visibly scored, the cyclone should be discarded since its size-selective characteristics may be changed.

Shipping Instructions:

Ship in a container designed to prevent damage during transit.

Sampling Data Sheet #5.01 Class D

March 11, 1974

Substance:

Cotton Dust (raw)

Standard:

29 CFR 1910.93(b), Table G-1 of October 18, 1972

8-hour time-weighted average: 1 mg/m^3

Sampling Equipment - Personal Samplers:

Cotton is to be determined primarily with the personal sampler attached to the workman's clothing with the face of the filter pointing down. The filter should not be covered. Our experience is that at least a 4-hour and preferably a 6-hour sample (at 1.5 lpm) is required in a textile plant opening or carding area to obtain reliable results. A preweighed filter is used and reweighed after collection. There is no ceiling or any limit on excursions. Because of the nature of both the sampling method and the development of byssinosis, it is neither desirable nor possible to get grab samples.

Sampling Equipment - General Work Area:

Preweighed Gelman VM-1 or MSA type FWS-B five-micron pore size filter or equivalent in 3-piece cassette, located in the general work area with the cap removed and the filter facing down. Suction provided by a pump with a 7.4 lpm critical orifice. The vacuum relief valve should be adjusted to maintain 15 in Hg suction. Sampling rate: 7.4 lpm for recommended minimum of 60 minutes. Longer period samples up to full shift are preferable. Filters should not be so heavily loaded that the sample is dislodged in transit.

Blanks:

With each batch of samples collected, two additional filters should be subjected to exactly the same handling except that no air is drawn through them. These should be used as blanks.

Shipping:

The cassettes in which samples are collected should be shipped in a suitable container designed to prevent damage in transit.

April 23, 1975

Substance:

Solvent vapors (sampled by adsorption on activated charcoal).

Standard:

Substance	8-hour time-weighted average (ppm)	Acceptable ceiling (ppm)	Acceptable peak (ppm)	Sample size (liters)
1. Benzene	10	25	50(10 min)	10
2. Carbon tetra-chloride	10	25	200 (5 min in 4 hrs)	10
3. Chloroform	50	-	-	10
4. p-Dioxane	100	-	-	10
5. Ethylene dichloride	50	100	200 (5 min in 3 hrs)	10
6. Methyl chloroform	350	-	-	5
7. Methyl ethyl ketone (2-Butanone)	200	-	-	10
8. Styrene	100	200	600 (5 min in 3 hrs)	5
9. Tetrachloro-ethylene	100	200	500 (10 min)	10
10. Toluene	200	300	-	10
11. 1,1,2-Trichloro-ethane	10	-	300 (5 min in 3 hrs)	10
12. Trichloroethylene	100	200	-	10
13. Xylene	100	-	-	10

Reference: 29 CFR 1910.93

Data Sheet #6.02

Analytical Method:

A known volume of air is drawn through a charcoal tube to trap the contaminant vapors present. The analyte is desorbed from the charcoal with carbon disulfide. The contaminants present are separated and analyzed using a gas chromatograph with a flame ionization detector.

Sampling Equipment:

A calibrated, personal sampling pump, whose flow rate at the recommended sampling rate can be determined accurately, within $\pm 5\%$, draws air through a charcoal tube. The glass tube has an inside diameter of 4-mm. The tube contains two sections of 20/40 mesh activated charcoal. The first section contains 100 mg of charcoal while the backup section contains 50 mg. The two sections are separated with a 3-mm piece of urethane foam. The pump must be calibrated with a representative charcoal tube in line.

Sample Size :

Recommended sample sizes are given in the preceding table. A sampling rate of 0.2 liters per minute or less is recommended. When alcohols, fluorocarbons, or other substances with standards greater than 500 ppm are present and likely to be adsorbed on to the charcoal, sample volume should not exceed one liter in the absence of recommended sample volumes.

Since most organic vapors and gases are adsorbed by activated charcoal, the effective adsorption capacity of contaminants present is reduced. Therefore, the recommended sample volume is reduced to the lowest recommended sample volume among the contaminants present. In the presence of high concentration of several contaminants, the sample volume should be reduced. The breakthrough data must be consulted to select a sample size.

Sampling Procedure :

1. Immediately before sampling, the ends of the tube should be broken so as to provide a minimum opening one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a back-up and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of contaminant.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.

Data Sheet #6.02

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record initial and final counter readings. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. At least one charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport), except for the taking of an air sample. This tube should be labeled as a blank. If a large number of samples are taken, submit one blank per 20 samples.

Special Consideration:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, use should not exceed eight hours of continuous operation.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively. An increase in relative humidity from 7% to 80% caused a 50% reduction in breakthrough volume for toluene.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Samples :

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes. The cap should be tightened and taped.

Shipping Instructions :

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

September 10, 1975

Substance :

Coal Tar Pitch Volatiles

Standard :

8-hour time-weighted average: 0.2 mg/m³

Reference: 29 CFR 1910.93

Analytical Method :

After the sample is collected, the filters are weighed, and the benzene solubles are removed by extraction with hot benzene. The filters are reweighed and the weight lost is the mass of benzene soluble material. The accuracy of this method is: ± 0.1 mg/filter.

Sampling Equipment :

Pump: A calibrated personal sampler pump whose flow rate can be set at 1.5 liters per minute with an accuracy of $\pm 5\%$. The pump must be calibrated with a representative filter and filter-holder in line.

Filter: A 0.8-micrometer pore size, 37-mm diameter silver membrane filter is preceded by a 37-mm diameter glass fiber filter without organic binder. The glass fiber filter must be at least 99% efficient as determined by the di-octyl phthalate penetration test. The filter holder must be held together by tape or shrinkable band.

Filter Holder: A 37-mm filter holder that is connected to the pump by flexible tubing. The filter holder must be held together by tape or shrinkable band.

Sample Size :

To evaluate an exposure at the standard, a minimum sample time of eight hours is required with a flow rate of 1.5 liters per minute.

Sampling Procedure :

1. Assemble the filter holder, filters, and backup pad. The glass fiber filter is mounted on top of the silver membrane filter. Close firmly to ensure that the center ring seals the edge of the filter. If the filter holder will not seal tightly, discard it. The filter holder should be held together by tape or a shrinking band.

Data Sheet #8.02

2. Remove the cassette plugs and attach to personal sampling pump tubing. An adaptor is needed to provide a tight connector between the tubing and cassette.
3. Clip the cassette to the worker's lapel.
4. Set the flow rate to 1.5-liters per minute as accurately as possible using the manufacturer's directions. Record the ambient temperature and pressure. If ambient pressure is not available, record the elevation. If the personal sampler pump is used, position the middle of the rotameter ball to the proper calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other mists in the air, the pump flow rate should be checked and readjusted as needed. If unable to readjust, terminate sampling.
5. After sampling, place small plugs in the cassette's inlet and outlet.
6. With each batch of samples, submit one representative filter holder containing a fiber glass filter and a silver membrane filter. This cassette is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

1. The filter holders must not be molded from Tenite plastic. Filters stored in filter holders molded from Tenite plastic have had systematic weight gains. Apparently, the plastic is outgassing and collecting on the filter. (1)
2. If samples are stored, store in a refrigerator below a temperature of 4 °C.

Shipping Instructions:

To prevent the photo-oxidation of the samples, protect the samples from light. Ship promptly in a light-proof container that will not be damaged during transit. Do not ship with bulk solvent samples.

References:

1. Seim et al, " Determination of Pitch Volatiles in Airborne Particulates," Amer. Ind. Hyg. Assoc. J. 35:11 (1974) p. 721.
2. Schulte et al, Report on Analytical Methods Used in a Coke Oven Effluent Study, National Institute for Occupational Safety and Health, Cincinnati, 1974.

March 11, 1974

Substance:

Beryllium and beryllium compounds

Standard:

29 CFR 1910.93(b), Table G-2 of October 18, 1972

8-hour time-weighted average: $2 \mu\text{g}/\text{m}^3$

Ceiling: $5 \mu\text{g}/\text{m}^3$

Peak: $25 \mu\text{g}/\text{m}^3$ (30 min)

Analytical Method:

Atomic absorption

Lower working limit: $0.5 \mu\text{g}/\text{filter}$

Sampling Equipment:

A personal sampler pump is used to pull air through a 37-mm, 3-piece filter holder. The contaminant is collected on a 0.8-micrometer pore size mixed cellulose ester filter (37 mm in diameter). The filter holder is held together by tape or a shrinking band. If the middle piece of the three-piece holder does not fit snugly into the bottom piece of the filter holder, the contaminant will leak around the filter. A piece of flexible tubing is used to connect the filter holder to the pump. Sample at a flow rate of 1.5 liters per minute with face cap on and small plugs removed. After sampling, replace small plugs.

Sample Size:

For peak limit evaluation, use 30-minute samples. Minimum of 180 minutes for measurement of $2 \mu\text{g}/\text{m}^3$ limit. Longer samples up to full shift are preferred. Sampler battery recharge required after 4 hours.

Blank:

With each batch of samples, submit one filter which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Data Sheet #9.01

Shipping:

The cassettes in which the samples are collected should be shipped in a suitable container designed to prevent damage in transit.

Sampling Data Sheet # 10.02 Class D

September 30, 1975

Substance:

Zinc Oxide Fume

Standard:

8-hour time-weighted average; 5 mg/m³

Reference: 29 CFR 1910.93

Analytical Method:

After air samples are collected on filters, the amount of zinc oxide is determined by X-ray diffraction. The filter is scanned by X-ray diffraction; peak intensities are determined; and the amount of zinc oxide is read from a calibration curve.

Interferences:

Some of the contaminants generated during wet-hot dip galvanizing may interfere with the analysis. These compounds have been tentatively identified as: α -Fe₂O₃, (NH₄)₃ ZnCl₅, (NH₄)₂ ZnSO₄·6H₂O, Zn, Zn(NH₃)₂ Cl₂, (NH₄)₂ ZnCl₄, and Zn(NH₃)₂ Cl₂.

Sampling Equipment:

Pump: A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm$ 5% at the recommended flow rate. The pump must have been calibrated with a representative filter holder and filter in line.

Filter: A 25-mm diameter, 0.8-micrometer pore size filter composed of a copolymer of acrylonitrile and polyvinyl chloride. The filter must not scatter X-rays and must be inert to isopropyl alcohol.

Filter Holder: A 25-mm diameter, closed-face filter holder which is connected to the pump by flexible tubing. The filter holder must support the filter and seal the edges of the filter.

Sample Size and Flow Rate:

The filter loading must not exceed 2.0 milligrams of total particulate. Sample at a flow rate of 1.5 lpm for a maximum of 4 hours. Evaluation of the standard will require sequential sampling. A direct-reading mass monitor would be helpful in establishing sampling times.

Data Sheet #10.02

Sampling Procedure:

1. Assemble the filter and filter holder. Examine the holder for a good filter seal. If the filter holder will not seal tightly, it should be discarded. Tape is placed over the outlet and inlet of the filter holder.
2. Remove tape and attach to personal sampling pump tubing.
3. Clip the cassette to the worker's lapel.
4. Set the flow rate to 1.5 liters per minute as accurately as possible using the manufacturer's directions. Record the ambient temperature and pressure. If ambient pressure is not available, record the elevation. If the personal sampler pump is used, position the middle of the rotameter ball to the proper calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other mists in the air, the pump flow rate should be checked and readjusted as needed. If unable to readjust, terminate sampling.
5. After sampling, cover the filter holder's inlet and outlet with tape or plugs (if available).
6. Blank: With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

1. When the mass of the total particulate collected exceeds two milligrams, the analytical method is not sensitive to all the zinc oxide collected. This will bias the sampling and analytical method.
2. Since other contaminants may interfere with the analysis, report and record the presence of other contaminants and the nature of the workplace.

Shipping Instructions:

The cassettes which contain the samples are shipped in a suitable container that will prevent damage during transit.

March 11, 1974

Substance:

Silver, metal and soluble compounds

Standard:

29 CFR 1910.93(a), Table G-1 of October 18, 1972

8-hour time-weighted average: 0.01 mg/m^3

Sampling Equipment:

A personal sampler pump is used to pull air through a 37-mm, 3-piece filter holder. The contaminant is collected on a 0.8-micrometer pore size mixed cellulose ester filter (37 mm in diameter). The filter holder is held together by tape or a shrinking band. If the middle piece of the three-piece holder does not fit snugly into the bottom piece of the filter holder, the contaminant will leak around the filter. A piece of flexible tubing is used to connect the filter holder to the pump. Sample at a flow rate of 1.5-liters per minute with face cap on and small plugs removed. After sampling, replace the small plugs.

Sample Size:

A minimum sampling period of 30 minutes is required, and longer periods, up to a full shift, are preferred for evaluation of the 8-hour average limit. Sampler battery recharge required after 4 hours.

Blank:

With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Shipping:

The cassettes in which the samples are collected should be shipped in a suitable container designed to prevent damage in transit.

March 11, 1974

Substance:

Copper

Standard:

29 CFR 1910.93(a), Table G-1 of October 18, 1972

Fume: 8-hour time-weighted average: 0.1 mg/m^3

Dusts and mists: 8-hour average: 1.0 mg/m^3

Analytical Method:

Atomic absorption

Lower working limit: $1.0 \text{ } \mu\text{g/filter}$

Sampling Equipment:

A personal sampler pump is used to pull air through a 37-mm, 3-piece filter holder. The contaminant is collected on a 0.8-micrometer pore size mixed cellulose ester filter (37 mm in diameter). The filter holder is held together by tape or a shrinking band. If the middle piece of the three-piece holder does not fit snugly into the bottom piece of the filter holder, the contaminant will leak around the filter. A piece of flexible tubing is used to connect the filter holder to the pump. Sample at a flow rate of 1.5 liters per minute with face cap on and small plugs removed. After sampling, replace small plugs.

Sample Size:

A minimum sampling period of 15 minutes is required, and longer periods, up to full shift, are preferred. Sampler battery recharge required after 4 hours.

Blank:

With each batch of samples, submit one filter which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Shipping:

The cassettes in which the samples are collected should be shipped in a suitable container designed to prevent damage in transit.

Sampling Data Sheets #16.01 Class E

March 11, 1974

Substance:

Cobalt, metal fume and dust.

Standard:

29 CFR 1910.93(a), Table G-1 of October 18, 1972.

8-hour average: 0.1 mg/m^3

Analytical Method:

Atomic absorption

Detection limit: $0.1 \text{ } \mu\text{g}/\text{filter}$

Sampling Equipment:

A personal sampler pump is used to pull air through a 37-mm, 3-piece filter holder. The contaminant is collected on a 0.8-micrometer pore size mixed cellulose ester filter (37 mm in diameter). The filter holder is held together by tape or a shrinking band. If the middle piece of the three-piece holder does not fit snugly into the bottom piece of the filter holder, the contaminant will leak around the filter. A piece of flexible tubing is used to connect the filter holder to the pump. Sample at a flow rate of 1.5 liters per minute with face cap on and small plugs removed. After sampling, replace small plugs.

Sample Size:

A minimum sampling period of 15 minutes is required, and longer periods, up to a full shift, are preferred. Sampler battery recharge required after 4 hours.

Blank:

With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Shipping:

The cassettes in which the samples are collected should be shipped in a suitable container designed to prevent damage in transit.

March 11, 1974

Substance:

Carbon Disulfide

Standard:

29 CFR 1910.93(b), Table G-2 of October 18, 1972

8-hour time-weighted average: 20 ppm

Ceiling 30 ppm

Peak: 100 ppm (30 minutes maximum duration)

Sampling Equipment:

A calibrated personal sampling pump plus organic vapor charcoal tubes. Sampling rate, 0.05 - 1.0 lpm.

Sample Size:

10 liters

Analytical Method:

Carbon disulfide is desorbed off the charcoal with benzene and analyzed using a gas chromatograph with a sulfur detector.

Minimum to be reported:

1.0 ppm (3.0 mg/m³)

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately 2 mm in diameter at each end.
2. The smaller section of charcoal is used as a back-up and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling.

Data Sheet #17.01

3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. If the low flow rate pump (50-200 cc/min) is used, set the approximate flow rate and record the initial reading on the counter and, after sampling, record the final counter number. Sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the personal sampling pumps are used, care should be taken to position the middle of the rotameter ball to the 1.0 lpm calibration mark.
5. The charcoal tubes must be capped with the supplied plastic caps immediately after sampling. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes, except no sample is taken. The tube ends are broken. Then the sample is immediately sealed and shipped with the rest of the tubes. This tube should be labelled as a blank.

Special Considerations:

1. High humidity does not present problems in sampling by this method, but the presence of airborne water in liquid form does. Where two or more solvents are known or suspected to be present in air, such information, including their suspected identities, should be transmitted with the sample, since with differences in polarity, one may displace another from the charcoal.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than ten charcoal tube samples should be taken without fully recharging the battery (applicable for gravimetric, dust personal sampling pumps)

Bulk Samples:

Samples of carbon disulfide (the bulk liquid from which the vapors are originating) should be submitted to the laboratory in containers furnished for such purposes by NIOSH. The containers must be labelled with the source.

Shipping Instructions:

Never transport, mail, or ship the liquid bulk samples in the same container as the sample or blank tubes.

Data Sheet #17.01

Application of Method:

Concentrations lower than the minimum to be reported concentration will customarily be reported merely as "less than." This will expedite rapid reporting of results. For compliance purposes, more precise information would usually not be necessary. If there are unusual circumstances requiring such information, special arrangements can be made for reporting smaller concentrations.

Accuracy:

Although the personal sampler pump is the preferred method of measuring worker exposure, the present gravimetric dust pumps were not designed for use with charcoal tubes and a sample flow rate error of up to 15% may occur. Analytical error is typically a maximum of 10% and a sampling error of up to 15% may occur if the pumps are not calibrated with a charcoal tube ahead of the pump.

Sampling Data Sheet #18.01 Class D

March 11, 1974

Substance:

Toluene-2,4-Diisocyanate (TDI)

Standard:

29 CFR 1910.93(a), Table G-1 of October 18, 1972

Ceiling value: 0.02 ppm

Sampling Equipment:

Personal sampling pump and one midget impinger containing 15 ml of absorbing solution. The absorbing solution will be provided by NIOSH and is prepared according to the Marcali method. Sample at 1.0 liter per minute for a period of 20 to 30 minutes.

Analytical Method:

Colormetric

Sensitivity: for 20 minutes sample 0.007 ppm
 for 30 minutes sample 0.0047 ppm

Shipping:

After sampling, remove the glass stopper and impinger stem from the impinger bottle. Tap the stem gently against the side of the bottle to remove as much of the sampling solution as possible. Wash the stem with a small amount of unused absorbing solution from a wash bottle and add the wash to the impinger. Stopper the impinger tightly with the plastic caps provided by NIOSH and return the impinger samples to the analytical laboratory in the special impinger shipping containers designed by NIOSH. Do not allow any of the sample to come in contact with rubber.

Reference:

1. Marcali, Kalman. "Microdetermination of Toluenediisocyanates," Analytical Chemistry, Vol. 29, pg. 552, April 1957.

March 11, 1974

Substance:

Sulfur Dioxide

Standard:

29 CFR 1910.93(a), Table G-1 of October 18, 1972

8-hour time-weighted average: 5 ppm

Sampling Equipment:

A calibrated personal sampling pump (range of 0 to 2 lpm), a midjet impinger containing 15 ml of 0.3 N hydrogen peroxide absorbing solution, and a 0.8-micrometer diameter pore size cellulose membrane filter with filter holder.

Sampling Procedure:

1. The filter is placed upstream of the impinger to collect any sulfuric acid mist or other airborne particulate sulfates prior to the air passing through the impinger.
2. The filter holder is connected to the impinger inlet by a piece of Tygon tubing as short as possible.
3. The impinger outlet is connected to the personal sampling pump inlet by a piece of tubing of convenient length, but not in excess of three feet.
4. The filter and impinger assembly is attached to the worker's clothing so as to sample from the worker's breathing zone.
5. The sample is collected at a rate of 1 to 2 liters per minute for an appropriate length of time to attain a 100 liters air sample. If SO_2 concentrations greater than 100 milligrams per cubic meter of ²air are expected, a smaller air volume should be sampled.

Analytical Method:

The SO_2 is converted to sulfate in the absorbing solution. The sulfate is titrated with barium perchlorate "....using Thorin as an indicator".

Data Sheet #19.01

Range and sensitivity:

The useful range for this method is 0.01 mg to 5 mg of SO₂ per sample.

Blank:

With each group of samples submitted for analysis, submit one filter and impinger which are subjected to exactly the same handling (filter with holder, impinger with solution added) except that no air is drawn through these devices. Label these "Blank".

Shipping:

After sampling, remove the glass stopper and impinger stem from the impinger bottle. Tap the stem gently against the inside wall of the impinger bottle to recover as much of the sampling solution as possible. Wash the stem with a small amount of unused absorbing solution from a wash bottle, adding the wash to the impinger. Stopper impinger tightly with plastic caps provided by NIOSH and return the impinger samples to the analytical laboratory in the special impinger shipping containers designed by NIOSH. Be sure that the impinger bottles are sealed very tightly to prevent leakage and subsequent loss of samples.

References:

1. Fritz, J.S., and S.S. Yamamura, Anal. Chem., 27, 1461. (1955).

March 11, 1974

Substance:

Total Mercury (organic and metallic mercury vapor) in air.

Standard:

29 CFR 1910.93(b), Table G-2, October 18, 1972

8-hour time-weighted average: 0.1 mg/m^3

Sampling Equipment:

1. A calibrated personal sampler pump (the small charcoal tube personal sampler pump with a flow range of 50-200 cc/min).
2. A tandem sampling tube for mercury, containing silvered Chromosorb P and Carbosieve B (Ref. 1).
3. Portable mercury vapor meter (J.W. Model MV-2, Mercury Vapor Detector or equivalent).

Sampling Procedure:

1. Screen the air in the area to be sampled with the portable mercury vapor meter to obtain an estimate of the mercury concentration prior to sampling with the tandem sampling tube.
2. Immediately before sampling with the tube, the ends of the tube should be broken so as to provide an opening at least 2 mm in diameter at each end.
3. The tube is inserted firmly into the tube holder to prevent leaks, or is connected by a piece of Tygon tubing to the pump inlet. The tube should be placed in a vertical position during sampling.
4. Air being sampled should not be passed through any hose or tubing before entering the tandem sampling tube.
5. To determine the flow rate and sampling time required to obtain a time-weighted average (TWA) over an eight-hour day, follow these guidelines:

Data Sheet #20.01

- a. If the preliminary indication of mercury concentration, as determined by the portable mercury meter, shows a concentration that is greater than the TLV concentration (0.1 mg/m^3), then the sample should be taken at 50 cc/min for no longer than one hour. A TWA can be determined by taking eight one-hour samples.
- b. If the preliminary indication shows a mercury concentration of 0.1 mg/m^3 or less, then the sample should be taken at 50 cc/min for no longer than four hours. A TWA can be determined by taking two four-hour samples.
- c. The total sample volume of air should be recorded. After sampling, the tubes should be capped immediately with supplied plastic caps.

Analytical Method:

The collected mercury is released from the two sections of the tubes, at different times, by heating the sections to several hundred degrees centigrade. The thermally desorbed mercury is analyzed by cold vapor atomic absorption.

Range and Sensitivity:

The detection limit by the cold vapor atomic absorption method of analysis is lower than ten nanograms of mercury per sample.

The useful range of the cold vapor atomic absorption analytical method extends from less than ten nanograms to about one microgram of mercury per sample. Samples analyzed by this method can be recollected for repeated analysis. If the total quantity of mercury in a given sample exceeds the analytical range of this method, an alternative method of analysis will be used.

Interferences:

Chlorine and sulfur compounds (especially SO_2) act as poisoning agents of the silvered Chromosorb P and thus will give erroneously low readings.

Blank:

One tandem sampling tube is to be handled in the same manner as the sample tubes (break ends, cap, and ship) except that no air is sampled through this tube. This tube should be labelled as a "blank" and shipped to the analytical laboratory with each group of samples.

Data Sheet #20.01

Shipping:

The tubes should be wrapped with cushioning material to prevent breakage during transit. The tubes may be shipped to the analytical laboratory in standard mailing tubes. Never ship mercury-containing liquids or dust samples in the same container with the tubes.

References:

1. Campbell, Evan E. et.al, Quarterly Report to NIOSH on LASL Project R-060, Los Alamos Scientific Laboratory, Los Alamos, New Mexico. July 1973.

March 11, 1974

Substance:

Organophosphorus Pesticides

Standard:

29 CFR 1910.93(a), Table G-1 of October 18, 197229 CFR 1910.267 (a), June 29, 1973

Substance:

Azinphosmethyl (Guthion)	0.2
Carbonphenothion (trithion)	-
Demeton (Systox)	0.1
Diazinon	0.1
Dimethoate (Cygon)	-
Dioxathion (Delnav)	-
Disulfoton (DiSyston)	-
EPN	0.5
Ethion	-
Imidan (Prolate)	-
Malathion	15.0
Methyl parathion	-
Mevinphos (Phosdrin)	0.1
Monocrotophos (Azodrin)	-
Naled (Dibrom)	-
Oxydemetonmethyl (Meta-Systox R)	-
Parathion	0.1
Phosphamidon (Dimecron)	-
Phosalone (Zolone)	-
TEPP	0.05
Trichlorfon (Dylox)	-

Sampling Equipment:

A calibrated personal pump (range of 0 to 2 lpm), a midget impinger containing 15 ml of pesticide grade ethylene glycol (1), and a 0.8-micrometer diameter pore size cellulose membrane filter with filter holder.

(Note: Pesticide grade ethylene glycol must be obtained from the Salt Lake City Analytical Services Laboratory along with chemically cleaned glass impingers which are free from phosphate detergent residues).

Data Sheet #21.01

Sampling Procedure:

1. The filter is placed upstream of the impinger to collect any of the pesticides in aerosol form such as mists, dusts, or inert solid particulates containing absorbed or adsorbed pesticides.
(A cellulose back-up pad should be used with the filter)
2. The filter holder is connected to the impinger inlet by a piece of Tygon tubing as short in length as possible.
3. The impinger outlet is connected to the personal sampler pump inlet by a piece of tubing of convenient length, but not in excess of three feet.
(If splash-over of liquid into the personal sampler pump occurs, an empty impinger or an impinger containing glass wool can be connected between the impinger of ethylene glycol and personal sampling pump to serve as a trap. If a significant amount of liquid collects in the trap, it should also be submitted for analysis.)
4. The filter and impinger assembly is attached to the worker's clothing so as to sample from the worker's breathing zone.
5. The sample should be collected at a rate of one liter per minute.
(Higher flow rates increase the splash-over problem and raise the resistances of the collection devices to an intolerable level.)
6. The sampling time at one lpm can be varied between 50 minutes and 4 hours, as desired. A 50 liter sample is necessary to measure one twentieth of the standard for parathion.

Analytical Method:

Gas chromatography will be used to separate various compounds in order to achieve the necessary specificity. The analytical instrument will employ a flame photometric detector for phosphorus. An electron capture detector may also be used at times. (2)

Range and Sensitivity:

A fifty liter air sample will provide a sufficient amount of collected pesticide (in terms of parathion) to measure an air concentration of five micrograms per cubic meter (or one twentieth of the 0.1 mg/m^3 standard for parathion).

Lower air concentrations may be measured by sampling for proportionately longer times. The upper limit of the measurable range for the method is essentially limited only by the capacity of the absorbing solution to collect the pesticide. It is recommended that air samples not exceed 240 liters (4 hours at one lpm) in order to prevent exceeding the collection capacity of the absorbing solution.

Data Sheet #21.01

Blank:

With each group of samples submitted for analysis, submit one filter and impinger which are subjected to exactly the same handling (filter with holder, impinger with absorbing liquid added) except that no air is drawn through them.

Shipping:

After sampling, remove the glass stopper and impinger stem from the impinger bottle. Tap the stem gently against the inside wall of the impinger bottle to recover as much of the sampling solution as possible. Wash the stem with a small amount of unused absorbing liquid from a wash bottle, adding the wash to the impinger. Stopper the impinger tightly with plastic caps provided by NIOSH and return the impinger samples to the analytical laboratory in the special impinger shipping containers designed by NIOSH. Be sure that the impinger bottles are sealed very tightly to prevent leakage and subsequent loss of samples.

If leakage persists during shipment in spite of all efforts to seal the impinger bottles tightly, the following procedure should be used. After sampling, remove the glass stopper and impinger stem and wash the stem with unused absorbing liquid as above. However, add the wash and the absorbing liquid from the impinger bottle to a small chemically cleaned glass vial with a Teflon-lined screw-on top. Wash the impinger bottle also with a small amount of unused absorbing liquid and add this wash to the vial. If the volume of solution exceeds the capacity of the vial, two vials may be used. However, mark both vials to indicate that they are part of the same sample. Ship the impingers, reagent bottles, etc., back to the analytical lab in the impinger shipping cases provided, in order to be cleaned properly. Return the glass vials in standard mailing tubes with some sort of cushioning.

Cap the inlet and outlet of the filter holder with plastic caps. Ship the filters and holders back to the analytical lab using the standard filter shipping container.

Note:

Although this sampling and/or analytical method is used by EPA, FDA, and others, its use for occupational health purposes must be considered tentative pending further evaluation by NIOSH.

References:

1. Miles, James W., Laurice E. Fetzner, and George W. Pearce, "Collection and Determination of Trace Quantities of Pesticides in Air", Env. Sci. & Tech. 420 (1970).

Data Sheet #21.01

2. "Analysis of Pesticide Residues in Human and Environmental Samples",
edited by J.F. Thompson, EPA Manual of Analytical Methods, EPA, Perrine,
Florida (November, 1972).

March 11, 1974

Substance:

Zinc Chloride

Standard:

29 CFR 1910.93(b), Table G-1 of October 18, 1972

8-hour time-weighted average: 1.0 mg/m^3

Analytical Method:

Atomic absorption

Lower working limit: $0.5 \text{ } \mu\text{g/filter}$

Sampling Equipment:

A personal sampler pump is used to pull air through a 37-mm, 3-piece filter holder. The contaminant is collected on a 0.8-micrometer pore size mixed cellulose ester filter (37 mm in diameter). The filter holder is held together by tape or a shrinking band. If the middle piece of the three-piece holder does not fit snugly into the bottom piece of the filter holder, the contaminant will leak around the filter. A piece of flexible tubing is used to connect the filter holder to the pump. Sample at a flow rate of 1.5 liters per minute with face cap on and small plugs removed. After sampling, replace small plugs.

Sample Size:

A minimum sampling period of 15 minutes is required and longer periods, up to a full shift, are preferred. Sampler battery recharge is required after 4 hours.

Blank:

With each batch of samples, submit one filter which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Shipping:

The cassettes in which the samples are collected should be shipped in a suitable container designed to prevent damage in transit.

March 11, 1974

Substance:

Iron oxide

Standard:

29 CFR 1910.93(a), Table G-1 of October 18, 1972

8-hour time-weighted average: 10 mg/m

Analytical Procedure:

Atomic absorption

Lower working limit: 1.5 µg/filter

Sampling Equipment:

A personal sampler pump is used to pull air through a 37-mm, 3 piece filter holder. The contaminant is collected on a 0.8-micrometer pore size mixed cellulose ester filter (37 mm in diameter). The filter holder is held together by tape or a shrinking band. If the middle piece of the three-piece holder does not fit snugly into the bottom piece of the filter holder, the contaminant will leak around the filter. A piece of the flexible tubing is used to connect the filter holder to the pump. Sample at a flow rate of 1.5 liters per minute with face cap on and small plugs removed. After sampling, replace small plugs.

Sample Size:

A minimum sample size of 30 liters is required. Personal sampler pump batteries should be checked and recharged after four hours.

Blank:

With each batch of samples, submit one filter labelled as blank. This filter should be subjected to the same handling as the samples, except that no air is drawn through the filters.

Shipping:

Ship in a container designed to prevent damage in transit.

February 20, 1975

Substance:

Vinyl chloride

Standard:

8-hour time-weighted average: 1 ppm

15 minute ceiling: 5 ppm

Reference: 29 CFR 1910.93, amended October 4, 1974

Analytical Method:

A known volume of air is drawn through two charcoal tubes connected in series to trap the vinyl chloride gas present. The analyte is desorbed from the charcoal with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The first charcoal tube is analyzed as a single sample (both front and back sections together) and the second tube is used as a breakthrough indicator.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range of 50 to 200 ml/min, plus charcoal tubes containing two sections of 20/40 mesh activated charcoal separated by a 2-mm portion of urethane foam.

Sample Size:

A maximum size of 5 liters is recommended. Sample at a flow rate of 50 ml/min.

Sampling Procedure:

1. Immediately before sampling, the ends of the two tubes should be broken so as to provide an opening at least one-half the internal diameter of the tube.
2. The first charcoal tube is positioned in the tube holder with the smaller backup section of charcoal being positioned nearest the pump. The second charcoal tube should be connected with a small, i.e. 0.5 inch, piece of Tygon tubing to the outlet of the plastic charcoal tube holder with the smaller section of charcoal being positioned nearest the pump and connected to the main sample line leading to the pump. Both tubes should be in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of vinyl chloride.
3. Air being sampled should not be passed through any hose or tubing before entering the first charcoal tube.

4. Set the flow rate on the predetermined setting. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If a low flow rate pump is used, set the flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes by the cc/stroke factor.
5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used. The two tubes used together should be labeled so as to distinguish the sample tube from the back-up tube.
6. One charcoal tube (at least one) for every 20 samples should be handled in the same manner as the sample tubes except that no sample is taken. The ends are broken and the tube is immediately capped and prepared for shipping. This tube is labeled as a blank.

Special Considerations:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance of two charcoal tubes in series, this sampling places a heavy load on the sampling pump. Therefore, the pumps should not be operated more than 8 hours continuously without fully recharging the battery.
3. The presence of high humidity or water mist causes a reduction in breakthrough volume. However, this has been taken into account and as long as a maximum of 5 liters is sampled, no breakthrough should occur.
4. The desorption efficiency of charcoal can vary from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.
5. The increased pressure drop of two tubes in series will cause the cc/stroke factor to change. Also this cc/stroke factor, at this high pressure drop, will vary slightly with flow rate. Therefore, for this special sampling situation, the pumps should be calibrated at a set flow rate with two charcoal tubes in line ahead of the pump and a new cc/stroke factor determined. When sampling, the flow rate should not be changed from that setting at which the cc/stroke factor was determined.

Bulk Samples:

If samples of material containing vinyl chloride are shipped to the lab, they should be submitted in a glass container with a Teflon-lined cap. Do not transport these samples in the same container with charcoal tubes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tubes. When the samples are received by the laboratory, they should be stored in the freezer compartment of a refrigerator to avoid any chance of loss of vinyl chloride from the samples.

Reference:

Vinyl chloride, NIOSH P&CA Method #178.

April 23, 1975

Substance :

Inert or Nuisance Dust

Standard :

8-hour time-weighted average for respirable dust: 5 mg/m^3

8-hour time-weighted average for total dust: 15 mg/m^3

Reference: 29 CFR 1910.93

Analytical Method:

The amount of material on a filter is determined by filter weight gain. Before sampling, the filter is pre-weighed to the nearest 0.01 mg. After sampling, the filter is reweighed. The difference in the filter's weight is assumed to be the mass of material collected.

Sampling Equipment:

Pump: A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$. The pump must have been calibrated with a representative filter and filter holder in line. If the respirable dust concentration is being measured, the pump must have a pulsation dampener and be certified under 30 CFR 74.

Filter Holder: 2 or 3-piece, 37-mm filter holder held together by tape or shrinking band.

Filter: 37-mm diameter, 5.0 micrometer pore size polyvinyl chloride filter or equivalent that has been pre-weighed to the nearest 0.01 mg. These filters must be hydrophobic. The filter should be supported with a back-up pad.

Cyclone: 10-mm nylon cyclone. When the respirable dust concentration is measured, it is used with a 2-piece filter holder.

Sampling Head Assembly: This assembly must hold the filter holder, cyclone, and coupler together rigidly so that air enters only at the cyclone inlet.

Sample Size :

A minimum sampling period of 60 minutes is recommended and longer periods up to eight hours are preferable. If the respirable dust concentration is being measured, a flow rate of 1.7 liters per minute must be used. To determine total dust concentration, use a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. If respirable dust is being measured, the center ring is not included in the filter holder. The filter cassette should be held together by a shrinking band or tape.
2. If total nuisance dust is being sampled, remove the filter holder plugs. Attach the filter holder to the sampling pump with a 1/4 inch diameter, 3-foot piece of tubing and an adaptor. The adaptor is used to provide a tight connection between the filter holder and tubing.
3. If the respirable dust is being sampled, assemble the two-piece filter holder, coupler, cyclone, and sampling head. The sampling head rigidly holds together the cyclone and filter holder. The outlet of the sampling head is connected to the pump by a 3-foot piece of 1/4 inch flexible tubing.
4. Clip the cassette or cyclone assembly to the worker's lapel.
5. Turn the pump on and begin sample collection. The pump flow rate should be checked periodically and readjusted if necessary.
6. Terminate sampling after the predetermined time and note sample flow rate, collection time, and ambient temperature and pressure. If a pressure reading is unavailable, record the elevation.
7. Collected sample cassette should be firmly sealed with the plugs in both the inlet and outlet.
8. With each batch of samples, submit one filter subjected to exactly the same handling as for the samples except that no air is drawn through it. Label these as blanks.

Special Considerations :

1. Filter holders molded from cellulose-acetate-butyrate, which is commonly known as Tenite plastic, have been shown to cause blank filter weight gains and must not be used.
2. The alignment of the filter holder and cyclone in the sampling head must be checked. If these parts are not aligned properly, leakage can result.
3. Before use, the cyclones grit cap or vortex finder should be removed and the interior of the cyclone should be inspected. If the inside of the cyclone is visibly scored, this cyclone should be discarded since the dust separation characteristics of the cyclone might be altered. If it is dirty, the interior of the cyclone should be cleaned before use. This will prevent the reentrainment of this dirt.

Data Sheet #29.02

Shipping :

After sampling, the samples and the blank should be shipped in a suitable container designed to prevent damage in transit.

Reference:

"Sampling and Evaluating Respirable Coal Mine Dust", US Bureau of Mines, Pittsburgh, Pa. Information Circular 8503, February, 1971, p. 47.

December 22, 1975

Substance:

Phosphoric Acid

Standard:

8-hour time-weighted average: 1 mg/m^3

Analytical Method:

After the sample has been collected on a filter, the phosphoric acid is recovered by washing the filter with distilled water. The phosphate ion is determined by the heteropoly blue method. This method was validated over the range of 0.47 to 1.93 mg/m^3 for a 90 liter sample.

Sampling Equipment:

Pump: A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ at the recommended flow rate. The pump must have been calibrated with a representative filter holder and filter in line.

Filter Holder: Three-piece, 37-mm filter holder connected to pump by means of flexible tubing. Filter holder must be held together by tape or shrinkable band.

Filter: 37-mm diameter, 0.8-micrometer pore size mixed cellulose ester membrane filter (MCEF). The filter is mounted on a cellulose support pad.

Sample Size:

To evaluate phosphoric acid concentrations at the standard level, a 15-liter air sample provides adequate analytical sensitivity. However, to determine an 8-hour time-weighted average, the entire eight hour shift should be sampled. Preferably, four sequential two hour samples should be taken. Sample at a rate of 1.5 lpm.

Sampling Procedure:

1. Assemble the filter, support pad, and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded.

Data Sheet #31.01

2. Remove the cassette plugs and attach to personal sampling pump tubing. An adaptor is needed to provide a tight connection between the tubing and cassette.
3. Clip the cassette to the worker's lapel.
4. Set the flow rate to 1.5 liters per minute as accurately as possible using the manufacturer's directions. Record the ambient temperature and pressure. If ambient pressure is not available, record the elevation. If the personal sampler pump is used, position the middle of the rotameter ball to the proper calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other mists in the air, the pump flow rate should be checked and readjusted as needed. If unable to readjust, terminate sampling.
5. After sampling, place small plugs in the cassette's inlet and outlet.
6. Blank: With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container designed to prevent damage in transit.

December 22, 1975

Substance:

Nitric Oxide, Nitrogen Dioxide

Standard:

8-hour time-weighted average

Nitrogen Dioxide

5 ppm (9 mg/m³)

Nitric Oxide

25 ppm (30 mg/m³)

Reference: 29 CFR 1910.93

Analytical Method:

Nitric oxide and nitrogen dioxide are collected on different sections of a solid sorbent tube. First, NO₂ is adsorbed on a triethanolamine (TEA)-impregnated molecular sieve. The nitric oxide is converted to NO₂ by an oxidizer and subsequently adsorbed on a second section of TEA-impregnated molecular sieve. The nitrogen dioxide is desorbed with TEA and analyzed colorimetrically. The NO₂ found on the first section is reported as NO₂ while the NO₂ found on the second section is reported as nitric oxide.

Sampling Equipment:

Solid Sorbent Tube: The solid sorbent tube is 15 cm. long and has an inside diameter of 0.5 cm. It contains two 400-mg sections of TEA-impregnated, type 13, 30/40 mesh molecular sieve. The two sections are separated by 800 mg of a proprietary oxidizer. This oxidizer is listed as material 1900277 by Drager Company of West Germany. The oxidizer and the first section of solid sorbent are separated by a 12-mm air space.

Personal Sampler Pump: A pump whose flow rate can be determined accurately, $\pm$ 5%, at 50 cc/min.

Sample Size:

A maximum sample size of 1.0 liter is recommended at the standard level. However, no more than 45 µg of NO should be collected because the oxidizer is apparently expended. Sample at 50 cc/min or less.

Data Sheet #32.01

Sampling Procedure :

1. Immediately before sampling, break open the ends of the tubes to provide an opening that is at least one-half the internal diameter of the tube.
2. The air must flow through the 12-mm air space before it flows through the oxidizer. Therefore, the end of the tube where the oxidizer and sorbent are separated by a 3-mm spacer is positioned nearest the pump.
3. The air being sampled should not pass through any hose or tubing before it enters the sorbent tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter readings. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
5. The sorbent tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of samples, submit one blank sorbent tube. This tube is handled in the same manner as the other tubes (break, seal, and transport) with one exception, no air is drawn through the blank tube. When more than 20 samples are submitted, include an additional blank for every 20 samples.

Special Considerations:

1. Due to the high resistance of the sorbent tube, this method places a heavy load on the sampling pump. Therefore, sample for no more than eight hours without recharging the battery.
2. If high humidity or water mist is present, breakthrough volume can be severely reduced. If water condensation occurs in the tube, nitrogen dioxide and nitric oxide may not be trapped quantitatively.
3. The desorption efficiency of the sorbent varies from batch to batch. All the tubes used to collect a set of samples should contain sorbent from the same batch.

Data Sheet #32.01

4. If the air does not flow through the 12-mm air space before it flows through the oxidizer, some of the nitric oxide which has been converted to nitrogen dioxide will be collected on the first section of solid sorbent and will be reported as nitrogen dioxide.

Shipping Instructions:

Before shipping, sorbent tubes should be packed tightly and padded to minimize breakage during shipping. Never transport, mail, or ship in the same container as the sample tubes.

Reference:

Willey, M., C. McCammon, L. Doemeny, "A Solid Sorbent Personal Sampling Method for the Simultaneous Collection of Nitrogen Dioxide and Nitric Oxide in Air." NIOSH Engineering Branch, 1014 Broadway, Cincinnati, Ohio, September, 1975, p. 13.

January 8, 1976

Substance:

Nitric Acid (HNO_3)

Standard:

8-hour time-weighted average: 5 mg/m^3

Analytical Method:

Nitric acid is collected in an impinger containing doubly distilled water. The water is analyzed spectrophotometrically at 220 nm for a total NO_3^- .

Interferences:

The following substances will interfere with NO_3^- analysis: dissolved organic matter, hexavalent chromium, surfactants, suspended particles, hydroxide (OH^-), and carbonate (CO_3^{2-}).

Sampling Equipment:

Impinger: A 25-ml midget impinger filled with 20 ml of doubly distilled water. A Teflon baffle should be installed on the impinger stem at the 25-ml level.

Pump: A personal sampling pump whose flow rate can be determined to within $\pm 5\%$ at 2.8 liters per minute.

Glass Vial: A vial with a Teflon-lined, threaded cap used for shipping.

Sample Size:

A sample size of 200 liters is required.

Sample Procedure:

1. Connect the impinger to the pump with a piece of flexible tubing. If personal sampling is being done, the midget impinger is placed in a midget impinger holder and fastened to the worker in his breathing zone.
2. Turn on the pump and set the flow rate to 2.8 liters per minute according to the manufacturer's directions. Periodically check the flow rate and readjust as needed. Terminate sampling if unable to readjust. In addition, check the level of solution in the impinger. If less than 5 ml of solution remains in the impinger, fill the impinger back up to the 20 ml mark.

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3. After sampling, quantitatively transfer the impinger solution to the glass vial. Use 1 or 2 ml of solution to wash the impinger. Transfer the wash to the glass vial. Tightly screw on the cap and seal with vinyl tape.
4. Record ambient temperature and pressure. If ambient pressure is unavailable, record the elevation.
5. Use one impinger as a blank. Handle it the same as any other impinger but do not draw air through it. Label this solution as a blank.

Special Considerations:

The sampling rate must be maintained at 2.8 liters per minute. A lower sampling rate will result in decreased sampling efficiency for particulates.

Shipping Instructions:

Ship in a container designed to prevent damage in transit.

Sampling Data Sheet # 34.01

Class E

December 19, 1975

Substance:

Phosphine (PH_3)

Standard:

8-hour time-weighted average: 0.3 ppm

Reference: 29 CFR 1910.93

Analytical Method:

After a prefilter eliminates the ambient particulate, the phosphine is collected on a silver nitrate impregnated cellulose support pad. The phosphine reacts with the silver nitrate to form free silver. After the impregnated filter is washed with hot dilute potassium nitrate solution to remove the remaining silver nitrate, the free silver is converted to silver nitrate by leaching with a hot nitric acid solution. The solution is neutralized with sodium hydroxide and buffered by adding a boric acid solution. Then, a dilute sodium sulfide solution is added and colloidal silver sulfide is formed. The colloidal silver sulfide is analyzed colorimetrically. The micrograms of silver sulfide equivalent to an amount of phosphine is read from a calibration curve.

Sampling Equipment:

Prefilter and Filter Holder: A 37-mm diameter glass fiber filter followed by an 0.8-micrometer pore size membrane filter is placed on a cellulose support pad in a 3-piece, 37-mm filter holder.

Impregnated Filter: A 37-mm diameter cellulose support pad collects the phosphine. The support pad has been impregnated with silver nitrate by dipping the pads into 0.1 N AgNO_3 solution and allowing the pads to dry.

Filter Holder: A modified 37-mm diameter filter holder is used to collect phosphine. The filter holder contains 3 spacers instead of the normal one spacer. The impregnated support pad is placed between the second and third spacer from the filter holder inlet. The first two spacers are used as an entrance plenum and the final spacer serves to distribute the air flowing through the impregnated filter.

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Pump: A pump which can draw an accurately known, $\pm 5\%$, volume of air through a filter at a flow rate of $50 \text{ cm}^3/\text{min}$. The pump must be calibrated with a representative filter and filter holder in line.

Sample Size:

A maximum sample size of 5 liters is recommended. Sample at $50 \text{ cm}^3/\text{min}$ or less.

Sampling Procedure:

1. Assemble the prefilter filter holder and the impregnated support pad and the modified filter holder. All parts of the filter holder should seal firmly to prevent leakage.
2. Remove the small plugs from the filter holder. Insert adaptors into the outlet of the prefilter filter holder and the inlet of the modified filter holder. Connect the two filter holders with a piece of Tygon tubing. The outlet of the modified filter holder is attached to the inlet of the pump with a piece of flexible tubing.
3. Before sampling, remove the face cap from the prefilter filter holder. Attach the filter holder to the worker's lapel with the filter's exposure face facing down.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record ambient temperature and pressure. If a pressure reading is unavailable, record elevation above sea level. If the pump has a counter, the sample volume is determined by multiplying the pump's cc/stroke factor times the number of strokes.
5. Place the small plugs back in the modified filter holders inlet and outlet.
6. With each batch of samples, submit one blank, impregnated filter to the same handling as the other filters with one exception: no air is drawn through a blank filter.

Shipping Instructions:

Wrap the filter holder in an opaque material. Ship in a container designed to prevent damage during transit.

Special Considerations:

Direct sunlight can cause silver nitrate to be reduced to silver. Therefore, the impregnated filter must be protected from sunlight during storage and shipment.

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Reference:

Hughes and Jones, "The Estimation of Phosphine in Air," AIHAJ,
Vol. 24 (1963), pp 164-167.

January 2, 1976

Substance:

Toluene-2,4-Diisocyanate (TDI)

Standard:

Ceiling: 0.02 ppm (0.14 mg/m³)

Reference: 29 CFR 1910.93

Analytical Method:

Sample air containing TDI is pulled through a continuously moving paper tape which has been impregnated with various chemicals. The TDI reacts with the chemicals on the tape to develop a stain. The tape is stained over an 8-hour sampling period. At the end of the sampling period, the stained tape is removed from the sampling unit and inserted in a reader/recorder unit. At the push of a button, the reader/recorder optically measures the stain density on the tape and provides a graphical record of TDI concentration over the 8-hour sampling period. The TDI concentration is directly proportional to the stain density on the paper tape. Also provided in the output of the reader/recorder is a record of the daily dosage of TDI as measured by the paper tape and is presented in ppm-hrs. The minimum detectable concentration with this system is 0.002 ppm.

Sampling Equipment:

A miniature continuous monitor for TDI pulls 0.1 liters per minute through a chemically impregnated tape. This monitor is equipped with a built-in pump, a separate power supply, and a chest harness. The flow rate through the unit should be known to within $\pm 5\%$. The monitor, impregnated tape, and reader/recorder are available from MDI Scientific Inc., 808 Busse Highway, Park Ridge, Illinois 60068.

Sampling Size:

The monitor can be operated for eight hours continuously.

Sampling Procedure:

1. Charge the battery pack to ensure a full 8 hours of operation. Check the flow rate of the pump (with a paper tape in the system) and set the flow to 0.1 lpm.

2. Install a new paper tape in the sampling unit. Be sure that the expiration date on the tape has not passed. Insert tape in take-up reel and then make one complete turn clockwise.

Use a non-indelible pencil to mark the tape at the far right side of the removable headplate. This mark is used to align the exposed tape on the reader/recorder before it is read. Carefully position the headplate over the tape so as to avoid leakage of air or fouling of the tape. Attach identification label to the inside of the sampling unit and record on the label the date, location, person's name or initials, starting time, and sampling unit number.

3. Slip the chest harness on the individual being monitored and attach sampling unit to the harness. Attach the power supply to the worker's belt or to the back of the chest harness and connect the power supply to the sampling unit.
4. At the end of the sampling period, disconnect the sampling unit, remove the tape, place the tape in the plastic storage container, remove the identification label from the sampling unit, and attach the label to the storage container.
5. If the analysis is to be done, remove the tape from the storage canister. Open the gate covering the readout optics of the Model 4100 R/R and place the unstained leading edge of the exposed tape over the readout ports. The tape should be inserted stained side down. Close the flap. Push the ON button and when the optic's light comes on, zero the recorder pen on the chart paper making sure that only the unstained leading edge of the tape is over the optics. Check the calibration of the recorder by pushing the CAL button. Push the tension release and slide the leading edge of the tape under the roller. Line up the pencil mark with the arrow indicating the top edge of the optics block. Push the START button and allow the tape to automatically be processed. Due to the natural curl of the MCM tape, care should be taken to keep the leading end of the tape from being tangled in the tape drive mechanism. Remove tape and tear off the calibrated graph paper. Be sure that the graph paper is properly labeled by transferring the identification label from the canister to the graph.

Special Consideration:

Because the exposed tapes are not stable for long periods of time (i.e., greater than 1 week), read the tapes as soon as possible after exposure.

Shipping Instructions:

The tapes can be easily shipped in the manufacturer's plastic storage containers. The tapes must be read within a week after sampling.

Sampling Data Sheet # 36.01

Class B

December 15, 1976

Substance:

Methyl Alcohol

Standard:

8-hour time-weighted average: 200 ppm (260 mg/cu m)

Analytical Method:

A known volume of air is drawn through silica gel to trap the methyl alcohol vapors present. The analyte is desorbed with water, the sample is separated with a gas chromatograph and analyzed with a flame ionization detector. The method was validated over the range of 130 to 535 mg/cu m for a 3-liter sample at 25⁰ C, 745 mm Hg, and 85-90% relative humidity.

Sampling Equipment:

Silica Gel Tube: The silica gel tube has an inside diameter of 8-mm and contains two sections of 45/60 or 42/60 mesh silica gel. The first section contains 700 mg of silica gel while the backup section contains 150 mg of silica gel. The two sections are separated by a 7-mm section plug (one 100 mesh stainless steel screen disc between 2 Teflon cyclinder supports), a 12-mm space and another 7-mm section plug.

Pump: A personal sampler pump whose flow can be determined accurately, $\pm 5\%$, at the recommended flow rate. The pump must be calibrated with a representative silica gel tube in line.

Sample Size:

A sample size of 3 liters is recommended. Sample at a flow rate of 0.05 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, both ends of the silica gel tube should be broken so as to provide openings approximately one-half the internal diameter of the tube.

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2. The smaller section of silica gel is used as a back-up and should be positioned nearest the sampling pump. The silica gel tube should be placed in a vertical position during sampling to prevent channeling and premature breakthrough.
3. Air being sampled should not be passed through any hose or tubing before entering the silica gel tube.
4. Set the approximate flow rate of the low flow rate pump and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. Record the atmospheric temperature and pressure. If the pressure reading is not available, record the elevation.
5. The silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One silica gel tube should be handled in the same manner as the sample tube (break, seal, and transport), except for the taking of an air sample. This tube should be labeled as a blank.

Special Considerations:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance of the silica gel tube, this sampling method places a heavy load on the sampling pump. Therefore, sample for no more than eight hours without recharging the pump's battery.
3. When the amount of water in the air is so great that condensation actually occurs in the tube, organic vapors will not be trapped efficiently. Preliminary experiments indicate that high humidity severely decreases the breakthrough volume.
4. The desorption efficiency of silica gel varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain silica gel from the same batch. Several unused silica gel tubes should accompany the samples. Information on the batch number of the silica gel must be supplied.

Data Sheet #36.01

Bulk Samples:

Bulk samples of the suspected compound should be submitted to the laboratory in glass containers with Teflon-lined caps. Labels of bulk samples should match the air samples for identification purposes.

Shipping Instructions:

Never transport, mail, or ship the bulk samples in the same container as the sample or blank tubes. The capped silica gel tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping.

January 1, 1976

Substance:

Tin (inorganic compounds, except oxides)

Standards:

8-hour time-weighted average: 2 mg/m^3

Analytical Method:

Because inorganic tin compounds may exist as aerosols and vapors, first aerosols are collected on a filter. Then the vapors which penetrate the filter are collected in an impinger containing 0.01 N sodium hydroxide. The filter and impinger solution are placed in the same beaker and are chemically ashed. The resulting solution is analyzed for tin by atomic absorption spectroscopy.

Sampling Equipment:

Pump: A calibrated personal sampling pump whose flow rate can be determined accurately, $\pm 5\%$, at the recommended flow rate. The pump must be calibrated with representative sampling train in line.

Filter Holder: Three-piece, 37-mm diameter filter holder. The filter holder must be held together by tape or shrinkable band.

Filter: 37-mm diameter, 0.8-micrometer pore size mixed cellulose ester membrane filter. This filter is mounted on a support pad.

Impinger: A midjet impinger which contains 15 ml of 0.01 N sodium hydroxide.

Glass Vial: A vial with a Teflon-lined, threaded cap.

Sample Size:

Sample for a minimum of 4 hours at a flow rate of 1.0 lpm.

Sampling Procedure:

1. Assemble filter, support pad, and filter holder. Be sure the filter holder's center ring seals the edge of the filter. Examine the filter holder for a good seal. If the filter holder does not seal tightly, discard it.

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2. Remove the plugs from the filter holder. A short piece of tubing is used to connect the outlet of the filter holder to the impinger's inlet. An adaptor may be needed to provide a tight connection between the tubing and filter holder. The impinger's outlet is connected to the pump tubing.
3. If personal sampling is being done, place midjet impinger in its holder. Attach the holder to the worker's clothing in his breathing zone.
4. Turn the pump on and set the flow rate to 1.0 lpm according to the manufacturer's directions. Periodically check the flow rate and readjust as needed. Terminate sampling if you are unable to readjust. In addition, check the level of solution in the impinger. When less than 5 ml remain, redilute with distilled water or deionized water to 15 ml.
5. Record the ambient pressure and temperature. If the ambient pressure is unavailable, record the elevation.
6. After sampling, transfer the solution to a glass vial. Wash the impinger stem with 1-2 ml of unused absorbing solution and add the wash to the vial. Tightly screw on the cap and seal with vinyl electrical tape.
7. Place the small plugs in the filter holder's inlet and outlet.
8. Blank: With each batch of samples, submit one filter and impinger to the same handling as the other samples, except that no air is drawn through it. Label this as a blank.

Shipping Instructions:

The filter holders and vials should be shipped in a container that prevents damage during shipment.

August 26, 1976

Substance:

4,4'-Methylenebis(2-chloroaniline)
(MOCA)

Standard:

The standard does not set a specific level. The intent of the standard is to minimize occupational exposure to MOCA. The sampling and analytical method for MOCA has a detection limit of 0.15 µg/sample.

Analytical Method:

After MOCA has been collected on a glass fiber filter and silica gel sorbent tube, the MOCA is desorbed with methanol. The MOCA is separated from the methanol and other interference using liquid chromatography and detected with a UV detector operated at 254 nm.

Sampling Equipment:

Filter: A 13-mm glass fiber filter without an organic binder. The filter is at least 99.7% efficient against 0.3-micrometer diameter dioctyl phthalate (DOP) particles. The filter is mounted in a 13-mm filter holder.

Silica Gel Tube: A solid sorbent tube that contains 50 milligrams of 30/60 mesh silica gel. The silica gel has a surface area of 720-760 m²/g. The silica gel tube has a 4-mm inside diameter and is flared to fit over the outlet of the filter holder.

Pump: A personal sampling pump whose flow rate can be determined accurately to better than +5% at a recommended flow rate. The pump must be calibrated with a representative sampling train in line.

Sample Size:

Sample for at least 30 minutes at a flow rate between 0.2 and 0.5 liters per minute. A maximum sample volume of 100-liters is recommended.

Sampling Procedure:

1. Assemble the filter and filter holder and make sure that the filter is properly seated in the filter holder.

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2. Remove and save the caps from the silica gel tube. Insert the flared end of the silica gel tube over the outlet of the filter holder.
3. The air being sampled should not pass through any hose or tubing before it enters the sampling train.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation.
5. The silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of samples, submit one blank sample. The tube and filter are handled in the same manner as the other samples with one exception, no air is drawn through the blank sample. When more than 20 samples are submitted, include an additional blank for every 20 samples.

Special Considerations:

1. Due to the high resistance of the sampling train, this method places a heavy load on the sampling pump. Therefore, sample for no more than eight hours without recharging the battery.
2. If high humidity or water mist is present, breakthrough volume can be severely reduced. If water condensation occurs in the tube, MOCA may not be trapped quantitatively.
3. The desorption efficiency of the sorbent may vary from batch to batch. All the tubes used to collect a set of samples should contain sorbent from the same batch.
4. Any contaminant which has the same retention time in the liquid chromatograph column as MOCA will be an interference. These compounds are known to be interferences: o-tolidine, 1- and 2-naphthylamine, n-methylamine, 3,3'-dichlorobenzidine, 2 chloro-4-methylaniline, 3 chloro-4-methylaniline, and p-toluidine. The presence and identity of these and other suspected air contaminants should be transmitted along with the samples. Often interferences can be eliminated by altering chromatographic conditions.

Data Sheet #39.01

Shipping Instructions:

Before shipping, sorbent tubes should be packed tightly and padded to minimize breakage during shipping. Never transport, mail, or ship bulk samples in the same containers as the sample tubes.

Sampling Data Sheet #40.01

Class C

October 7, 1976

Substance:

Respirable Coal Mine Dust

Standard:

Under the Federal Coal Mine Health and Safety Act of 1969, concentrations of respirable dust are defined as "the average concentration if measured with an MRE instrument or such equivalent concentrations if measured with another device approved by the Secretary of the Interior and the Secretary of Health, Education, and Welfare."

Analytical Method:

The sampled air is passed through a two-stage sampler. The first stage, a nylon cyclone, collects the nonrespirable dust. The second stage, a cassette which contains a tared capsule, collects the respirable dust. The cassette and the mine data card are shipped in a special shipping box to the Mining Enforcement and Safety Administration (MESA). In a controlled environment, MESA weighs the capsule to the nearest 0.01 mg and truncates the weight to the last 0.1 mg. The coal mine dust concentrations are computed from the data on the mine data card and the weight gain of the capsule. This coal mine dust concentration is multiplied by a factor of 1.38 in order to convert it to an equivalent MRE concentration.

The MRE Horizontal Elutriator can be used for area sampling. This eliminates the need for a conversion factor. However, a description of the MRE Horizontal Elutriator's use is beyond the scope of this Sampling Data Sheet.

Sampling Equipment:

For sampling with devices other than the MRE Horizontal Elutriator, Coal Mine Dust Personal Sampler Units (CMDPSU) that have been jointly certified by both NIOSH and MESA must be used. Components of different certified CMDPSU cannot be interchanged because CMDPSU's are certified as units. The certified CMDPSU consists of a pump, a sampling head, and a battery charger. The sampling head consists of a filter assembly and a cyclone.

Pumps: A personal sampler pump whose flow rate can be determined accurately to $\pm 5\%$ at 2.0 liters per minute. The pump must have a pulsation dampener or be free of pulsation and be certified under 30 CFR 74. The pumps of certified units have NIOSH and MESA approval labels.

Filter Assembly: The filter assembly consists of a filter, a capsule, and a cassette. The filter has a nominal pore size of less than 5 micrometers. The capsule encloses the filter. The capsule and filter are preweighed to the nearest 0.1 mg by the manufacturer. The cassette encloses the capsule. The weight of the cassette is not used in any determination of weight gain in this procedure.

Cyclone: A 10-mm diameter nylon cyclone.

Mine Data Card: A data card which must be submitted with the sample to MESA. It contains the capsule's tare weight and serial number. It is supplied by the manufacturer.

Charger: A battery charger used to charge the pump's battery over a 16-or 64-hour period. Pumps must be completely charged with the appropriate charger.

Sample Size:

Sample at a rate of 2.0 lpm for a full shift (portal-to-portal). However, the sampling time is not to exceed 8 hours.

Sampling Procedure:

1. Assemble the CMDPSU according to the manufacturer's directions. The cyclone's vortex finder must be squarely seated in the cyclone's body. The cyclone body, vortex finder, and cassette must remain rigid, aligned, firmly in contact and air tight. The airflow into the cyclone must be perpendicular to and away from the backing plate.
2. Connect the outlet of the sampling head to the pump's inlet with a piece of flexible tubing so that the connection is air tight.
3. Attach the sampling head assembly to the worker in his/her breathing zone.
4. Turn the pump on and adjust the flow rate to 2.0 lpm according to manufacturer's instructions. The pump's flow rate should be checked and adjusted within the first hour of operation and at midday. If unable to adjust the flow rate to 2.0 lpm, terminate sampling and note the reason for termination on the mine data card.

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5. Terminate sampling as specified above.
6. Fill out the mine data card. If the sample was damaged or destroyed, print VOID on the mine data card and state the reason for voiding the sample on the mine data card. Both the miner and a mine official must initial or sign the mine data card at the end of the sampling period.

Special Considerations:

1. When components from different manufacturers are used in a unit, it is not NIOSH certified and the sample collected does not comply with the coal mine dust sampling requirements of 30 CFR 70.
2. The cyclone's vortex finder must fit squarely and securely on the cyclone's shoulder. Misalignment of the vortex finder may cause leakage and alteration of the cyclone's collection efficiency.
3. Before use, the cyclone's grit cap or vortex finder should be removed and the interior of the cyclone should be inspected. If the inside of the cyclone is visibly scored, this cyclone should be discarded since the dust separation characteristics of the cyclone might be altered. If it is dirty, the interior of the cyclone should be cleaned before use. This will prevent the reentrainment of this dirt.

Shipping Instructions:

If collected, samples are to be used in fulfilling the requirements of Section 202(a) of the Federal Coal Mine Health and Safety Act, the data cards must be completed. After packing the samples and the corresponding data cards to prevent damage during transit, mail them to the following laboratory for processing:

MESA
Weighing Laboratory, Dust Branch
Pittsburgh Technical Support Center
4800 Forbes Avenue
Pittsburgh, PA 15213

Reference:

Sampling and Evaluating Respirable Coal Mine Dust, Bureau of Mines,
Pittsburgh, PA. IC 8503, 1971, p. 47.

Sampling Data Sheet #42.02

September 29, 1976

Class D

Substance:

Sodium Hydroxide

Standard:

8-hour time-weighted average: 2 mg/m^3

Analytical:

Sodium hydroxide aerosol is collected in a bubbler that contains 7.5×10^{-3} normal hydrochloric acid. The total alkalinity of the bubbler solution is determined by back titration of the remaining hydrochloric acid with 0.1 normal sodium hydroxide.

Interferences:

Other acids and bases which affect the pH of the bubbler solution will interfere. The presence and suspected identities of acids and bases must be identified and transmitted with the sample.

Sampling Equipment:

Pump: A personal sampler pump whose flow rate can be determined accurately, $\pm 5\%$, at the recommended flow rate. The pump must be calibrated with a representative sampling train in line.

Bubbler: A 25 ml midget bubbler filled with exactly 15 ml of 7.5×10^{-3} normal hydrochloric acid. A Teflon baffle should be installed on the bubbler stem at the 25 ml level.

Glass Vial: A vial with a Teflon lined, threaded cap used for shipment.

Sample Size:

To evaluate exposures at the standard, a minimum sample size of 350 liters is recommended. Sample at a rate of 1.0 liter per minute. At least 700 μg of sodium hydroxide should be collected. If more than 4 milligrams of sodium hydroxide are collected, the excess sodium hydroxide will not be detected because all the hydrochloric acid in the collecting liquid will be consumed.

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Sample Procedure:

1. Connect the bubbler to the pump with a piece of flexible tubing. If personal sampling is being done, the midget bubbler is placed in a midget bubbler holder and fastened to the worker in his breathing zone.
2. Turn on the pump and set the flow rate to 1.0 liter per minute according to the manufacturer's directions. Periodically check the flow rate and readjust as needed. Terminate sampling if unable to readjust. In addition, check the level of solution in the bubbler. If less than 10 ml of solution remains in the bubbler, fill the bubbler back up to the 15 ml mark with distilled water.
3. After sampling, quantitatively transfer the bubbler solution to the glass vial. Use 1 or 2 ml of distilled water to wash the bubbler. Transfer the wash to the glass vial. Tightly screw on the cap and seal with vinyl tape.
4. Record ambient temperature and pressure. If ambient pressure is unavailable, record the elevation.
5. Use one bubbler as a blank. Handle it the same as any other bubbler but do not draw air through it. Label this solution as a blank.

Shipping Instructions:

Ship glass vials in a container that is designed to prevent damage during shipment.

Special Instructions:

Under no circumstances is additional acid solution to be added to the bubbler. The addition of more acid solution will be a negative interference.

Sampling Data Sheet #S1.01 Class B

December 19, 1975

Substance:

Acetone

Standard:

8-hour time-weighted average: 1000 ppm (2380 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately, $\pm 5\%$, at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 2 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S2

Substance:

Antimony and Compounds (as Sb)

Standard:

8-hour time-weighted average: 0.5 mg/cu m

Analytical Method:

A known volume of air is drawn through a mixed cellulose ester membrane filter to trap the antimony-containing aerosol present. The antimony is recovered from the filter by digestion with nitric acid. Hydrochloric acid is added to dissolve the analyte and tartaric acid is added to prevent precipitation of SbOCl . The solutions are analyzed by atomic absorption spectroscopy at 217.6 nm. The method has been validated over the range 0.26-1.1 mg/cu m for a 360-liter sample at 24°C and 766 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

The following items are needed: a calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm, three-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm/0.8-micrometer pore size mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 360 liters is recommended. Sample at a flow rate of 1.5 liters per minute for 4 hours.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with shrinkable band or tape such as vinyl electrical tape.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record all the necessary information to determine flow rate or volume and record also the initial and final sampling time.

Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the flow rate cannot be adjusted to correct a problem, terminate the sampling.

5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant data.
7. Blank: With each batch of samples, submit one filter from the same lot of filters used for sample collection and which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank. Submit one blank for every ten samples.

Special Considerations:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be submitted with the sample. Lead and copper are known to be a positive interference to this analysis and should be recorded if known to be present. This method will not work for compounds of antimony which exist as vapor.

Bulk Sample:

A bulk sample of the suspected material should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes. This bulk sample should be used to prepare analytical samples.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Antimony and Compounds (as Sb), NIOSH Method No. S2.

December 19, 1975

Substance:

2-Butanone

Standard:

8-hour time-weighted average: 200ppm (590 mg/cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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Data Sheet #S3.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Consideration:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

May 28, 1976

Substance:

Hydrogen Sulfide

Standard:

Ceiling: 20 ppm (30 mg/cu m)

Peak : 50 ppm (70 mg/cu m) for one 10 minute period if no other measurable exposure occurs.

Reference: 29 CFR 1910.93

Analytical Method:

Hydrogen sulfide is collected by aspirating a measured volume of air through cadmium hydroxide. The sulfide is precipitated as cadmium sulfide, and the collected sulfide is determined by spectrophotometric measurement of the methylene blue produced by the reaction of the sulfide with an acid solution of N,N-dimethyl-p-phenylenediamine and ferric chloride. The method has been validated over the range of 8.5-63 mg/cu m for a 2-liter sample at 25°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

Pump: A personal sampling pump whose flow rate can be determined accurately $\pm 5\%$ at a recommended flow rate. The pump must be calibrated with a representative sampling train in line.

Impinger: A midjet impinger containing 10 ml of a cadmium hydroxide STRactan absorbing solution. The impinger solution must be protected from light to prevent photodecomposition of cadmium sulfide. This can easily be accomplished by wrapping the impinger in aluminum foil.

Sample Size:

1. At peak concentrations, a sample size of 2 liters is recommended. Sample for 10 minutes at a flow of 0.20 liters per minute.
2. At ceiling concentrations, a sample size of 2 liters is recommended. Sample at a rate of 0.2 liters per minute or less.

Data Sheet #S4.01

Sampling Procedure:

1. Prepare 10 ml of absorbing solution (as described in Section 7.8 of NIOSH Method No. S4 for Hydrogen Sulfide) directly in the midget impinger. The addition of 5 ml of 95% ethanol to the absorbing solution just prior to aspiration controls foaming for 2 hours.
2. Connect the impinger (via the absorption tube) to the sampling pump with a short piece of flexible tubing. A loosely packed plug of fiber glass can be inserted between the impinger and the pump to minimize splash-over.
3. Air being sampled should not be passed through any other tubing or other equipment before entering the impinger.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
5. After sampling, the impinger stem must not be removed since it contains CdS deposits.
6. Care should be taken to minimize spillage or loss by evaporation at all times. Refrigerate samples if analysis cannot be done within a day.
7. It is necessary to ship the impingers with the stems in; so the outlets of the stem should be sealed with Parafilm or other non-rubber covers, and the ground glass joints should be sealed (i.e., taped to secure the top tightly.)
8. A "blank" impinger should be handled as the other samples (fill, seal, and transport) except that no air is sampled through this impinger.

Special Consideration:

Strong reducing agents such as SO_2 inhibit color development in the analysis step, so the method may not be applicable if the SO_2 level in the air sample is high (NIOSH Method No. S4 for Hydrogen Sulfide.) Nitrogen dioxide and ozone may also interfere. Cadmium sulfide may be decomposed if exposed to light, so the collected sample should be kept in the dark.

Data Sheet #S4.01

Shipping Instructions :

Whenever possible, hand delivery of the samples is recommended.
Otherwise, special impinger shipping cases designed by NIOSH
should be used to ship the samples.

Reference :

Hydrogen Sulfide, NIOSH Method No. S4.

Sampling Data Sheet # S5

Substance:

Manganese and compounds (as Mn)

Standard:

Ceiling: 5 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the manganese (including manganese compounds) present. The filter is digested with nitric acid to remove the organic matrix, then solubilized in a hydrochloric acid solution, and aspirated into an atomic absorption spectrometer for determination of concentration. The method has been validated over the range of 2.5 - 10 mg/cu m at an atmospheric temperature and pressure of 24°C and 749 mm Hg, using a 22 liter sample.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm, three piece cassette filter holder held together by tape or shrinkable band; and a 37-mm/0.8-micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 22.5 liters is recommended. Sample at a flow rate of 1.5 liter per minute, for 15 minutes. Since the standard for manganese is a ceiling value, collection time is restricted to 15 minutes.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

4. If the low flow rate pump is used, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1.0-liter per minute personal sample pump is used, position the middle of the rotameter ball to the 1.0-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and the sampling should be terminated at any evidence of a problem. Record the temperature and pressure of the atmosphere being sampled. If pressure reading is not available, record the elevation.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank: With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples :

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions :

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Manganese and Compounds (as Mn), NIOSH Method No. S5

Sampling Data Sheet # S8

Substance:

Ozone

Standard:

8-hour time-weighted average: 0.2 mg/cu m

Reference: 29 CRF 1910.93.

Analytical Method:

Ozone is collected by aspirating a measured volume of air through an alkaline potassium iodide solution. For analysis, the solution is acidified with phosphoric acid and the ozone level is determined by spectrophotometric measurement of the iodine liberated. This method has been validated over the range of 0.1-0.4 mg/cu m at 25 C and 760 mm Hg, using a 45 liter sample.

Sampling Equipment:

An approved and calibrated personal sampling pump whose flow can be determined accurately at 1.0 liter per minute, $\pm 5\%$, plus a 25-ml midjet impinger with a standard glass-tapered gas delivery tube containing 10 ml of absorbing solution and ground glass stoppers for shipment.

Sample Size:

A sample size of 45 liters is recommended. This requires a sampling period of 45 minutes at 1.0 liter per minute.

Sampling Procedure:

1. Connect the impinger (via the absorption tube) to the vacuum pump with a short piece of flexible tubing. The air being sampled should not be passed through any other tubing or other equipment before entering the impinger.
2. Turn on pump to begin sample collection. Care should be taken to measure the flow rate, time and/or volume as accurately as possible. The sample should be taken at a flow rate of 1.0 liters per minute for 45 minutes.
3. The temperature and pressure of the atmosphere being sampled should be recorded.

4. After sampling, the impinger stem should be removed and replaced with the ground glass stopper. And the ground glass joints should be sealed (i.e., taped) to secure the top tightly.
5. Care should be taken to minimize spillage or loss of evaporation at all times.
6. A "blank" impinger should be handled as the other samples (fill, seal, and transport), except that no air is sampled through this impinger.

Special Considerations:

1. The absorbing solution should never be exposed to direct sunlight. It is recommended that the impingers be wrapped in aluminum foil to minimize exposure to light.
2. Chlorine, hydrogen peroxide, organic peroxides, and various other oxidants will liberate iodine by this method.
3. The response to nitrogen dioxide is limited to 10 percent by the use of sulfamic acid in the procedure to destroy nitrite, thus minimizing any error due to the collection of NO_2 .
4. The negative interferences from reducing gases such as sulfur dioxide and hydrogen sulfide are very serious (probably on a mole-to-mole equivalency).
5. The procedure is very sensitive to reducing dusts that may be present in the air or on the glass. Losses of iodine also occur even on clean glass surfaces and, thus, the manipulations should minimize this exposure.

Shipping Instructions:

Whenever possible, hand delivery of the samples is recommended. Otherwise, ship in an upright position to the laboratory in special impinger shipping cases designed by NIOSH.

Reference:

Ozone, NIOSH Method No. S8

Sampling Data Sheet #S10.01 Class B

February 5, 1976

Substance:

Camphor

Standard:

8-hour time-weighted average: 2 ppm (12.5 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide containing 1% methanol; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S10.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport), with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S12.01 Class B

February 5, 1976

Substance:

Mesityl Oxide

Standard:

8-hour time-weighted average: 25 ppm (100 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with n-heptane; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm$ 5% at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport), with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

5-Methyl-3-heptanone

Listed incorrectly as ethyl sec-amyl ketone in 29CFR1910.93.

Standard:

8-hour time-weighted average: 25 ppm (130 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide containing 1% methanol; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm$ 5% at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S13.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S15.01 Class B

February 5, 1976

Substance:

Methyl n-Amyl Ketone

Standard:

8-hour time-weighted average: 100 ppm (465 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide containing 1% methanol; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S16.01 Class B

February 5, 1976

Substance:

Ethyl Butyl Ketone (3-Heptanone)

Standard:

8-hour time-weighted average: 50 ppm (230 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide containing 1% methanol; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm$ 5% at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S16.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S18.01 Class B

December 19, 1975

Substance:

Hexone (Methyl Isobutyl Ketone)

Standard:

8-hour time-weighted average: 100 ppm (409 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S18.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations :

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample :

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S19.01 Class B

December 19, 1975

Substance:

Cyclohexanone

Standard:

8-hour time-weighted average: 50 ppm (200 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 40 liters. Sample at a rate of 1.0 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S119.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S20.01 Class B

December 19, 1975

Substance:

2-Pentanone

Standard:

8-hour time-weighted average: 200 ppm (705 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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Data Sheet #S20.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S22.01 Class B

December 19, 1975

Substance:

p-tert-Butyltoluene

Standard:

8-hour time-weighted average: 10 ppm (60 mg/cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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Data Sheet #S22.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

December 19, 1975

Substance:

Cumene

Standard:

8-hour time-weighted average: 50 ppm (245 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S23.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations :

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S25.01 Class B

December 19, 1975

Substance:

Vinyl Toluene

Standard:

8-hour time-weighted average: 100 ppm (480 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm$ 5% at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations :

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S26.01 Class B

February 5, 1976

Substance:

alpha-Methylstyrene

Standard:

Ceiling: 100 ppm (483 mg/cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 3 liters. Sample at a rate of 0.2 liters per minute for 15 minutes.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Substance :

Terphenyls (o-Terphenyl)

Standard:

Ceiling: 1 ppm (10 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the o-terphenyl particulate present. The analyte is extracted from the filter with carbon disulfide, and the analyte is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 4.5-20 mg/cu m for a 15-liter sample at 22°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of + 5%, at 1 liter per minute; a 37-mm, three-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm/0.8-micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad. The filter holder should be made of polystyrene. Do not use tenite filter holders.

Sample Size:

A sample size of 15 liters is recommended. Sample at a flow of 1 liter per minute for 15 minutes.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

Data Sheet #S27

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.0 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and the sampling should be terminated at any evidence of a problem.
5. The cellulose filter should be removed from the cassette filter holder and cellulose backup pad and placed in a clean screw cap bottle within 1 hour of sampling. Care must be taken to handle the filter only with clean tweezers. The tweezers and the screw cap bottle should be rinsed with carbon disulfide before use.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Consideration

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions

The screw cap bottles in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference

Terphenyls, NIOSH Method No. S27.

December 19, 1975

Substance:

Cyclohexane

Standard:

8-hour time-weighted average: 300 ppm (1030 mg/cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 2.5 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S28.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S29.01 Class B

December 19, 1975

Substance:

Ethyl Benzene

Standard:

8-hour time-weighted average: 100 ppm (435 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S30.01 Class B

February 5, 1976

Substance:

Styrene

Standard:

Ceiling: 200 ppm (850 ng/cu m)

Peak: 600 ppm (2550 ng/cu m); maximum duration - 5 minutes in any 3 hours

8-hour time-weighted average: 100 ppm (425 ng/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

1. To evaluate time weighted average concentrations, a sample size of 12 liters is recommended. Sample at a rate of 0.2 liters per minute or less.
2. To evaluate ceiling concentrations, a sample volume of 5 liters is recommended. Sample at a rate of 0.2 liters per minute or less.
3. To evaluate peak concentrations, a sample size of 1 liter is recommended. Sample for 5 minutes at a rate of 0.2 liters per minute.

Sampling Procedure :

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.
3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Data Sheet #S30.01

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S31.01 Class B

December 19, 1975

Substance:

sec-Amyl Acetate

Standard:

8-hour time-weighted average: 125 ppm (650 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S32.01

Class B

December 19, 1975

Substance:

tert-Butyl Acetate

Standard:

8-hour time-weighted average: 200 ppm (950 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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Data Sheet #S32.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample;

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S33

Substance:

Dibutyl Phthalate

Standard:

8-hour time-weighted average: 5 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the dibutyl phthalate aerosols present. The analyte is extracted from the filter with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 1.82 - 9.78 mg/cu m for a 30-liter sample at 23°C and 769 mm Hg atmospheric temperature and pressure.

Sampling equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm, three piece cassette filter holder held together by tape or shrinkable band; and a 37 mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 30 liters is recommended. Sample at a flow rate of 1.0 liter per minute.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

4. If the low flow rate pump is used, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1.0-liter per minute personal sample pump is used, position the middle of the rotameter ball to the 1.0-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and the sampling should be terminated at any evidence of a problem. Record the temperature and pressure of the atmosphere being sampled. If pressure reading is not available, record the elevation.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank: With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container designed to prevent damage in transit.

Reference:

Dibutyl Phthalate, NIOSH Method No. S33.

Sampling Data Sheet #S35.01

Class B

December 19, 1975

Substance:

Ethyl Acrylate

Standard:

8-hour time-weighted average: 25 ppm (100 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm$ 5% at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S35.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S36.01 Class B

December 19, 1975

Substance:

Ethyl Formate

Standard:

8-hour time-weighted average: 100 ppm (300 mg/cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S36.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

December 19, 1975

Substance:

Methyl Isoamyl Acetate (4-Methyl-2-pentyl acetate)

This compound is listed incorrectly as sec-Hexyl Acetate in 29CFR1910.93

Standard:

8-hour time-weighted average: 50 ppm (300 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S37.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

December 19, 1975

Substance:

Methyl Acrylate

Standard:

8-hour time-weighted average: 10 ppm (35 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 5 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S38.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

December 19, 1975

Substance:

Methyl Cellosolve Acetate

Standard:

8-hour time-weighted average: 25 ppm (120 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 20 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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Data Sheet #S39.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S40

Substance:

Di-2-ethylhexyl phthalate*

Standard:

8-hour time-weighted average: 5 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the di-2-ethylhexyl phthalate aerosol present. The analyte is extracted from the filter with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 2.03 - 10.9 mg/cu m for a 32-liter sample at 23°C and 761 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm, three-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm/0.8-micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 30 liters is recommended. Sample at a flow rate of 1.0-liter per minute.

Sampling Procedure :

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

* Listed incorrectly as di-sec-octyl phthalate in 29 CFR 1910.93

4. If the low flow rate pump is used, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1.0-liter per minute personal sample pump is used, position the middle of the rotameter ball to the 1.0-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and the sampling should be terminated at any evidence of a problem. Record the temperature and pressure of the atmosphere being sampled. If pressure reading is not available, record the elevation.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank: With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container designed to prevent damage in transit.

Reference:

Di-2-ethylhexyl phthalate, NIOSH Method No. S40.

Sampling Data Sheet #S41.01

Class B

December 19, 1975

Substance:

2-Ethoxyethyl Acetate

Standard:

8-hour time-weighted average: 100 ppm (540 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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Data Sheet #S41.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S42.01 Class B

December 19, 1975

Substance:

Methyl Acetate

Standard:

8-hour time-weighted average: 200 ppm (610 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 7 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S44.01 Class B

December 19, 1975

Substance:

Isobutyl Acetate

Standard:

8-hour time-weighted average: 150 ppm (700 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

December 19, 1975

Substance:

Isoamyl Acetate

Standard:

8-hour time-weighted average: 100 ppm (525 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S45.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations :

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample :

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

December 19, 1975

Substance:

sec-Butyl Acetate

Standard:

8-hour time-weighted average: 200 ppm (950 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S46.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

December 19, 1975

Substance:

Butyl Acetate

Standard:

8-hour time-weighted average: 150 ppm (710 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S47.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

December 19, 1975

Substance:

n-Propyl Acetate

Standard:

8-hour time-weighted average: 200 ppm (840 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size :

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure :

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S48.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S49.01 Class B

December 19, 1975

Substance:

Ethyl Acetate

Standard:

8-hour time-weighted average: 400 ppm (1400 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 6 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

December 19, 1975

Substance:

Isopropyl Acetate

Standard:

8-hour time-weighted average: 250 ppm (950 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 9 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample;

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S51.01 Class B

December 19, 1975

Substance:

n-Amyl Acetate

Standard:

8-hour time-weighted average: 100 ppm (525 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm$ 5% at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S51.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S52.01 Class B

February 5, 1976

Substance:

Allyl Alcohol

Standard:

8-hour time-weighted average: 2 ppm (4.75 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide containing 5% 2-propanol; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S52.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

sec-Butyl Alcohol

Standard:

8-hour time-weighted average: 150 ppm (455 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide containing 1% 2-propanol; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S53.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations :

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample :

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions :

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Cyclohexanol

Standard:

8-hour time-weighted average: 50 ppm (205 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide containing 5% 2-propanol; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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Data Sheet #S54.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S55.01

Class B

February 5, 1976

Substance:

Diacetone Alcohol

Standard:

8-hour time-weighted average: 50 ppm (240 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide containing 5% 2-propanol; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S55.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S56.01

Class B

February 5, 1976

Substance:

Ethyl Alcohol

Standard:

8-hour time-weighted average: 1000 ppm (1885 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide containing 1% 2-butanol; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 1 liter. Sample at a rate of 0.05 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations :

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample :

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions :

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Isoamyl Alcohol

Standard:

8-hour time-weighted average: 100 ppm (360 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide containing 5% 2-propanol; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S58.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Methyl Isobutyl Carbinol

Standard:

8-hour time-weighted average: 25 ppm (105 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide containing 5% 2-propanol the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S60.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S62.01 Class B

February 5, 1976

Substance:

Propyl Alcohol

Standard:

8-hour time-weighted average: 200 ppm (490 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide containing 1% 2-propanol; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm$ 5% at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size :

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure :

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S62.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations :

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample :

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions :

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S63.01 Class B

February 5, 1976

Substance:

tert-Butyl Alcohol

Standard:

8-hour time-weighted average: 100 ppm(305 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide containing 1% 2-butanol; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S63.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations :

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions :

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Isobutyl Alcohol

Standard:

8-hour time-weighted average: 100 ppm (305 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide containing 1% 2-propanol; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size :

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure :

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S64.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Isopropyl Alcohol

Standard:

8-hour time-weighted average: 400 ppm (985 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide containing 1% 2-butanol. the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 3 liters.

Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure :

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S65.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Butyl Alcohol

Standard:

8-hour time-weighted average: 100 ppm (305 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide containing 1% 2-propanol. The sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.



Data Sheet #S66.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Substance :

Chlorinated Camphene (Toxaphene)

Standard:

8-hour time-weighted average: 0.5 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the chlorinated camphene particulate present. The analyte is extracted from the filter with petroleum ether, and the analyte is separated and analyzed using a gas chromatograph with an electron capture detector. The method has been validated over the range of 0.227-1.167 mg/cu m for a 15-liter sample at 22°C and 761 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$, at 1 liter per minute; a 37-mm, three-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm/0.8-micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad. The filter holder should be made of polystyrene. Do not use tenite filter holders.

Sample Size:

A sample size of 15 liters is recommended. Sample at a flow of 1 liter per minute.

Sampling Procedure

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere

Data Sheet #S67

being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.0-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and the sampling should be terminated at any evidence of a problem.

5. The cellulose filter should be removed from the cassette filter holder and cellulose backup pad and placed in a clean screw cap bottle within 1 hour of sampling. Care must be taken to handle the filter only with clean tweezers. The tweezers and the screw cap bottle should be rinsed with petroleum ether before use. (Mallinckrodt Nanograde petroleum ether or equivalent)
6. Carefully record sample identity and all relevant sample data.
7. Blank: With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

The screw cap bottles in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Chlorinated Camphene, NIOSH Method No. S67.

December 19, 1975

Substance:

Dipropylene Glycol Methyl Ether

Standard:

8-hour time-weighted average: 100 ppm (610 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S69.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S70.01 Class B

February 5, 1976

Substance:

Glycidol

Standard:

8-hour time-weighted average: 50 ppm (150 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with tetrahydrofuran; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 50 liters. Sample at a rate of 1.0 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S70.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S71.01 Class B

February 5, 1976

Substance:

Methylal (Dimethoxymethane)

Standard:

8-hour time-weighted average: 1000 ppm (3110 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with hexane; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm$ 5% at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 2 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Phenyl Ether (vapor)

Standard:

8-hour time-weighted average: 1 ppm (7 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S73

Substance:

Phenyl Ether-Biphenyl Mixture

Standard:

8-hour time-weighted average: 1 ppm (7 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a silica gel tube to trap the phenyl ether-biphenyl vapors present. The analyte is desorbed from the silica gel tube with benzene, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 3.86-15.7 mg/cu m for a 10-liter sample at 23°C and 761 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range of 0.05 to 0.20 liter per minute, plus silica gel tube containing two sections of 20/40 mesh activated silica gel separated by a 2-mm portion of urethane foam.

Sample Size:

A sample size of 10 liters is recommended. Sample at a flow of 0.20 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of silica gel is used as a back-up and should be positioned nearest the sampling pump. The silica gel tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the phenyl ether-biphenyl mixture.
3. Air being sampled should not be passed through any hose or tubing before entering the silica gel tube.
4. Set the flow rate as accurately as possible using the manufacturer's

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directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.

5. The silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One silica gel tube should be handled in the same manner as the sample tubes (break, seal, and transport), except for the taking of an air sample. This tube should be labeled as a blank.

Special Consideration:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample. Since benzene is used rather than carbon disulfide to desorb the mixture from the silica gel, it is not possible to measure benzene in the sample with this desorbing solvent. If it is suspected that benzene is present, a separate sample should be collected for benzene analysis.
2. Due to the high resistance of the silica gel tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. Silica gel has a high affinity for water, so organic vapors will not be trapped efficiently in the presence of a high relative humidity. This effect may be important even though there is no visual evidence of condensed water in the silica gel tube.
4. The desorption efficiency of silica gel varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain silica gel from the same batch. Several unused silica gel tubes should accompany the samples. Information on the batch number of the silica gel must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

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Shipping Instructions:

Capped silica gel tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Phenyl Ether-Biphenyl Mixture, NIOSH Method No. S73.

Sampling Data Sheet #S74.01 Class B

December 19, 1975

Substance:

Phenyl Glycidyl Ether

Standard:

8-hour time-weighted average: 10 ppm (60 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 50 liters. Sample at a rate of 1.0 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S75.01 Class B

December 19, 1975

Substance:

Propylene Oxide

Standard:

8-hour time-weighted average: 100 ppm (240 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm$ 5% at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 5 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S76.01 Class B

February 5, 1976

Substance:

2-Butoxy Ethanol (Butyl Cellosolve)

Standard:

8-hour time-weighted average: 50 ppm (240 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with 5% methanol in methylene chloride; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S77.01 Class B

December 19, 1975

Substance:

Isopropyl Glycidyl Ether

Standard:

8-hour time-weighted average: 50 ppm (240 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S78.01 Class B

December 19, 1975

Substance:

Tetrahydrofuran

Standard:

8-hour time-weighted average: 200 ppm (560 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 9 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Methyl Cellosolve

Standard:

8-hour time-weighted average: 25 ppm (80 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with 5% methanol in methylene chloride; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 50 liters. Sample at a rate of 1.0 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Ethyl Ether

Standard:

8-hour time-weighted average: 400 ppm (1210 mg/cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with ethyl acetate; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 3 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S81.01 Class B

December 19, 1975

Substance:

n-Butyl Glycidyl Ether

Standard:

8-hour time-weighted average: 50 ppm (270 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size :

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure :

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S82.01 Class B

December 19, 1975

Substance:

Cyclohexene

Standard:

8-hour time-weighted average: 300 ppm (1010 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 5 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure :

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S82.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

December 19, 1975

Substance:

Naptha, Coal Tar (Boiling range: 154-195 C)

Standard:

8-hour time-weighted average: 100 ppm (400 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations :

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S87

Substance :

Propane

Standard:

8-hour time-weighted average: 1000 ppm (1800 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

The propane vapor present in the atmosphere is measured directly by drawing the air sample into a combustible gas meter properly calibrated with propane. The meter reading is recorded and the equivalent concentration in ppm is read off the calibration curve. The method has been validated over the range of 481-2016 ppm at 20.5°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment :

Dual range explosive gas meter such as the MSA Model 40 is used. No sample is actually collected since the atmosphere to be analyzed is usually drawn into the meter using a rubber aspirator bulb. The air can also be drawn into the meter with a personal sampling pump.

Sampling Procedure :

The instructions given in the manual for the appropriate combustible gas meter used must be followed carefully for proper results. Typically, the procedure will require the following steps:

1. The combustion chamber must be swept free of combustible gases and be filled with fresh air.
2. Batteries must be turned on, and the proper voltage applied to the bridge.
3. The bridge must be balanced to zero deflection on the meter with fresh air in the open chamber.
4. The sample is drawn into the meter, and the meter reading is recorded. Repeat at least three times and report average.
5. The concentration of propane in the air samples tested is determined from the calibration curve provided with the properly calibrated meter.

Data Sheet #S87

Special Consideration :

1. Any hydrocarbon present in the atmosphere will interfere with the analysis. Where other hydrocarbons are known or suspected to be present in the air, such information, including their suspected identities, should be noted.
2. Water vapor will impair the proper functioning of the sensing filaments. When testing atmospheres of high humidity, use available cotton filters or special humidity conditioning sample probes to remove excessive dust and moisture from the sample under test.

Reference :

Instrument Manual, MSA Combustible Gas Indicator, Model 40, Mine Safety Appliance Company, Pittsburgh, Pennsylvania.

December 19, 1975

Substance:

Turpentine (Boiling range 150-170 C)

Standard:

8-hour time-weighted average: 100 ppm (560 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm$ 5% at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S88.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Heptane

Standard:

8-hour time-weighted average: 500 ppm (2000 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 4 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S89.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S90.01 Class B

February 5, 1976

Substance:

Hexane

Standard:

8-hour time-weighted average: 500 ppm (1800 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 4 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S90,01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S91.01 Class B

December 19, 1975

Substance:

Butadiene

Standard:

8-hour time-weighted average: 1000 ppm (2200 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 1 liter. Sample at a rate of 0.05 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S91.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S92

Substance:

Ketene

Standard:

8-hour time-weighted average: 0.5 ppm (0.9 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a midget bubbler which contains 10 ml of alkaline hydroxylammonium chloride solution. The ketene is hydrolyzed to acetohydroxamic acid and is subsequently reacted with ferric chloride to form the purple complex.

The amount of complex is determined with a spectrophotometer to give a quantitative measure of ketene. The method has been validated over the range of 0.40-1.74 mg/cu m for a 50-liter sample at 23°C and 757 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, at 1.0 liter per minute for 50 minutes, plus standard midget bubbler fitted with fritted glass inlet containing 10 ml of absorbing solution prepared according to the NIOSH Method S92. The sampling pump is protected from splashover or water condensation by an adsorption tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump.

Sample Size:

A sample of 50 liters is recommended. This requires a sampling period of 50 minutes at a flow of 1.0 liter per minute.

Sampling Procedure:

1. Connect the bubbler to the sampling pump with a short piece of flexible tubing containing a glass wool plug to protect the pump.
2. The bubbler must be maintained in a vertical position during the sampling.
3. Air being sampled should not be passed through any hose or tubing before entering the bubbler.

Data Sheet #S92

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1-liter per minute personal sampler pump is used, position the middle of the rotameter ball to the 1-liter per minute calibration mark as accurately as possible.
5. After sampling, the bubbler stem can be removed and cleaned. Tap the stem gently against the inside wall of the bubbler bottle to recover as much of the sampling solution as possible. Wash the stem with 1.0 ml of unused absorbing solution and add the washing to the bubbler. Make up the solution volume in the bubbler to 10.0 ml using unused absorbing solution or distilled water. (Note: All subsequent dilutions and measurements are based on this sample volume of 10.0 ml).
6. Quantitatively transfer (avoiding any loss of sample solution) the total contents of the bubbler into a 20-ml polyethylene scintillation vial with screw cap. Close cap tightly and secure with plastic tape around edges to avoid sample loss during transit.
7. Care should be taken to minimize spillage or loss by evaporation at all times.
8. A "blank" bubbler should be handled as the other samples (fill, transfer, seal and transport) except that no air is sampled through this bubbler.

Special Consideration:

Where esters or anhydrides, such as acetic anhydride, are known or suspected to be present in the air sampled, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

Whenever possible, hand delivery of the samples is recommended. Otherwise, special shipping cases should be used to ship the samples.

Reference:

Ketene, NIOSH Method No. S92.

Sampling Data Sheet # S93

Substance :

LPG (Liquified Petroleum Gas)

Standard:

8-hour time-weighted average: 1000 ppm (1800 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

The LPG vapor present in the atmosphere is measured directly by drawing the air sample into a combustible gas meter properly calibrated with LPG. The meter reading is recorded and the equivalent concentration in ppm is read off the calibration curve. The method has been validated over the range of 478-2006 ppm at 23°C and 750 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A dual range explosive gas meter of sufficient sensitivity, such as the Davis Vapotester Model M 6, must be used. No sample is actually collected since the atmosphere to be analyzed is usually drawn into the meter using a rubber aspirator bulb. The air can also be drawn into the meter with a personal sampling pump.

Sampling Procedure:

The instructions given in the manual for the appropriate combustible gas meter used must be followed carefully for proper results. Typically, the procedure will require the following steps:

1. The combustion chamber must be swept free of combustible gases and be filled with fresh air.
2. Batteries must be turned on, and the proper voltage applied to the bridge.
3. The bridge must be balanced to zero deflection on the meter with fresh air in the open chamber.
4. The sample is drawn into the meter, and the meter reading is recorded. Repeat at least three times and report average.
5. The concentration of LPG in the air samples tested is determined from the calibration curve provided with the properly calibrated meter.

Data Sheet #S93

Special Consideration:

1. Any hydrocarbon present in the atmosphere will interfere with the analysis. Where other hydrocarbons are known or suspected to be present in the air, such information, including their suspected identities, should be noted.
2. Water vapor will impair the proper functioning of the sensing filaments. When testing atmospheres of high humidity, use available cotton filters or special humidity conditioning sample probes to remove excessive dust and moisture from the sample under test.

Reference:

Instruction Manual, Davis Vapotester Model M-6, Davis Instruments,
45 Halleck Street, Newark, New Jersey.

Sampling Data Sheet # S94

Substance:

Methylcyclohexane

Standard:

8-hour time-weighted average: 500 ppm (2000 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a charcoal tube to trap the methylcyclohexane vapors present. The analyte is desorbed from the charcoal with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 940 - 3941 mg/cu m for a 4-liter sample at 18.5°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range 0.05 to 0.2 liters per minute, plus charcoal tube containing two sections of 20/40 mesh activated charcoal separated by a 2-mm portion of urethane foam.

Sample Size:

A sample size of 4 liters is recommended. Sample at a flow rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a back-up and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.

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5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport), except for the taking of an air sample. This tube should be labeled as a blank.

Special Consideration:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method placed a heavy load on the sampling pump. Therefore, no more than ten charcoal tube samples should be taken without fully recharging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Methylcyclohexane, NIOSH Method No. S94

Sampling Data Sheet #S95.01 Class B

December 19, 1975

Substance:

Propylene Dichloride

Standard:

8-hour time-weighted average: 75 ppm (350 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S95,01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample :

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions :

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Substance:

Pentachloronaphthalene

Standard:

8-hour time-weighted average: 0.5 mg/cu m - skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a glass fiber filter connected in series with a midget bubbler containing 15 ml of iso-octane to trap the pentachloronaphthalene present. The solution in the midget bubbler is transferred to a 20-ml scintillation vial and the filter is added. The analyte is separated and analyzed using a gas chromatograph with an electrolytic conductivity detector. The method has been validated over the range of 0.293-1.541 mg/cu m for a 250-liter sample at 23°C and 761 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$, at 1.3 liters per minute; a 37-mm, two-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm diameter glass fiber filter connected in series with a midget bubbler. The filter holder should be made of polystyrene. Do not use Tenite filter holders. The sampling pump is protected from splashover or solvent condensation by a 5-cm long X 6-mm I.D. glass tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump. (One hundred milliliters of iso-octane should accompany each set of samples for rinsing the bubbler stems and transferring the contents of the bubblers to the scintillation vials.) The scintillation vials which are used for shipping should be marked at 15 ml.

Sample Size:

A sample size of 250 liters, taken at a flow rate of 1.5 liters per minute, is recommended.

Sampling Procedure:

1. Assemble the filter in the two-piece filter cassette holder and close firmly. Pipet 15 ml of the collection medium (iso-octane)

into each bubbler and mark the liquid level. The liquid level in the bubbler must be checked frequently. If the liquid level is lowered by an appreciable amount (to less than 10 ml) from evaporation, the bubbler must be refilled with additional iso-octane.

2. Remove the cassette plugs and attach the outlet of the filter cassette to the inlet arm of the midget bubbler using a short piece of flexible tubing. Connect the outlet arm of the midget bubbler with a 5-cm glass splashover tube (6-mm I.D.) containing the glass wool plug, then to the personal sampling pump, using short pieces of flexible tubing. The bubbler must be maintained in a vertical position during sampling.
3. Air being sampled should not pass through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.3-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. After sampling, remove the bubbler stem and tap the stem gently against the inside wall of the bubbler bottle to recover as much of the sampling solution as possible. Rinse the bubbler stem with 1 ml of iso-octane into the midget bubbler.
6. Transfer the contents of the midget bubbler to the scintillation vial which has been marked at 15 ml. Rinse the bubbler with 2 ml of iso-octane, adding rinse to the vial. Bring the volume in the vial to the 15-ml mark with iso-octane.
7. Remove the glass fiber filter from the cassette filter holder and place into the scintillation vial. Care must be taken to handle the filter only with clean tweezers. Cap the scintillation vial with an appropriate cap with a Teflon cap liner.
8. Carefully record the sample identity and all relevant sampling data.
9. With each batch of ten samples submit one filter and midget bubbler which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Data Sheet #S96

Special Consideration :

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The scintillation vials in which the samples are stored should be shipped in a suitable container, designed to prevent damage in transit.

Reference :

Pentachloronaphthalene, NIOSH Method No. S96.

Sampling Data Sheet # S97

Substance:

Octachloronaphthalene

Standard:

8-hour time-weighted average: 0.1 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the octachloronaphthalene aerosol present. The analyte is extracted from the filter with hexane, and the sample is separated and analyzed using a gas chromatograph with an electron capture detector. The method has been validated over the range of 0.055-0.215 mg/cu m for a 30-liter sample at 26°C and 756 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three piece cassette filter holder held together by tape or shrinkable band; and a 37-mm/0.8-micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 30 liters is recommended. Sample at a flow rate of 1.0 liter per minute.

Sampling Procedure:

1. Assemble the filter and three piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

Data Sheet #S97

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1.0 liter per minute personal sampler pump is used, position the middle of the rotameter ball to the 1.0 liter per minute mark as accurately as possible.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference :

Octachloronaphthalene, NIOSH Method No. S97.

December 19, 1975

Substance:

Methyl Iodide

Standard:

8-hour time-weighted average: 5 ppm (28 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with toluene; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 50 liters. Sample at a rate of 1.0 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S98,01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample :

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions :

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S100

Substance :

Hexachloronaphthalene

Standard:

8-hour time-weighted average: 0.2 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the hexachloronaphthalene aerosol present. The analyte is extracted from the filter with hexane, and the sample is separated and analyzed using a gas chromatograph with an electron capture detector. The method has been validated over the range of 0.104-0.459 mg/cu m for a 30-liter sample at 26°C and 759 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three piece cassette filter holder held together by tape or shrinkable band; and a 37 mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size :

A sample size of 30 liters is recommended. Sample at a flow rate of 1.0 liter per minute.

Sampling Procedure :

1. Assemble the filter and three piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

Data Sheet #S100

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1.0 liter per minute personal sampler pump is used, position the middle of the rotameter ball to the 1.0 liter per minute mark as accurately as possible.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Hexachloronaphthalene, NIOSH Method No. S100

December 19, 1975

Substance:

Hexachloroethane

Standard:

8-hour time-weighted average: 1 ppm (10 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S100,01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S102

Substance :

Fluorotrichloromethane

Standard:

8-hour time-weighted average: 1000 ppm (5600 mg/cu m)

Analytical Method:

A known volume of air is drawn through a charcoal tube to trap the fluorotrichloromethane vapors present. The fluorotrichloromethane is desorbed from the charcoal with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 2390 - 10520 mg/cu m for a 4-liter sample at 25°C and 752 mm Hg atmospheric temperature and pressure.

Sampling Equipment :

The sampling equipment needed consists of a charcoal sampling tube and a personal sampling pump calibrated with a representative charcoal tube in the line. The pump flow rate should be determined accurately, $\pm 5\%$, at 0.01 to 0.05 liter per minute. A suitable tube holder should be used to protect the worker from the sharp edges of the glass sampling tube.

The charcoal tube used to collect the sample consists of a glass tube flame sealed at both ends, 10-cm long with an 8-mm O.D. and a 6-mm I.D., packed with two sections of 20/40 mesh-activated coconut charcoal. The two sections include a front section containing 400 mg of charcoal and a backup section containing 200 mg. The two sections are separated by a 2-mm portion of urethane foam, and a 3-mm portion of urethane foam is placed between the outlet end of the tube and the backup section. A plug of silylated glass wool is placed in front of the adsorbing section. The pressure drop across the tube must be less than 25 mm of mercury at a flow rate of 1 liter per minute.

Sample Size:

A sample size of 4 liters is recommended. Sample at a flow rate of 0.01 to 0.05 liter per minute; do not use flow rates less than 0.01 liter per minute.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken so as to provide openings approximately one-half the internal diameter of the tubes.
2. The section containing 200 mg of charcoal is used as a backup and should be positioned nearest the sampling pump. The charcoal tube series should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.
3. Air being sampled should not be passed through any hose or tubing before entering the front section of the charcoal tube.
4. A low flow rate pump is used. Set the flow rate as accurately as possible using the manufacturer's directions. Record all the necessary information to determine flow rate or volume and also record the initial and final sampling time. Record the temperature and pressure of the atmosphere being sampled. If pressure reading is not available, record the elevation.
5. The charcoal tubes should be labeled properly and capped with the supplied plastic caps immediately after sampling. Under no circumstances should rubber caps be used.
6. One large charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport), except for the taking of an air sample. This tube should be labeled as a blank. Submit one blank for every batch of 10 samples.

In addition, several unused and sealed charcoal tubes should accompany the samples. These tubes are used in desorption efficiency studies in conjunction with these samples, because desorption efficiency varies from one batch of charcoal to another. Record the batch number of the charcoal used.

Special Considerations:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than 8 hours of sampling should be done without first fully recharging the battery.
3. The sample size recommended is based on two-thirds the breakthrough capacity at 90% relative humidity for a test atmosphere at 2S the

Data Sheet #S102

OSHA standard level. If condensation of water occurs in the tube, the substance may not be trapped quantitatively.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping.

Reference:

Fluorotrichloromethane, NIOSH Method No. S102

February 5, 1976

Substance:

Ethylene Chlorohydrin

Standard:

8-hour time-weighted average: 5 ppm (16 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide containing 5% isopropyl alcohol; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh petroleum based activated charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer. Coconut charcoal does not give satisfactory results.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm$ 5% at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 20 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S103.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Ethylene Dibromide

Standard:

Ceiling: 30 ppm (230 mg/cu m)

Peak: 50 ppm (385 mg/cu m); maximum duration - 5 minutes in any 3 hours

8-hour time-weighted average: 20 ppm (155 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

1. To evaluate time-weighted average concentrations, a sample size of 10 liters is recommended. Sample at a rate of 0.2 liters per minute or less.
2. To evaluate ceiling concentrations, a sample volume of 1-liter is recommended. Sample at a rate of 0.2 liters per minute or less.
3. To evaluate peak concentrations, a sample size of 1 liter is recommended. Sample for 5 minutes at a rate of 0.2 liters per minute.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.
3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Ethyl Bromide

Standard:

8-hour time-weighted average: 200 ppm (890 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with isopropyl alcohol; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 4 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S106.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Difluorodibromomethane

Standard:

8-hour time-weighted average: 100 ppm (860 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with isopropyl alcohol; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.20 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S107.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S108

Substance:

Dichlorotetrafluoroethane*

Standard:

8-hour time-weighted average: 1000 ppm (7000 mg/cu m)

Analytical Method:

A known volume of air is drawn through a charcoal tube containing activated coconut charcoal connected in series with a smaller backup charcoal tube to trap the dichlorotetrafluoroethane vapors present. The dichlorotetrafluoroethane is desorbed from the charcoal with methylene chloride, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 3540-14090 mg/cu m for a 3-liter sample at 25°C and 759 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

Sampling equipment includes a calibrated personal sampling pump whose flow can be determined accurately (+5%) in the range of 0.01 to 0.05 liter/minute. A larger charcoal tube (approximately 10-cm long with a 8-mm O.D. and a 6-mm I.D.), containing two sections of 20/40 mesh activated coconut charcoal separated by a 2-mm portion of urethane foam, is used to collect the samples. The front section of the tube contains 400 mg of charcoal, and the back section contains 200 mg. A smaller charcoal tube (6-mm O.D. and 4-mm I.D.) is used as a backup tube. This charcoal tube contains 100 mg of charcoal in the front section and 50 mg in the back section.

Sample Size:

A maximum sample size of 3 liters is recommended. Sample at a flow rate between 0.01 and 0.05 liter per minute.

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Sampling Procedure:

1. Immediately before sampling, the ends of the large and small charcoal tubes should be broken so as to provide an opening at least one-half the internal diameter of the tube.
2. Connect the larger charcoal tube in line with the smaller charcoal tube by connecting the backup section of the large charcoal tube to the front section of the small charcoal tube with Tygon tubing. The shortest length of tubing compatible with maintaining a leak-free connection should be used. The smaller charcoal tube is used as a backup and should be positioned nearer the sampling pump. Air should flow through the large charcoal tube before entering the small charcoal tube. The charcoal tubes should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of dichlorotetrafluoroethane.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature, relative humidity, and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Also report the type of sampling pump that is used.
5. The charcoal tubes should be separated and capped individually with plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used. Each set of tubes should be marked to identify the large charcoal tube with the corresponding backup charcoal tube.
6. With each batch of ten samples, submit one set of charcoal tubes (a large charcoal tube and a smaller backup charcoal tube) from the same lot of tubes used for sample collection. These tubes must be subjected to exactly the same handling as the samples except that no air is drawn through them. Label this set of tubes as a blank. Information on the batch number of the charcoal must be supplied.

Special Considerations:

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Data Sheet #S108

2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without first fully recharging the battery.
3. The volume recommended is based on high humidity breakthrough tests. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping.

Reference:

Dichlorotetrafluoroethane, NIOSH Method No. S108.

Sampling Data Sheet # S109

Substance:

Dichloromonofluoromethane

Standard:

8-hour time-weighted average: 1000 ppm (4200 mg/cu m)

Analytical Method:

A known volume of air is drawn through two charcoal tubes connected in series to trap the dichloromonofluoromethane vapors present. The dichloromonofluoromethane is desorbed from the charcoal with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 1730-7640 mg/cu m for a 3-liter sample at 24°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

The sampling equipment needed includes a calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, at 0.05 liter per minute or less and a charcoal sampling tube.

The sampling tube series consists of two separate large charcoal tubes. The tubes are glass tubes with both ends flame-sealed, 10-cm long with an 8-mm O.D. and a 6-mm I.D. Each tube contains the appropriate amount of 20/40 mesh activated coconut charcoal. The front tube contains 400 mg of charcoal; the backup tube, 200 mg. A plug of silylated glass wool is placed at each end of the charcoal tubes. The pressure drop across the tubes must be less than one inch of mercury at a flow rate of 1 liter per minute.

This tube series can be prepared by modifying commercially available large charcoal tubes as follows. For the front tube--break off exit end of a large tube and using pointed tweezers remove glass wool plug and the backup charcoal section; push in snugly remaining plug and charcoal to minimize channeling. For the backup tube--similarly break off inlet end of a second large tube and remove retaining plug and the front charcoal section; again push together remaining plug and charcoal. The front tube is connected to the backup tube with a minimal piece of plastic or rubber tubing.

Note: This sampling tube scheme is necessary to minimize observed sample migration effects upon storage.

Sample Size:

A sample size of 3 liters is recommended. Sample at a flow rate of 0.01 to 0.05 liter per minute; do not use flow rates less than 0.01 liter per minute.

Sampling Procedure :

1. Immediately before sampling, the ends of the tubes should be broken so as to provide openings approximately one-half the internal diameter of the tubes. Prepare and assemble tubes as described in sampling equipment section. Connect the front 400-mg tube to the 200-mg backup tube with a short piece of tubing.
2. The tube containing 200 mg of charcoal is used as a backup and should be positioned nearest the sampling pump. The charcoal tube series should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.
3. Air being sampled should not be passed through any hose or tubing before entering the front charcoal tube.
4. A low flow rate pump is used. Set the flow rate as accurately as possible using the manufacturer's directions. Record the necessary information to determine flow rate and also record the initial and final sampling time. Record the temperature and pressure of the atmosphere being sampled. If pressure reading is not available, record the elevation.
5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used. The two tubes must be separated and each tube recapped tightly. The tubes should be identified accordingly to distinguish the corresponding pair of front and backup sampling tubes.
6. One set of charcoal tubes (a 400-mg tube and a 200-mg backup tube) should be handled in the same manner as the sample tubes (break, seal, and transport), except for the taking of an air sample. This set of tubes should be labeled as a blank. Submit one blank for every batch of 10 samples.

In addition, several unused and sealed charcoal tubes should accompany the samples. These tubes are used in desorption efficiency studies in conjunction with these samples because desorption efficiency varies from one batch of charcoal to another. Record the batch number of the charcoal used.

Special Considerations:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than 8 hours of sampling should be done without first fully recharging the battery.
3. The sample size recommended is based on two-thirds the breakthrough capacity at 90% relative humidity for a test atmosphere at 2S the OSHA standard level. If condensation of water occurs in the tube, the substance may not be trapped quantitatively.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping.

Reference:

Dichloromonofluoromethane, NIOSH Method No. S109.

December 19, 1975

Substance:

1,2-Dichloroethylene

Standard:

8-hour time-weighted average: 200 ppm (790 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 3 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S111

Substance:

Dichlorodifluoromethane*

Standard:

8-hour time-weighted average: 1000 ppm (4950 mg/cu m)

Analytical Method:

A known volume of air is drawn through a tube containing activated coconut charcoal connected in series with a smaller backup charcoal tube to trap the dichlorodifluoromethane vapors present. The dichlorodifluoromethane is desorbed from the charcoal with methylene chloride, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 2940-10500 mg/cu m for a 3-liter sample at 25°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

Sampling equipment includes a calibrated personal sampling pump whose flow can be determined accurately (+5%) in the range of 0.01 to 0.05 liter per minute. A larger charcoal tube (approximately 10-cm long with a 8-mm O.D. and a 6-mm I.D.), containing two sections of 20/40 mesh activated coconut charcoal separated by a 2-mm portion of urethane foam, is used to collect the samples. The front section of the tube contains 400 mg of charcoal, and the back section contains 200 mg. A smaller charcoal tube (6-mm O.D. and a 4-mm I.D.) is used as a backup tube. This charcoal tube contains 100 mg of charcoal in the front section and 50 mg in the back section.

Sample Size:

A maximum sample size of 3 liters is recommended. Sample at a flow rate between 0.01 and 0.05 liter per minute.

Sampling Procedure:

1. Immediately before sampling, the ends of the large and small charcoal tubes should be broken so as to provide an opening at least one-half the internal diameter of the tube.
2. Connect the larger charcoal tube in line with the smaller charcoal tube by connecting the backup section of the larger charcoal tube to the front section of the small charcoal tube with Tygon tubing. The shortest length of tubing compatible with maintaining a leak-free

*Refrigerant 12

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connection should be used. The smaller charcoal tube is used as a backup and should be positioned nearer the sampling pump. Air should flow through the larger charcoal tube before entering the small charcoal tube. The charcoal tubes should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of dichlorodifluoromethane.

3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature, relative humidity, and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Also report the type of sampling pump that is used.
5. The charcoal tubes should be separated and capped individually with plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used. Each set of tubes should be marked to identify the large charcoal tube with the corresponding backup charcoal tube.
6. With each batch of ten samples, submit one set of charcoal tubes (a larger charcoal tube and a smaller backup charcoal tube) from the same lot of tubes used for sample collection. These tubes must be subjected to exactly the same handling as the samples except that no air is drawn through them. Label this set of tubes as a blank. Information on the batch number of the charcoal must be supplied.

Special Considerations:

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without first fully recharging the battery.
3. The volume recommended is based on high humidity breakthrough tests. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping.

Reference:

Dichlorodifluoromethane, NIOSH Method No. S111.

Sampling Data Sheet # S112

Substance:

Chloroprene*

Standard

8-hour time-weighted average: 25 ppm (90 mg/cu m) - skin

Analytical Method:

A known volume of air is drawn through a charcoal tube containing activated coconut charcoal to trap the chloroprene vapors present. The chloroprene is desorbed from the charcoal with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 44.2-173.9 mg/cu m for a 3-liter sample at 21°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

Sampling equipment includes a calibrated personal sampling pump whose flow can be determined accurately (+5%) in the range of 0.01 to 0.05 liter per minute. A charcoal tube (7-cm long with a 6-mm O.D. and a 4-mm I.D.), containing two sections of 20/40 mesh activated coconut charcoal separated by a 2-mm portion of urethane foam, is used to collect the samples. The front section of the tube contains 100 mg of charcoal, and the back section contains 50 mg.

Sample Size:

A maximum sample size of 3 liters is recommended. Sample at a flow rate between 0.01 and 0.05 liter per minute. Do not sample at a flow rate less than 0.01 liter per minute.

Sampling Procedure:

1. Immediately before sampling, the ends of the charcoal tube should be broken so as to provide an opening at least one-half the internal diameter of the tube. All tubes must be from the same manufacturer's lot.

*2-Chloro-1,3-butadiene

2. The smaller section of charcoal is used as a backup and should be positioned nearer the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of chloroprene.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature, relative humidity, and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Also report the type of sampling pump that is used.
5. The charcoal tube should be capped individually with plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples, submit one charcoal tube from the same lot of tubes used for sample collection. This tube must be subjected to exactly the same handling as the samples except that no air is drawn through it. Label this tube as a blank. Information on the batch number of the charcoal must be supplied.

Special Considerations:

1. When other compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without first fully recharging the battery.
3. The volume recommended is based on high humidity breakthrough tests. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Data Sheet #S112

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Chloroprene, NIOSH Method No. S112.

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Substance:

Chlorobromomethane

Standard:

8-hour time-weighted average: 200 ppm (1050 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 5 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S113,01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Bromoform

Standard:

8-hour time-weighted average: 0.5 ppm (5 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S114.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

December 19, 1975

Substance:

Benzyl Chloride

Standard:

8-hour time-weighted average: 1 ppm (5 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S115.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

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Substance:

Allyl Chloride

Standard:

8-hour time-weighted average: 1 ppm (3 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with benzene; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 100 liters. Sample at a rate of 1.0 liter per minute or less.

Sampling Procedure;

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Acetylene Tetrabromide

Standard:

8-hour time-weighted average: 1 ppm (14 mg/ cu m)

Analytical Method:

A known volume of air is drawn through silica gel to trap the contaminant vapors present. The analyte is desorbed with tetrahydrofuran; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Silica Gel Tube: The silica gel tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh silica gel. The first section contains 150 mg of silica gel while the backup section contains 75 mg of silica gel. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative silica gel tube in line.

Sample Size:

The recommended sample volume is 100 liters. Sample at a rate of 1.0 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the silica gel is used as a backup section and should be positioned nearest the sampling pump. The silica gel tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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3. Air being sampled should not pass through any hose or tubing before entering the silica gel tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One silica gel tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the silica gel tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the silica gel, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of silica gel varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain silica gel from the same batch. Information on the batch number of the silica gel must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped silica gel tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

December 19, 1975

Substance:

Epichlorohydrin (1-Chloro-2,3-epoxypropane)

Standard:

8-hour time-weighted average: 5 ppm (20 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 20 liters. Sample at a rate of 0.2 liters per minute or less .

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S119

Substance:

Chlorinated Diphenyl Oxide

Standard:

8-hour time-weighted average: 0.5 mg/cu m

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a cellulose membrane filter to trap the chlorinated diphenyl oxide particulate present. The analyte is extracted from the filter with iso-octane, and the analyte is separated and analyzed using a gas chromatograph with an electrolytic conductivity detector. The method has been validated over the range of 0.1002-0.965 mg/cu m for a 90-liter sample at 22°C and 767 mm Hg atmospheric temperature and pressure.

Sampling Equipment;

A calibrated personal sampling pump whose flow can be determined to an accuracy of + 5%, at 1.5 liters per minute; a 37-mm two-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm diameter/0.8-micrometer pore size mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad. The filter holder should be made of polystyrene. Do not use Tenite filter holders.

Sample Size:

A sample size of 90 liters is recommended. Sample at a flow of 1.5 liters per minute.

Sampling Procedure :

1. Assemble the filter and two-piece filter cassette and close firmly. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with a shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

Data Sheet #S119

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. The cellulose filter should be removed from the cassette filter holder and cellulose backup pad and placed in a clean screw cap bottle within 1 hour of sampling. Care must be taken to handle the filter only with clean tweezers.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The screw cap bottles in which the samples are collected should be shipped in a suitable container designed to prevent damage in transit. The bottle caps should be lined with Teflon for proper seal.

Reference:

Chlorinated Diphenyl Oxide, NIOSH Method No. S119.

Sampling Data Sheet # S121

Substance :

Chlorodiphenyl (54% Chlorine)

Standard:

8-hour time-weighted average: 0.5 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method :

A known volume of air is drawn through a cellulose membrane filter to trap the chlorodiphenyl (54% chlorine) particulate present. The analyte is extracted from the filter with petroleum ether, and the analyte is separated and analyzed using a gas chromatograph with an electron capture detector. The method has been validated over the range of 0.322-1.255 mg/cu m for a 100-liter sample at 22°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment :

A calibrated personal sampling pump whose flow can be determined to an accuracy of +5%, at 1.5 liters per minute; a 37-mm three piece cassette filter holder held together by tape or shrinkable band; and a 37-mm/0.8-micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad. The filter holder should be made of polystyrene. Do not use Tenite filter holders.

Sample Size :

A sample size of 100 liters is recommended. Sample at a flow of 1.5 liters per minute.

Sampling Procedure ;

1. Assemble the filter and three piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sample should not be passed through any hose or tubing before entering the filter cassette.

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Data Sheet #S121

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and the sampling should be terminated at any evidence of a problem.
5. The cellulose filter should be removed from the cassette filter holder and cellulose backup pad and placed in a clean screw cap bottle within 1 hour of sampling. Care must be taken to handle the filter only with clean tweezers. The tweezers and the screw cap bottle should be rinsed with petroleum ether and dried before use.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

Where substances other than the analyte are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected substance should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

The screw cap bottles in which the samples are collected should be shipped in a suitable container designed to prevent damage in transit. The bottle caps should be lined with Teflon for proper seals. Never transport, mail, or ship the bulk sample in the same container with the sample or blank filter.

Reference:

Chlorodiphenyl (54% Chlorine), NIOSH Method No. S121.

February 5, 1976

Substance:

Ethylene Dichloride (1,2-Dichloroethane)

Standard:

Ceiling: 100 ppm (405 mg/cu m)

Peak: 200 ppm (810 mg/cu m); maximum duration - 5 minutes in any 3 hours

8-hour time-weighted average: 50 ppm (200 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

1. To evaluate time weighted average concentrations, a sample size of 10 liters is recommended. Sample at a rate of 0.2 lpm or less.
2. To evaluate ceiling concentrations, a sample volume of 3 liters is recommended. Sample for 15 minutes at a rate of 0.2 liters per minute.
3. To evaluate peak concentrations, a sample size of 1 liter is recommended. Sample for 5 minutes at a rate of 0.2 liters per minute.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.
3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Data Sheet #S122.01

Bulk Sample :

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions :

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

December 19, 1975

Substance:

1,1-Dichloroethane (Ethylidene Chloride)

Standard:

8-hour time-weighted average: 100 ppm (405 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S123.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

1,1,2,2-Tetrachloroethane

Standard:

8-hour time-weighted average: 5 ppm (35 mg/cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of petroleum-based charcoal while the backup section contains 50 mg of petroleum-based charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.20 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S124,01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Trifluoromonobromomethane

Standard:

8-hour time-weighted average: 1000 ppm (6090 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with methylene chloride; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Small Charcoal Tube: This charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Large Charcoal Tube: This charcoal tube has an inside diameter of 6-mm and contains two sections of 20/40 mesh charcoal. The first section contains 400 mg of activated charcoal while the backup section contains 200 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 1 liters. Sample at a rate of 0.05 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. Connect the large charcoal tube to the small charcoal tube with Tygon tubing. The shortest length of tubing compatible with

maintaining a leak free connection should be used. The small charcoal tube is used as a back-up tube and is placed between the sampling pump and the large charcoal tube. The charcoal tubes should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tubes are placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Data Sheet #S125.01

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

December 19, 1975

Substance:

1,2,3-Trichloropropane

Standard:

8-hour time-weighted average: 50 ppm (300 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm$ 5% at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S126.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S128

Substance:

Trichloronaphthalene

Standard:

8-hour time-weighted average: 5 mg/cu m - skin

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a glass fiber filter connected in series with a midget bubbler containing 15 ml of iso-octane to trap the trichloronaphthalene present. The solution in the midget bubbler is transferred to a 20-ml scintillation vial and the filter is added. The analyte is separated and analyzed using a gas chromatograph with an electrolytic conductivity detector. The method has been validated over the range of 1.647-8.79 mg/cu m for a 100-liter sample at 22°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$, at 1.3 liters per minute; a 37-mm two-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm diameter glass fiber filter connected in series with a midget bubbler. The filter holder should be made of polystyrene. Do not use Tenite filter holders. The sampling pump is protected from splashover or solvent condensation by a 5-cm long X 6-mm I.D. glass tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump. (One hundred milliliters of iso-octane should accompany each set of samples for rinsing the bubbler stems and transferring the contents of the bubblers to the scintillation vials.) The scintillation vials which are used for shipping should be marked at 15 ml.

Sample Size:

A sample size of 100 liters, taken at a flow rate of 1.3 liters per minute, is recommended.

Sampling Procedure:

1. Assemble the filter in the two-piece filter cassette holder and close firmly. Pipet 15 ml of the collection medium (iso-octane)

into each bubbler and mark the liquid level. The liquid level in the bubbler must be checked frequently. If the liquid level is lowered by an appreciable amount (to less than 10 ml) from evaporation, the bubbler must be refilled with additional iso-octane.

2. Remove the cassette plugs and attach the outlet of the filter cassette to the inlet arm of the midget bubbler using a short piece of flexible tubing. Connect the outlet arm of the midget bubbler with a 5-cm glass splashover tube (6-mm I.D.) containing the glass wool plug, then to the personal sampling pump, using short pieces of flexible tubing. The bubbler must be maintained in a vertical position during sampling.
3. Air being sampled should not pass through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.3-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. After sampling, remove the bubbler stem and tap the stem gently against the inside wall of the bubbler bottle to recover as much of the sampling solution as possible. Rinse the bubbler stem with 1 ml of iso-octane into the midget bubbler.
6. Transfer the contents of the midget bubbler to the scintillation vial which has been marked at 15 ml. Rinse the bubbler with 2 ml of iso-octane, adding rinse to the vial. Bring the volume in the vial to the 15-ml mark with iso-octane.
7. Remove the glass fiber filter from the cassette filter holder and place into the scintillation vial. Care must be taken to handle the filter only with clean tweezers. Cap the scintillation vial with an appropriate cap with a Teflon cap liner.
8. Carefully record the sample identity and all relevant sampling data.
9. With each batch of ten samples submit one filter and midget bubbler which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Data Sheet #S128

Special Consideration :

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The scintillation vials in which the samples are stored should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Trichloronaphthalene, NIOSH Method No. S128.

December 19, 1975

Substance:

1,1,2-Trichloro-1,2,2-trifluoroethane (Refrigant 113)

Standard:

8-hour time-weighted average: 1000 ppm (7660 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 1.5 liters. Sample at a rate of 0.05 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S129.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S130

Substance:

Tetrachloronaphthalene

Standard:

8-hour time-weighted average: 2 mg/cu m - skin

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a glass fiber filter connected in series with a midget bubbler containing 15 ml of iso-octane to trap the tetrachloronaphthalene present. The solution in the midget bubbler is transferred to a 20-ml scintillation vial and the filter is added. The analyte is separated and analyzed using a gas chromatograph with an electrolytic conductivity detector. The method has been validated over the range of 0.912-4.04 mg/cu m for a 100-liter sample at 22°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$, at 1.3 liters per minute; a 37-mm two-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm diameter glass fiber filter connected in series with a midget bubbler. The filter holder should be made of polystyrene. Do not use Tenite filter holders. The sampling pump is protected from splashover or solvent condensation by a 5-cm long X 6-mm I.D. glass tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump. (One hundred milliliters of iso-octane should accompany each set of samples for rinsing the bubbler stems and transferring the contents of the bubblers to the scintillation vials.) The scintillation vials which are used for shipping should be marked at 15 ml.

Sample Size :

A sample size of 100 liters, taken at a flow rate of 1.3 liters per minute, is recommended.

Sampling Procedure:

1. Assemble the filter in the two-piece filter cassette holder and close firmly. Pipet 15 ml of the collection medium (iso-octane)

into each bubbler and mark the liquid level. The liquid level in the bubbler must be checked frequently. If the liquid level is lowered by an appreciable amount (to less than 10 ml) from evaporation, the bubbler must be refilled with additional iso-octane.

2. Remove the cassette plugs and attach the outlet of the filter cassette to the inlet arm of the midget bubbler using a short piece of flexible tubing. Connect the outlet arm of the midget bubbler with a 5-cm glass splashover tube (6-mm I.D.) containing the glass wool plug, then to the personal sampling pump, using short pieces of flexible tubing. The bubbler must be maintained in a vertical position during sampling.
3. Air being sampled should not pass through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.3-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. After sampling, remove the bubbler stem and tap the stem gently against the inside wall of the bubbler bottle to recover as much of the sampling solution as possible. Rinse the bubbler stem with 1 ml of iso-octane into the midget bubbler.
6. Transfer the contents of the midget bubbler to the scintillation vial which has been marked at 15 ml. Rinse the bubbler with 2 ml of iso-octane, adding rinse to the vial. Bring the volume in the vial to the 15-ml mark with iso-octane.
7. Remove the glass fiber filter from the cassette filter holder and place into the scintillation vial. Care must be taken to handle the filter only with clean tweezers. Cap the scintillation vial with an appropriate cap with a Teflon cap liner.
8. Carefully record the sample identity and all relevant sampling data.
9. With each batch of ten samples submit one filter and midget bubbler which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Data Sheet #S130

Special Consideration:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The scintillation vials in which the samples are stored should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Tetrachloronaphthalene, NIOSH Method No. S130.

Sampling Data Sheet #S131.01 Class B

December 19, 1975

Substance:

1,1,1,2-Tetrachloro-2,2-difluoroethane

Standard:

8-hour time-weighted average: 500 ppm (4,170 mg/. cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 2 liters. Sample at a rate of 0.035 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S131.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S132.01 Class B

December 19, 1975

Substance:

1,1,2,2-Tetrachloro-1,2-difluoroethane

Standard:

8-hour time-weighted average: 500 ppm (4,170 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 2 liters. Sample at a rate of 0.05 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S132.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

December 19, 1975

Substance:

Chlorobenzene (Monochlorobenzene)

Standard:

8-hour time-weighted average: 75 ppm (345 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S134.01 Class B

December 19, 1975

Substance:

1,1,2-Trichloroethane

Standard:

8-hour time-weighted average: 10 ppm (55 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

o-Dichlorobenzene

Standard:

Ceiling: 100 ppm (483 mg/cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S137

Substance:

Diazomethane

Standard:

8-hour time-weighted average: 0.2 ppm (0.4 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a glass tube which contains XAD-2 resin coated with 1% by weight of octanoic acid. The diazomethane reacts with the octanoic acid to form methyl octanoate. The ester is desorbed from the resin with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 0.17-0.80 mg/cu m for a 10-liter sample at 26°C and 765 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range 0.05 to 0.2 liters per minute, plus a special sampling tubing containing two sections of XAD-2 resin coated with 1% by weight of octanoic acid; the 100-mg front and 50-mg backup sections are separated by a plug of silylated glass wool.

Sample Size:

A sample size of 10 liters is recommended. Sample at a flow rate of 0.2 liters per minute only. Otherwise the correction factors recommended in NIOSH Method S137 will not be applicable.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of coated XAD-2 resin is used as a back-up and should be positioned nearest the sampling pump. The coated XAD-2 resin tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.
3. Air being sampled should not be passed through any hose or tubing before entering the coated XAD-2 resin tube.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
5. The coated XAD-2 resin tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One coated XAD-2 resin tube should be handled in the same manner as the sample tubes (break, seal, and transport), except for the taking of an air sample. This tube should be labeled as a blank.

Special Considerations:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance of the coated XAD-2 resin tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than 8 hours of sampling should be done without fully recharging the battery.
3. The presence of high humidity or water mist will not significantly decrease the breakthrough volume.
4. The desorption efficiency of coated XAD-2 resin varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain coated XAD-2 resin from the same batch. Several unused coated XAD-2 resin tubes should accompany the samples. Information on the batch number of the coated XAD-2 resin must be supplied.

Shipping Instructions:

Capped coated XAD-2 resin tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping.

Reference:

Diazomethane, NIOSH Method No. S137

Sampling Data Sheet #S139.01 Class B

February 5, 1976

Substance:

Diethylamine

Standard:

8-hour time-weighted average: 25 ppm (75 mg/ cu m)

Analytical Method:

A known volume of air is drawn through silica gel to trap the contaminant vapors present. The analyte is desorbed with 0.2N sulfuric acid in 10% methanol, the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Silica Gel Tube: The silica gel tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh silica gel. The first section contains 150 mg of silica gel while the backup section contains 75 mg of silica gel. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative silica gel tube in line.

Sample Size:

The recommended sample volume is 50 liters. Sample at a rate of 1.0 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the silica gel is used as a backup section and should be positioned nearest the sampling pump. The silica gel tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the silica gel tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One silica gel tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations :

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the silica gel tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the silica gel, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of silica gel varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain silica gel from the same batch. Information on the batch number of the silica gel must be supplied.
5. Because desorption efficiency decreases with time, arrange for analysis within six days after sampling.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped silica gel tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Dimethyamine

Standard:

8-hour time-weighted average: 10 ppm (18 mg/ cu m)

Analytical Method:

A known volume of air is drawn through silica gel to trap the contaminant vapors present. The analyte is desorbed with 0.2N sulfuric acid in 10% methanol, the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Silica Gel Tube: The silica gel tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh silica gel. The first section contains 150 mg of silica gel while the backup section contains 75 mg of silica gel. The two sections are separated by a spacer. Two silica gel tubes are used because of possible sample migration.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative sampling train in line.

Sample Size:

The recommended sample volume is 50 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The two silica gel tubes are connected by a short piece of Tygon tubing. To minimize any adsorption effects, use the minimum length of tubing that provides a leak free connection. The smaller sections of the silica gel are used as a backup section and should be positioned nearest the sampling pump. The silica gel tubes should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of

vapors. Normally, the tubes are placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the first silica gel tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One silica gel tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the silica gel tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the silica gel, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of silica gel varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain silica gel from the same batch. Information on the batch number of the silica gel must be supplied.
5. Because desorption efficiency decreases with time, arrange for analysis within six days after sampling.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Data Sheet #S142.01

Shipping Instructions:

Capped silica gel tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S143

Substance:

1,1-Dimethylhydrazine

Standard:

8-hour time-weighted average: 0.5 ppm (1 mg/cu m) - skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a bubbler (midget bubbler with a fritted inlet), which contains 10 ml of 0.1 M hydrochloric acid. The solution is then reacted with phosphomolybdic acid solution to form a colored complex. The amount of complex is determined with a spectrophotometer to give a quantitative measure of 1,1-dimethylhydrazine. The method has been validated over a range of 0.506-2.22 mg/cu m for a 100-liter sample at 23°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

An approved and calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, at 1.0 liter per minute or less, plus midget bubbler (fitted with a fritted glass inlet) containing 10 ml of the collection medium prepared according to the NIOSH method referenced below. The sampling pump is protected from splash-over or water condensation by a 5-cm long X 6-mm I.D. glass adsorption tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump. Twenty-five milliliters of the collection medium should accompany each set of bubblers for use in rinsing the bubbler stem after sampling.

Sample Size:

A 100-liter sample taken at a flow rate of 1.0 liter per minute or less is recommended.

Sampling Procedure:

1. Connect the bubbler (via absorption tube) to the sampling pump with a short piece of flexible tubing. The minimum amount of tubing should be used between the sampling pump and bubbler.

Data Sheet #S143

2. The bubbler must be maintained in a vertical position during sampling.
3. Air being sampled should not be passed through any hose or tubing before entering the bubbler.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1 liter per minute personal sampler pump is used, position the middle of the rotameter ball to the 1-liter per minute calibration mark as accurately as possible.
5. After sampling, the bubbler stem can be removed and cleaned. Tap the stem gently against the inside wall of the bubbler bottle to recover as much of the sampling solution as possible. Wash the stem with 2 ml of 0.01 M hydrochloric acid, and add the wash to the bubbler. Then seal the bubbler with a hard, non-reactive stopper (preferably Teflon or glass). Do not seal with rubber. The stoppers on the bubblers should be tightly sealed to prevent leakage during shipping.
6. Care should be taken to minimize spillage or loss by evaporation at all times.
7. With each batch of ten samples, submit one bubbler from the same lot of bubblers which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When other hydrazine derivatives, reducing agents, or oxidizing agents are known or suspected to be present in the air sampled, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Whenever possible, hand delivery of the samples is recommended. Otherwise, special bubbler shipping cases designed by NIOSH should be used to ship the samples. Never transport, mail, or ship the bulk sample in the same container as the sample or blank bubbler.

Reference:

1,1-Dimethylhydrazine, NIOSH Method No. S143.

Sampling Data Sheet # S144

Substance:

Ethylamine

Standard:

8-hour time-weighted average: 10 ppm (18 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a silica gel tube to trap the ethylamine vapors present. The analyte is ultrasonically desorbed from the silica gel with 0.1 M sulfuric acid, and the sample is separated, made alkaline, and analyzed using a gas chromatograph equipped with a flame ionization detector. The method has been validated over the range of 7.41-31.8 mg/cu m for a 30-liter sample at 25°C and 744 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range of 0.05 to 0.20 liter per minute, plus silica gel tube (7 cm long by 4-mm I.D.) containing two sections of 20/40 mesh silica gel separated by a 2-mm portion of urethane foam. The adsorbing section contains approximately 150 mg of silica gel, and the backup section contains approximately 75 mg.

Sample Size:

A sample size of 30 liters is recommended. Sample at a flow of 0.2 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of silica gel is used as a back-up and should be positioned nearest the sampling pump. The silica gel tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of ethylamine.
3. Air being sampled should not be passed through any hose or tubing before entering the silica gel tube.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
5. The silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples, submit one tube from the same lot of tubes which was used for sample collection and which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance to flow of air through the silica gel tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. Silica gel has a high affinity for water so organic vapors may not be trapped efficiently in the presence of a high relative humidity. This effect may be important even though there is no visual evidence of condensed water in the silica gel tube.
4. The desorption efficiency of silica gel may vary from batch to batch. Therefore, all the tubes used to collect a set of samples should contain silica gel from the same batch. Several unused silica gel tubes should accompany the samples. Information on the batch number of the silica gel must be supplied.

Shipping Instructions:

Capped silica gel tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Ethylamine, NIOSH Method No. S144.

Substance:

N-Ethylmorpholine

Standard:

8-hour time-weighted average: 20 ppm (94 mg/cu m) - skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a silica gel tube to trap the N-ethylmorpholine vapors present. The analyte is ultrasonically desorbed from the silica gel with 0.1 M sulfuric acid, and the sample is separated, made alkaline, and analyzed using a gas chromatograph equipped with a flame ionization detector. The method has been validated over the range of 57-206 mg/cu m for a 10-liter sample at 25°C and 744 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range of 0.05 to 0.20 liter per minute, plus silica gel tube (7 cm long by 4-mm I.D.) containing two sections of 20/40 mesh silica gel separated by a 2-mm portion of urethane foam. The adsorbing section contains approximately 150 mg of silica gel, and the backup section contains approximately 75 mg.

Sample Size:

A sample size of 10 liters is recommended. Sample at a flow of 0.2 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of silica gel is used as a back-up and should be positioned nearest the sampling pump. The silica gel tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of N-ethylmorpholine.
3. Air being sampled should not be passed through any hose or tubing before entering the silica gel tube.

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4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
5. The silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples, submit one tube from the same lot of tubes which was used for sample collection and is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance to flow of air through the silica gel tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. Silica gel has a high affinity for water so organic vapors may not be trapped efficiently in the presence of a high relative humidity. This effect may be important even though there is no visual evidence of condensed water in the silica gel tube.
4. The desorption efficiency of silica gel may vary from batch to batch. Therefore, all the tubes used to collect a set of samples should contain silica gel from the same batch. Several unused silica gel tubes should accompany the samples. Information on the batch number of the silica gel must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped silica gel tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

N-Ethylmorpholine, NIOSH Method No. S146.

Sampling Data Sheet # S147

Substance:

Isopropylamine

Standard:

8-hour time-weighted average: 5 ppm (12 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a midget bubbler containing 10 ml of 0.05 M sulfuric acid to trap isopropylamine vapors. The resulting solution is made alkaline with 4 M sodium hydroxide, and the sample is analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 8.9-21.5 mg/cu m for a 100-liter sample at an atmospheric temperature and pressure of 22°C and 760 mm Hg.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately (+5%) at 1 liter per minute, plus midget bubbler containing 10 ml of 0.05 M sulfuric acid solution. The sampling pump is protected from splashover or solvent condensation by a 5-cm long X 6-mm I.D. glass tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump. (Twenty milliliters of 0.05 M sulfuric acid should accompany each set of bubblers for use in rinsing the bubbler stem after sampling).

Sample Size:

A sample size of 100 liters, taken at a flow rate of 1 liter per minute or less, is recommended.

Sampling Procedure :

1. Connect the midget bubbler (containing 10 ml of 0.05 M sulfuric acid solution) in series with the glass tube containing the glass wool plug, and the personal sampling pump using short pieces of flexible tubing. Mark the liquid level in each bubbler.
2. The bubbler must be maintained in a vertical position during sampling.

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3. Air being sampled should not be passed through any hose or tubing before entering the bubbler.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1 liter per minute personal sampler pump is used, position the middle of the rotameter ball to the 1 liter per minute calibration mark as accurately as possible.
5. After sampling, the bubbler stems may be removed and cleaned. If necessary, bring the volume of each sample to the 10-ml mark with 0.05 M sulfuric acid. Tap the stems gently against the inside walls of the bubbler bottles to recover as much of the sampling solution as possible. Wash the stem with 1 ml of 0.05 M sulfuric acid, adding the wash to the bubbler. The bubbler should be sealed with a hard, non-reactive stopper (preferably Teflon or glass). Do not seal with rubber. The stoppers on the bubblers should be tightly sealed to prevent leakage during shipping.
6. Care should be taken to minimize spillage or loss by evaporation.
7. With each batch of ten samples, submit one bubbler from the same lot of bubblers which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Whenever possible, hand delivery of the samples is recommended. Otherwise, special bubbler shipping cases designed by NIOSH should be used to ship the samples. Never transport, mail, or ship the bulk sample in the same container as the sample or blank bubbler.

Reference:

Isopropylamine, NIOSH Method No. S147.

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Sampling Data Sheet # S149

Substance :

Monomethyl Hydrazine

Standard:

8-hour time-weighted average: 0.2 ppm (0.35 mg/cu m) - skin (Ceiling)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a bubbler (midget bubbler with a fritted inlet), which contains 15 ml of 0.1 M hydrochloric acid. The solution is then reacted with phosphomolybdic acid solution to form a colored complex. The amount of complex is determined with a spectrophotometer to give a quantitative measure of monomethyl hydrazine. The method has been validated over a range of 0.169-0.78 mg/cu m for a 15-minute sample at 23°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment :

An approved and calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, at 1.5 liter per minute for 15 minutes plus midget bubbler (fitted with a fritted glass inlet) containing 15 ml of the collection medium prepared according to the NIOSH method referenced below. The sampling pump is protected from splash-over or water condensation by a 5-cm long X 6-mm I.D. glass adsorption tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump. Twenty-five milliliters of the collection medium should accompany each set of bubblers for use in rinsing the bubbler stem after sampling.

Sample Size:

A 15-minute sample taken at a flow rate of 1.5 liter per minute is recommended.

Sampling Procedure:

1. Connect the bubbler (via absorption tube) to the sampling pump with a short piece of flexible tubing. The minimum amount of tubing should be used between the sampling pump and bubbler.

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2. The bubbler must be maintained in a vertical position during sampling.
3. Air being sampled should not be passed through any hose or tubing before entering the bubbler.
4. Set the flow rate as accurately as possible using the manufacturer's directions to the 1.5-liter per minute calibration mark. Record the initial and final sampling times and the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation.
5. After sampling, the bubbler stem can be removed and cleaned. Tap the stem gently against the inside wall of the bubbler bottle to recover as much of the sampling solution as possible. Wash the stem with 1 ml of 0.01 M hydrochloric acid, and add the wash to the bubbler. Then seal the bubbler with a hard, non-reactive stopper (preferably Teflon or glass). Do not seal with rubber. The stoppers on the bubblers should be tightly sealed to prevent leakage during shipping.
6. Care should be taken to minimize spillage or loss by evaporation at all times.
7. With each batch of ten samples, submit one bubbler from the same lot of bubblers which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When other hydrazine derivatives, reducing agents, or oxidizing agents are known or suspected to be present in the air sampled, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Whenever possible, hand delivery of the samples is recommended. Otherwise, special bubbler shipping cases designed by NIOSH should be used to ship the samples. Never transport, mail, or ship the bulk sample in the same container as the sample or blank bubbler.

Reference:

Monomethyl Hydrazine, NIOSH Method No. S149.

Sampling Data Sheet # S150

Substance:

Morpholine

Standard:

8-hour time-weighted average: 20 ppm (70 mg/cu m) - skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a silica gel tube to trap the morpholine vapors present. The analyte is desorbed from the silica gel with 0.05 M sulfuric acid, and an aliquot of the desorbed sample is neutralized with 1.2 M sodium hydroxide. The sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 28.5-108.4 mg/cu m for a 20-liter sample at 23°C and 763 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range of 0.05 to 0.20 liter per minute, plus silica gel tube (7 cm long by 4-mm I.D.) containing two sections of 20/40 mesh silica gel separated by a 2-mm portion of urethane foam. The adsorbing section contains approximately 150 mg of silica gel, and the backup section contains approximately 75 mg.

Sample Size:

A sample size of 20 liters is recommended. Sample at a flow of 0.2 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of silica gel is used as a back-up and should be positioned nearest the sampling pump. The silica gel tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of morpholine.
3. Air being sampled should not be passed through any hose or tubing before entering the silica gel tube.

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4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
5. The silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples, submit one tube from the same lot of tubes which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance to flow of air through the silica gel tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. Silica gel has a high affinity for water so organic vapors may not be trapped efficiently in the presence of a high relative humidity. This effect may be important even though there is no visual evidence of condensed water in the silica gel tube.
4. The desorption efficiency of silica gel may vary from batch to batch. Therefore, all the tubes used to collect a set of samples should contain silica gel from the same batch. Several unused silica gel tubes should accompany the samples. Information on the batch number of the silica gel must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped silica gel tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Morpholine, NIOSH Method No. S150.

S150-2346<

Sampling Data Sheet # S152

Substance:

Triethylamine

Standard:

8-hour time-weighted average: 25 ppm (100 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a midget bubbler containing 10 ml of 0.05 M sulfuric acid to trap triethylamine vapors. The resulting solution is made alkaline with 4 M sodium hydroxide, and the sample is analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 50-193 mg/cu m for a 100-liter sample at an atmospheric temperature and pressure of 23°C and 761 mm Hg.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately (+5%) at 1 liter per minute, plus midget bubbler containing 10 ml of 0.05 M sulfuric acid solution. The sampling pump is protected from splashover or solvent condensation by a 5-cm long X 6-mm I.D. glass tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump. (Twenty milliliters of 0.05 M sulfuric acid should accompany each set of bubblers for use in rinsing the bubbler stem after sampling).

Sample Size:

A sample size of 100 liters, taken at a flow rate of 1 liter per minute or less, is recommended.

Sampling Procedure:

1. Connect the midget bubbler (containing 10 ml of 0.05 M sulfuric acid solution) in series with the glass tube containing the glass wool plug, and the personal sampling pump using short pieces of flexible tubing. Mark the liquid level in each bubbler.
2. The bubbler must be maintained in a vertical position during sampling.

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3. Air being sampled should not be passed through any hose or tubing before entering the bubbler.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1 liter per minute personal sampler pump is used, position the middle of the rotameter ball to the 1 liter per minute calibration mark as accurately as possible.
5. After sampling, the bubbler stems may be removed and cleaned. If necessary, bring the volume of each sample to the 10-ml mark with 0.05 M sulfuric acid. Tap the stems gently against the inside walls of the bubbler bottles to recover as much of the sampling solution as possible. Wash the stem with 1 ml of 0.05 M sulfuric acid, adding the wash to the bubbler. The bubbler should be sealed with a hard, non-reactive stopper (preferably Teflon or glass). Do not seal with rubber. The stoppers on the bubblers should be tightly sealed to prevent leakage during shipping.
6. Care should be taken to minimize spillage or loss by evaporation.
7. With each batch of ten samples, submit one bubbler from the same lot of bubblers which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Whenever possible, hand delivery of the samples is recommended. Otherwise, special bubbler shipping cases designed by NIOSH should be used to ship the samples. Never transport, mail, or ship the bulk sample in the same container as the sample or blank bubbler.

Reference:

Triethylamine, NIOSH Method No. S152.

Sampling Data Sheet # S153

Substance:

Monomethyl Aniline (N-Methylaniline)

Standard:

8-hour time-weighted average: 2 ppm (9 mg/cu m) - skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a midget bubbler containing 10 ml of 0.05 M sulfuric acid to trap monomethyl aniline vapors. The resulting solution is made alkaline with 4 M sodium hydroxide, and the sample is analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 4.38-17.52 mg/cu m for a 100-liter sample at an atmospheric temperature and pressure of 22°C and 762 mm Hg.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately (+5%) at 1 liter per minute, plus midget bubbler containing 10 ml of 0.05 M sulfuric acid solution. The sampling pump is protected from splashover or solvent condensation by a 5-cm long X 6-mm I.D. glass tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump. (Twenty milliliters of 0.05 M sulfuric acid should accompany each set of bubblers for use in rinsing the bubbler stem after sampling).

Sample Size:

A sample size of 100 liters, taken at a flow rate of 1 liter per minute or less, is recommended.

Sampling Procedure:

1. Connect the midget bubbler (containing 10 ml of 0.05 M sulfuric acid solution) in series with the glass tube containing the glass wool plug, and the personal sampling pump using short pieces of flexible tubing. Mark the liquid level in each bubbler.
2. The bubbler must be maintained in a vertical position during sampling.

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3. Air being sampled should not be passed through any hose or tubing before entering the bubbler.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1 liter per minute personal sampler pump is used, position the middle of the rotameter ball to the 1 liter per minute calibration mark as accurately as possible.
5. After sampling, the bubbler stems may be removed and cleaned. If necessary, bring the volume of each sample to the 10-ml mark with 0.05 M sulfuric acid. Tap the stems gently against the inside walls of the bubbler bottles to recover as much of the sampling solution as possible. Wash the stem with 1 ml of 0.05 M sulfuric acid, adding the wash to the bubbler. The bubbler should be sealed with a hard, non-reactive stopper (preferably Teflon or glass). Do not seal with rubber. The stoppers on the bubblers should be tightly sealed to prevent leakage during shipping.
6. Care should be taken to minimize spillage or loss by evaporation.
7. With each batch of ten samples, submit one bubbler from the same lot of bubblers which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Whenever possible, hand delivery of the samples is recommended. Otherwise, special bubbler shipping cases designed by NIOSH should be used to ship the samples. Never transport, mail, or ship the bulk sample in the same container as the sample or blank bubbler.

Reference:

Monomethyl Aniline, NIOSH Method No. S153.

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Sampling Data Sheet # S155

Substance:

Tetramethyl Succinonitrile

Standard:

8-hour time-weighted average: 0.5 ppm (3 mg/cu m) - skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a charcoal tube to trap the tetramethyl succinonitrile vapors present. The analyte is desorbed from the charcoal tube with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 1.80-8.20 mg/cu m for a 55-liter sample at 22°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, at 1.0 liter per minute, plus charcoal tube containing two sections of 20/40 mesh activated charcoal separated by a 2-mm portion of urethane foam.

Sample Size:

A sample size of 50 liters is recommended. Sample at a flow of 1.0 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a back-up and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of tetramethyl succinonitrile.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the

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approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1 liter per minute personal sampler pump is used, position the middle of the rotameter ball to the 1-liter per minute calibration mark as accurately as possible.

5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples submit one tube from the same lot of tubes which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Tetramethyl Succinonitrile, NIOSH Method No. S155

February 5, 1976

Substance:

Acrylonitrile

Standard:

8-hour time-weighted average: 20 ppm (45 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with methanol; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 20 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the silica gel tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One silica gel tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the silica gel tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the silica gel, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of silica gel varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain silica gel from the same batch. Information on the batch number of the silica gel must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped silica gel tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S160

Substance:

Phenylhydrazine

Standard:

8-hour time-weighted average: 5 ppm (22 mg/cu m)--skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a bubbler (midget impinger with a fritted inlet), which contains 15 milliliters of 0.1 N hydrochloric acid. The solution is then reacted with phosphomolybdic acid solution to form a colored complex. The amount of complex is determined with a spectrophotometer to give a quantitative measure of phenylhydrazine. The method has been validated over a range of 10.37-44.8 mg/cu m for a 100-liter sample at 22°C and 761 mm atmospheric pressure.

Sampling Equipment:

An approved and calibrated personal sampling pump whose flow can be determined accurately, +5%, at 1.0 liter per minute for 100 minutes plus standard midget bubbler (fitted with a fritted glass inlet) containing 15 ml of the collection medium prepared according to the NIOSH method referenced below. The sampling pump is protected from splashover or water condensation by a 5-cm long X 6-mm I.D. glass adsorption tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump. (One hundred milliliters of distilled or deionized water should accompany each set of bubblers for use in washing out the bubbler stem after sampling.) A 5-ml graduated cylinder is required to measure the water used to wash out the bubbler stem.

Sample Size:

A sample of 100 liters is recommended. This requires a sampling period of 100 minutes at a flow of 1.0 liter per minute.

Sampling Procedure:

1. Connect the bubbler (via absorption tube) to the sampling pump with a short piece of flexible tubing. The minimum amount of tubing should be used between the sampling pump and bubbler.

Data Sheet #S160

2. The bubbler must be maintained in a vertical position during sampling.
3. Air being sampled should not be passed through any hose or tubing before entering the bubbler.
4. Set the flow rate of the pump at 1.0 liter per minute. Record the initial and final sampling times and the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation.
5. After sampling, the bubbler stem can be removed and cleaned. Tap the stem gently against the inside wall of the bubbler bottle to recover as much of the sampling solution as possible. Wash the stem with 5 ml of distilled or deionized water and add the wash to the bubbler. Then seal the bubbler with a hard, non-reactive stopper (preferably Teflon or glass). Do not seal with rubber. The stoppers on the bubblers should be tightly sealed to prevent leakage during shipping.
6. Care should be taken to minimize spillage or loss by evaporation at all times.
7. A "blank" bubbler should be handled as the other samples (fill, seal and transport) except that no air is sampled through this bubbler.

Special Considerations:

1. Where other hydrazine derivatives or reducing agents are known or suspected to be present in the air sampled, such information including their suspected identities, should be transmitted with the sample.
2. Aldehydes and ketones in the air may interfere because of the potential formation of phenylhydrazones in the acid medium in the bubbler.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Data Sheet #S160

Shipping Instructions:

Whenever possible, hand delivery of the samples is recommended. Otherwise, special bubbler shipping cases designed by NIOSH should be used to ship the samples. Never transport, mail, or ship the bulk sample in the same container as the sample or blank bubbler.

Reference:

Phenylhydrazine, NIOSH Method No. S160.

December 19, 1975

Substance:

Pyridine

Standard:

8-hour time-weighted average: 5 ppm (15 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 100 liters. Sample at a rate of 1.0 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

Data Sheet #S161.01

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S162

Substance :

Xylidine (2,4-Dimethylaminobenzene)

Standard :

8-hour time-weighted average: 5 ppm (25 mg/cu m) - skin

Reference: 29 CFR 1910.93

Analytical Method :

A known volume of air is drawn through a silica gel tube to trap the xylidine vapors present. The analyte is desorbed from the silica gel with 95% ethanol, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 12.5-50.0 mg/cu m for a 20-liter sample at 22°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment :

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range of 0.05 to 0.20 liter per minute, plus silica gel tube (7 cm long by 4-mm I.D.) containing two sections of 20/40 mesh silica gel separated by a 2-mm portion of urethane foam. The adsorbing section contains approximately 150 mg of silica gel, and the backup section contains approximately 75 mg.

Sample Size :

A sample size of 20 liters is recommended. Sample at a flow of 0.2 liter per minute or less.

Sampling Procedure :

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of silica gel is used as a back-up and should be positioned nearest the sampling pump. The silica gel tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of xylidine.
3. Air being sampled should not be passed through any hose or tubing before entering the silica gel tube.

Data Sheet #S162

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
5. The silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One silica gel tube should be handled in the same manner as the sample tubes (break, seal, and transport), except that no air is drawn through the tube. This tube should be labeled as a blank.

Special Considerations :

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance to flow of air through the silica gel tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. Silica gel has a high affinity for water so organic vapors may not be trapped efficiently in the presence of a high relative humidity. This effect may be important even though there is no visual evidence of condensed water in the silica gel tube.
4. The desorption efficiency of silica gel may vary from batch to batch. Therefore, all the tubes used to collect a set of samples should contain silica gel from the same batch. Several unused silica gel tubes should accompany the samples. Information on the batch number of the silica gel must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped silica gel tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Xylidine, NIOSH Method No. S162.

December 19, 1975

Substance:

Dimethylaniline

Standard:

8-hour time-weighted average: 5 ppm (25 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 20 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample :

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Acetonitrile

Standard:

8-hour time-weighted average: 40 ppm (70 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with benzene ; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 6-mm and contains two sections of 20/40 mesh charcoal. The first section contains 400 mg of activated charcoal while the backup section contains 200 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 10 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S167

Substance:

Cresol (all isomers)

Standard:

8-hour time-weighted average: 5 ppm (22 mg/cu m) - skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a silica gel tube to trap the organic vapors present. The analyte is desorbed from the silica gel tube with acetone, and the solution is analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 10.54-42.2 mg/cu m for a 20-liter sample at 22°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range of 0.05 to 0.20 liter per minute, plus silica gel tube (7 cm long, 6-mm O.D. and 4-mm I.D.) containing two sections of 20/40 mesh silica gel separated by a 2-mm portion of urethane foam.

Sample Size:

A sample size of 20 liters is recommended. Sample at a flow of 0.20 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of silica gel is used as a back-up and should be positioned nearest the sampling pump. The silica gel tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the cresols.
3. Air being sampled should not be passed through any hose or tubing before entering the silica gel tube.

Data Sheet #S167

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
5. The silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One silica gel tube should be handled in the same manner as the sample tubes (break, seal, and transport), except that no air is drawn through the tube. This tube should be labeled as a blank.

Special Considerations:

1. Where compounds other than the isomers of cresol are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample. Since acetone is used to desorb the analyte from the silica gel, it is not possible to measure acetone in the sample.
2. Due to the high resistance to flow of air through the silica gel tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. Silica gel has a high affinity for water so organic vapors will not be trapped efficiently in the presence of a high relative humidity. This effect may be important even though there is no visual evidence of condensed water in the silica gel tube.
4. The desorption efficiency of silica gel may vary from batch to batch. Therefore, all the tubes used to collect a set of samples should contain silica gel from the same batch. Several unused silica gel tubes should accompany the samples. Information on the batch number of the silica gel must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Data Sheet #S167

Shipping Instructions:

Capped silica gel tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Cresol (all isomers), NIOSH Method No. S167.

Sampling Data Sheet # S168

Substance :

o-Toluidine

Standard:

8-hour time-weighted average: 5 ppm (22 mg/cu m) - skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a silica gel tube to trap the o-toluidine vapors present. The analyte is desorbed from the silica gel with 95% ethanol, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 11.72-46.9 mg/cu m for a 55-liter sample at 22°C and 759 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, at 1 liter per minute or less, plus silica gel tube (7 cm long by 4-mm I.D.) containing two sections of 20/40 mesh silica gel separated by a 2-mm portion of urethane foam. The adsorbing section contains approximately 150 mg of silica gel, and the backup section contains approximately 75 mg.

Sample Size:

A sample size of 50 liters is recommended. Sample at a flow of 1.0 liter per minute or less.

Sampling Procedure :

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of silica gel is used as a back-up and should be positioned nearest the sampling pump. The silica gel tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of o-toluidine.
3. Air being sampled should not be passed through any hose or tubing before entering the silica gel tube.

Data Sheet #S168

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1 liter per minute personal sampler pump is used, position the middle of the rotameter ball to the 1 liter per minute calibration mark as accurately as possible.
5. The silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One silica gel tube should be handled in the same manner as the sample tubes (break, seal, and transport), except that no air is drawn through the tube. This tube should be labeled as a blank.

Special Considerations:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance to flow of air through the silica gel tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. Silica gel has a high affinity for water so organic vapors may not be trapped efficiently in the presence of a high relative humidity. This effect may be important even though there is no visual evidence of condensed water in the silica gel tube.
4. The desorption efficiency of silica gel may vary from batch to batch. Therefore, all the tubes used to collect a set of samples should contain silica gel from the same batch. Several unused silica gel tubes should accompany the samples. Information on the batch number of the silica gel must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Data Sheet #S168

Shipping Instructions:

Capped silica gel tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

o-Toluidine, NIOSH Method No. S168.

Sampling Data Sheet # S170

Substance:

Acetic Anhydride

Standard:

8-hour time-weighted average: 5 ppm (20 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a bubbler (midget impinger with a fritted glass inlet), which contains 10 ml of alkaline hydroxylamine. The solution is then reacted with a ferric chloride solution to form a colored complex. The amount of complex is determined with a spectrophotometer to give a quantitative measure of acetic anhydride. The method has been validated over a range of 9.35-37.4 mg/cu m for a 100-liter sample at 22°C and 761 mm atmospheric pressure.

Sampling Equipment:

An approved and calibrated personal sampling pump whose flow can be determined accurately $\pm 5\%$ at 1.0 liter per minute for 100 minutes, plus standard midget bubbler (fitted with a fritted glass inlet) containing 10 ml of absorbing solution prepared according to the NIOSH method referenced below. The absorbing solution should be mixed just prior to use, since it is only stable for two hours. The sampling pump is protected from splashover or water condensation by a 5-cm long by 6-mm I.D. glass adsorption tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump. (An additional twenty milliliters of absorbing solution should accompany each set of bubblers for use in washing out the bubbler stem after sampling.)

Sample Size:

A sample of 100 liters is recommended. This requires a sampling period of 100 minutes at a flow of 1.0 liter per minute.

Sampling Procedure:

1. Connect the bubbler (via absorption tube) to the sampling pump with a short piece of flexible tubing. The minimum amount of tubing should be used between the sampling zone and bubbler.

Data Sheet #S170

2. The bubbler must be maintained in a vertical position during sampling.
3. Air being sampled should not be passed through any hose or tubing before entering the bubbler.
4. Set the flow rate of the pump at 1.0 liter per minute. Record the initial and final sampling times and the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation.
5. After sampling, the bubbler stem can be removed and cleaned. Tap the stem gently against the inside wall of the bubbler bottle to recover as much of the sampling solution as possible. Wash the stem with 2 ml of absorbing solution and add the wash to the bubbler. Then seal the bubbler with a hard, non-reactive stopper (preferably Teflon or glass). Do not seal with rubber. The stoppers on the bubblers should be tightly sealed to prevent leakage during shipping.
6. Care should be taken to minimize spillage or loss by evaporation at all times.
7. A "blank" bubbler should be handled in the same manner as the bubblers in which samples are collected (fill, seal and transport) except that no air is sampled through this bubbler.

Special Consideration:

Where aldehydes or esters are known or suspected to be present in the air sampled, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Whenever possible, hand delivery of the samples is recommended. Otherwise, special bubbler shipping cases designed by NIOSH should be used to ship the samples. Never transport, mail, or ship the bulk sample in the same container as the sample or blank bubbler.

Reference:

Acetic Anhydride, NIOSH Method No. S170.

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Sampling Data Sheet # S174

Substance:

Sulfuric Acid

Standard:

8-hour time-weighted average: 1 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap sulfuric acid particles. The analyte is extracted from the filter with distilled water and isopropyl alcohol, and the extract is titrated with 0.005 M barium perchlorate using Thorin as the indicator. The method has been validated over the range of 0.561-2.577 mg/cu m for a 180-liter sample at 22°C and 764 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of +5%, at 1.5 liters per minute; a 37-mm three-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm/0.8-micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad. The filter holder should be made of polystyrene.

Sample Size:

A sample size of 180 liters is recommended. Sample at a flow of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

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4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct the problem, terminate the sampling.
5. The cellulose filter should be removed from the cassette filter holder and cellulose backup pad and placed in a clean screw cap bottle within 1 hour of sampling. Care must be taken to handle the filter only with clean tweezers.
6. Carefully record sample identity and all relevant sample data.
7. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

When any sulfate containing compounds, other than sulfuric acid, are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The screw cap bottles in which the samples are collected should be shipped in a suitable container designed to prevent damage in transit.

Reference:

Sulfuric Acid, NIOSH Method No. S174.

Sampling Data Sheet # S175

Substance:

Hydrogen Bromide

Standard:

8-hour time-weighted average: 3 ppm (10 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a midget bubbler containing 15 ml of 0.01 N sodium hydroxide to trap hydrogen bromide. The resulting solution is diluted to 25 ml with 0.01 N sodium hydroxide. The sample is analyzed using a bromide ion specific electrode and an expanded scale millivolt/pH meter. The method has been validated over the range of 6.14-20.37 mg/cu m for a 100-liter sample at an atmospheric temperature and pressure of 22°C and 763 mm Hg.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, + 5%, at 1.0 liter per minute, plus midget bubbler, containing 15 ml of 0.01 N sodium hydroxide. The sampling pump is protected from splashover by a 5-cm long by 6-mm I.D. glass adsorption tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump. (An additional 100 ml of collection medium should accompany each set of bubblers for use in rinsing the bubbler stems after sampling.)

Sample Size:

A sample size of 100 liters, taken at a flow of 1.0 liter per minute, is recommended.

Sampling Procedure:

1. Connect the midget bubbler (containing 15 ml of the collection medium) with a 5-cm glass adsorption tube containing the glass wool plug to the personal sampling pump using short pieces of flexible tubing.
2. The bubbler must be maintained in a vertical position during sampling.

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3. Air being sampled should not be passed through any hose or tubing before entering the bubbler.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Position the middle of the rotameter ball of the personal sampling pump to the 1.0 liter per minute calibration mark as accurately as possible. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation.
5. After sampling, the bubbler stems may be removed and cleaned. Tap the stems gently against the inside walls of the bubbler bottles to recover as much of the sampling solution as possible. Wash the stem with 1 ml of 0.01 N sodium hydroxide, adding the wash to the bubbler. Rinse the bubbler vessel with 2-3 ml of 0.01 N sodium hydroxide and add the wash to the bubbler. Seal tightly for shipment.
6. Care should be taken to minimize spillage or loss by evaporation.
7. A "blank" bubbler should be handled in the same manner as the bubblers containing the samples (fill, seal, and transport) except that no air is sampled through this bubbler.

Special Considerations:

Where interfering compounds such as bromides are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

Whenever possible, hand delivery of the samples is recommended. Otherwise, special bubbler shipping cases designed by NIOSH should be used to ship the samples.

Reference:

Hydrogen Bromide, NIOSH Method No. S175.

Sampling Data Sheet # S176

Substance:

Hydrogen Fluoride

Standard:

8-hour time-weighted average: 3 ppm (2.45 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a midget bubbler containing 10 ml of 0.1 N sodium hydroxide to trap hydrogen fluoride. The resulting solution is diluted to 25 ml with 0.1 N sodium hydroxide and buffered with an equal volume of total ionic strength activity buffer (TISAB). The sample is analyzed using a fluoride ion specific electrode and an expanded scale millivolt/pH meter. The method has been validated over the range of 1.33-4.50 mg/cu m for a 45-liter sample at an atmospheric temperature and pressure of 22°C and 761 mm Hg.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, at 1.5 liters per minute, plus midget bubbler with 1/8-in O.D. Teflon inlet tube, containing 10 ml of 0.1 N sodium hydroxide. A prefilter unit, consisting of a 37-mm/0.8-micrometer mixed cellulose ester membrane filter and a polystyrene cassette filter holder, is connected in front of the bubbler to collect fluoride particulate that may be present. A backup pad should not be used. Care must be taken to insure that the filter is sealed tightly to avoid air leaks during sampling. The sampling pump is protected from splashover by a 5-cm long by 6-mm I.D. glass adsorption tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump. (An additional 100 ml of collection medium should accompany each set of bubblers for use in rinsing the bubbler stems after sampling).

Sample Size:

A sample size of 45 liters, taken at a flow of 1.5 liters per minute for 30 minutes, is recommended.

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Sampling Procedure :

1. Connect the midget bubbler (containing 10 ml of the collection medium) with a 5-cm glass adsorption tube containing the glass wool plug to the prefilter unit and the personal sampling pump using short pieces of flexible tubing. The minimum amount of tubing necessary to make the joint between the prefilter and bubbler should be used.
2. The bubbler must be maintained in a vertical position during sampling.
3. Air being sampled should not be passed through any hose or tubing before entering the bubbler.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation.
5. After sampling, the bubbler stems may be removed and cleaned. Tap the stems gently against the inside walls of the bubbler bottles to recover as much of the sampling solution as possible. Wash the stem with 1 ml of 0.1 N sodium hydroxide, adding the wash to the bubbler. Transfer the contents of the bubbler to a 50-ml polyethylene bottle. Rinse the bubbler vessel with 2-3 ml of 0.1 N sodium hydroxide and add the wash to the bottle. Seal tightly for shipment.
6. Care should be taken to minimize spillage or loss by evaporation.
7. A "blank" bubbler should be handled in the same manner as the bubblers containing the samples (fill, seal, and transport) except that no air is sampled through this bubbler.
8. The filter may be discarded since the method is designed to measure gaseous hydrogen fluoride only.

Special Consideration :

Where interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

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Shipping Instructions:

Whenever possible, hand delivery of the samples is recommended.
Otherwise, special bubbler shipping cases designed by NIOSH should
be used to ship the samples.

Reference:

Hydrogen Fluoride, NIOSH Method No. S176.

Sampling Data Sheet # S178

Substance:

2-Hexanone

Standard:

8-hour time-weighted average: 100 ppm (410 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a charcoal tube to trap the 2-hexanone vapors present. The analyte is desorbed from the charcoal with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 188-790 mg/cu m for a 10-liter sample at 27.7°C and 767 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range 0.05 to 0.2 liter per minute, plus charcoal tube containing two sections of 20/40 mesh activated charcoal with 100-mg front and 50-mg backup sections separated by a 2-mm portion of urethane foam.

Sample Size:

A sample size of 10 liters is recommended. Sample at a flow rate of 0.2 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a backup and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The

sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.

5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport), except for the taking of an air sample. This tube should be labeled as a blank.

Special Considerations:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than 8 hours of sampling should be done without fully re-charging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

2-Hexanone, NIOSH Method No. S178

Sampling Data Sheet # S179

Substance:

Phthalic Anhydride

Standard:

8-hour time-weighted average: 12 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the phthalic anhydride aerosol present. The anhydride is extracted from the filter and hydrolyzed with 0.2 N ammonium hydroxide and assayed as phthalic acid using high pressure liquid chromatography on a silica column using acetic acid/methanol/methylene chloride as the chromatographic solvent system. The method has been validated over the range of 5.5 - 28 mg/cu m for a 100-liter sample at 22°C and 765 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three piece cassette filter holder held together by tape or shrinkable band; and a 37 mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 100 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with plastic tape or shrinkable cellulose band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the evaluation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank. Submit one blank filter for every ten samples.

Special Considerations:

When two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, design to prevent damage in transit.

Reference:

Phthalic Anhydride, NIOSH Method No. S179

Sampling Data Sheet # S183

Substance:

Tin, Inorganic Compounds except Oxides

Standard:

8-hour time-weighted average: 2 mg/cu m

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a cellulose membrane filter to trap the tin (including tin compounds) present. The filter is digested with nitric and sulfuric acids to destroy the filters and any organic material. The analyte is then solubilized in a dilute hydrochloric acid solution, and aspirated into an atomic absorption spectrophotometer for determination of concentration. The method has been validated over the range of 0.939-4.32 mg/cu m using a 250-liter sample at 22.7°C and 747 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three-piece cassette filter holder and a 37-mm diameter 0.8-micrometer pore size mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 250 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.

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2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. Cassettes containing collected samples should be firmly sealed with the plugs in both the inlets and outlets.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When interfering compounds such as other tin compounds (except inorganic tin compounds) are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Tin, Inorganic Compounds Except Oxides, NIOSH Method No. S183.

Sampling Data Sheet # S185

Substance:

Zirconium Compounds (as Zr)

Standard:

8-hour time-weighted average: 5.0 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the zirconium compounds present in the air. The filter is digested with nitric acid and perchloric acid to remove the organic matrix, then solubilized in an acid solution, and aspirated into an atomic absorption spectrophotometer for determination of zirconium concentration. The method has been validated over the range of 2.14-9.02 mg/cu m at an atmospheric temperature and pressure of 21°C and 766 mm Hg, using a 720-liter sample.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three piece cassette filter holder held together by tape or shrinkable band; and a 37-mm diameter/0.8 micrometer pore size mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 720 liters is recommended. Sample at a flow rate of 1.5 liters per minute for 480 minutes.

Sampling Procedure:

1. Assemble the filter and three piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape such as vinyl electrical tape or with a shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel. The filter holder inlet should face downward.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

Where other metals or ionic species are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample. Because of solubility requirements, the identity of the zirconium compound should be reported with the sample, whenever possible.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Zirconium Compounds (as Zr), NIOSH Method No. S185.

Sampling Data Sheet # S186

Substance:

Copper Dusts and Mists

Standard:

8-hour time-weighted average: 1.0 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the copper dusts and mists present. The filter is digested with nitric acid to remove the organic matrix, then solubilized in a hydrochloric acid solution, and aspirated into an atomic absorption spectrometer for determination of copper concentration. The method has been validated over the range of 0.468-1.830 mg/cu m at an atmospheric temperature and pressure of 25°C and 768 mm Hg, using a 90-liter sample.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three piece cassette filter holder held together by tape or shrinkable band; and a 37 mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 90 liters is recommended. Sample at a flow rate of 1.5 liters per minute or less.

Sampling Procedure:

1. Assemble the filter and three piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and the sampling should be terminated at any evidence of a problem.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Copper Dusts and Mists, NIOSH Method No. S186

Sampling Data Sheet # S187

Substance:

Tellurium Hexafluoride

Standard:

8-hour time-weighted average: 0.02 ppm (0.2 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a charcoal tube to trap the tellurium hexafluoride vapors present; the charcoal tube is preceded by a 37-mm cellulose ester membrane filter to separate any particulate tellurium compounds. The analyte is desorbed from the charcoal with 0.01 N sodium hydroxide and the sample is analyzed by aspirating into an air-acetylene flame of an atomic absorption spectrophotometer. The method has been validated over the range of 0.094-0.373 mg/cu m for a 390-liter sample at 23°C and 761 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A personal sampling pump calibrated with a representative filter and charcoal tube in line and whose flow can be determined accurately, $\pm 5\%$ over the range 1.1 liters per minute, plus charcoal tube containing two sections of 20/40 mesh activated coconut charcoal with the 100-mg front and 50-mg backup sections separated by a 2-mm portion of urethane foam; a 37-mm cellulose ester membrane filter and cassette holder to trap the particulate tellurium compounds.

Sample Size:

A sample size of at least 360 liters is recommended. Sample at a flow rate of 1.0 liter per minute.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. Connect the filter cassette holder to the front section of the charcoal with a very short piece of tubing. If particulate tellurium is known to be absent, the filter is not necessary.
3. The smaller section of charcoal is used as a backup and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to

avoid channeling and subsequent premature breakthrough of the analyte.

4. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
5. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.0 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
6. After sample collection, separate the filter from the charcoal tubes. The filters may be discarded but the charcoal tubes should be handled for future analysis.
7. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
8. One charcoal tube for every 10 samples submitted should be handled in the same manner as the sample tubes (break, seal, and transport), except for the taking of an air sample. This tube should be labeled as a blank.

Special Considerations:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than 8 hours of sampling should be done without fully recharging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping.

Reference:

Tellurium Hexafluoride, NIOSH Method No. S187

Sampling Data Sheet # S188

Substance:

Rhodium, Metal Fume and Dust

Standard:

8-hour time weighted average: 0.1 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the rhodium-containing aerosol present. The filter is wet-ashed with concentrated nitric acid and the analyte is solubilized in a hydrochloric acid solution. The amount of rhodium present in the sample is determined by atomic absorption spectroscopy at 343.5 nm. The method has been validated over the range of 0.057-0.21 mg/cu m for a 720-liter sample at 24°C and 756 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 720 liters is recommended. Sample at a flowrate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere

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being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and the sampling should be terminated at any evidence of a problem.

5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Rhodium, Metal Fume and Dust, NIOSH Method No. S188

Sampling Data Sheet # S189

Substance:

Rhodium, Soluble Salts

Standard:

8-hour time-weighted average: 0.001 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the rhodium-containing aerosol present. The sample filters are digested in HNO_3 and $\text{HNO}_3/\text{HClO}_4$. The quantity of rhodium present is determined by atomic absorption spectrophotometry at 369.5 nm, using a high temperature graphite atomizer. The method has been validated over the range 0.0004-0.0018 mg/cu m for a 370-liter sample at 22°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$, over the range of 1.0 to 2.0 liters per minute; a 37-mm three piece cassette filter holder held together by tape or shrinkable band; and a 37 mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 370 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record

the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.

5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank. Submit one blank for every ten samples.

Special Considerations:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Rhodium, Soluble Salts, NIOSH Method No. S189

Sampling Data Sheet # S190

Substance:

Selenium Compounds (as Se)

Standard:

8-hour time-weighted average: 0.2 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the particulate selenium compound present. The sample filters are extracted with 0.1 N nitric acid to recover any acid soluble selenium compound. The quantity of analyte present is determined by atomic absorption spectrophotometry at 196.0 nm, using an argon/hydrogen-air flame. The method has been validated over the range of 0.10-0.50 mg/cu m for a 360-liter sample at 19°C and 762 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 360 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank. Submit one blank filter for every ten samples.

Special Considerations:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Bulk Sample:

It is important that a bulk sample of the suspected compound be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Selenium Compounds (as Se), NIOSH Method No. S190

Sampling Data Sheet # S191

Substance :

Platinum, Soluble Salts

Standard:

8-hour time-weighted average: 0.002 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method :

A known volume of air is drawn through a cellulose membrane filter to trap the platinum containing aerosol present. The sample filters are digested in HNO_3 and $\text{HNO}_3/\text{HClO}_4$. The quantity of platinum present is determined by atomic absorption spectrophotometry at 265.9 nm, using a high temperature graphite atomizer. The method has been validated over the range of 0.00079-0.0031 mg/cu m for a 720-liter sample at 24°C and 767 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm, 3-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 720 liters is recommended. Sample at a flow rate of 1.5 liters per minute for 480 minutes.

Sampling Procedure:

1. Assemble the filter and 3-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record

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Data Sheet #S191

the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.

5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank. Submit one blank filter for every ten samples.

Special Considerations:

Where other metals or ionic species are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Platinum, Soluble Salts, NIOSH Method No. S191

Sampling Data Sheet # S193

Substance:

Molybdenum, Soluble Compounds

Standard:

8-hour time-weighted average: 5.0 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the molybdenum-containing aerosol present. The analyte is leached from the filter with hot water and analyzed by atomic absorption spectroscopy at 313.3 nm. The method has been validated over the range 1.96-9.75 mg/cu m for a 90-liter sample at 26°C and 763 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three piece cassette filter holder held together by tape or shrinkable band; and a 37 mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 90 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

Data Sheet #S193

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and the sampling should be terminated at any evidence of a problem.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Molybdenum, Soluble Compounds, NIOSH Method No. S193

Sampling Data Sheet # S198

Substance:

Barium, Soluble Compounds

Standard:

8-hour time-weighted average: 0.5 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the barium compounds present. The samples are leached from the filter with hot water. The soluble portion is decanted, filtered, dried, and then dissolved in dilute hydrochloric acid containing sodium chloride. The solution is then aspirated into an atomic absorption spectrophotometer for determination of concentration. The method has been validated over the range of 0.281-1.084 mg/cu m using a 168-liter sample at 24°C and 747 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of + 5% over the range of 1.0 to 2.0 liters per minute; a 37-mm three-piece cassette filter holder and a 37-mm diameter, 0.8-micrometer pore size mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 180 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.

Data Sheet #S198

3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. Cassettes containing collected samples should be firmly sealed with the plugs in both the inlets and the outlets.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference :

Barium, Soluble Compounds, NIOSH Method No. S198.

Sampling Data Sheet # S200

Substance:

Yttrium

Standard:

8-hour time-weighted average: 1 mg/cu m

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a cellulose membrane filter to trap the yttrium present. The filter is digested with nitric and perchloric acids to destroy the filters and any organic material. The analyte is then solubilized in a hydrochloric acid solution, and aspirated into an atomic absorption spectrophotometer for determination of concentration. The method has been validated over the range of 0.529-2.211 mg/cu m using a 500-liter sample at 24.5°C and 745 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three-piece cassette filter holder and a 37-mm diameter/0.8-micrometer pore size mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 500 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.

Data Sheet #S200

3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. Cassettes containing collected samples should be firmly sealed with the plugs in both the inlets and the outlets.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Yttrium, NIOSH Method No. S200.

Sampling Data Sheet # S204

Substance:

Tellurium

Standard:

8-hour time-weighted average: 0.1 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the tellurium present. The filter is digested with nitric and perchloric acids to destroy the filter and any organic material. The analyte is then solubilized in a nitric acid solution, and aspirated into an atomic absorption spectrophotometer for determination of concentration. The method has been validated over the range of 0.0495-0.240 mg/cu m using a 670-liter sample at 22.5°C and 746 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three-piece cassette filter holder and a 37-mm diameter/0.8-micrometer pore size mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 670 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.

Data Sheet #S204

3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. Cassettes containing collected samples should be firmly sealed with the plugs in both the inlets and the outlets.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Tellurium, NIOSH Method No. S204.

Sampling Data Sheet # S205

Substance:

Calcium Oxide

Standard:

8-hour time-weighted average: 5 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the calcium oxide present. The filter is digested with nitric and perchloric acids to remove the organic matrix. The resulting residue is solubilized in a hydrochloric acid solution, and the solution is aspirated into an atomic absorption spectrophotometer for determination of concentration. The method has been validated over the range of 2.6-10.16 mg/cu m using an 85-liter sample at 23.5°C and 744.5 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three-piece cassette filter holder and a 37-mm diameter and 0.8-micrometer pore size mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 85 liters at a flow rate of 1.5 liters per minute is recommended.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or a shrinkable band.
2. Remove the cassette plugs and attach the outlet of the cassette to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

Data Sheet #S205

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. Cassettes containing collected samples should be firmly sealed with the plugs in both the inlets and the outlets.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample. Interferences to the calcium AA method include Si, Al, PO_4^{-3} , other calcium salts, sodium, potassium, and other ionizable elements.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Calcium Oxide, NIOSH Method No. S205.

Sampling Data Sheet # S206

Substance:

Nickel, Metal and Soluble Compounds (as Ni)

Standard:

8-hour time-weighted average: 1 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the nickel (including nickel compounds) present. The filter is digested with nitric and perchloric acids to destroy the filters and any organic material. The analyte is then solubilized in a nitric acid solution, and aspirated into an atomic absorption spectrophotometer for determination of concentration. The method has been validated over the range of 0.447-2.075 mg/cu m using an 85-liter sample at 26.5°C and 745 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three-piece cassette filter holder and a 37-mm diameter and 0.8-micrometer pore size mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 90 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or a shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

Data Sheet #S206

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. Cassettes containing collected samples should be firmly sealed with the plugs in both the inlets and outlets.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Nickel, Metal and Soluble Compounds (as Ni), NIOSH Method No. S206.

Sampling Data Sheet # S208

Substance:

Tributyl Phosphate

Standard:

8-hour time-weighted average: 5.0 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the tributyl phosphate aerosol present. The analyte is extracted from the filter with ether and the sample is analyzed by gas chromatography using a phosphorus flame photometric detector. The method has been validated over the range 2.7-12.6 mg/cu m for a 100-liter sample at 19°C and 761 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Note: When sampling atmospheres at temperatures above 23°C, use two filter cassettes--each containing a cellulose ester membrane filter and cellulose backup pad--connected in series with a short piece of flexible tubing.

Sample Size:

A sample size of 100 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band. If the temperature of the air being sampled is greater than 23°C, connect two filter cassettes in series.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.

3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and the sampling should be terminated at any evidence of a problem.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample. The two filter cassettes are needed at temperatures above 23°C, since some of the tributyl phosphate may exist as a vapor.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit. Never transport, mail, or ship the bulk sample in the same container as the sample or the blank tube.

Reference:

Tributyl Phosphate, NIOSH Method No. S208

Sampling Data Sheet # S209

Substance:

Triorthocresyl Phosphate

Standard:

8-hour time-weighted average: 0.1 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the triorthocresyl phosphate aerosol present. The analyte is extracted from the filter with ether, and the sample is separated and analyzed using a gas chromatograph with a phosphorus flame photometric detector. The method has been validated over the range of 0.029-0.17 mg/cu m for a 100-liter sample at 19°C and 761 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm, three-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 100 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the

atmosphere sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently and re-adjusted as needed; if the rotameter cannot be re-adjusted terminate sampling.

5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank. At least one blank per 10 samples should be submitted.

Special Consideration:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference :

Triorthocresyl Phosphate, NIOSH Method No. S209.

Sampling Data Sheet # S210

Substance :

Triphenyl phosphate

Standard:

8-hour time-weighted average: 3 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the triphenyl phosphate aerosol present. The analyte is extracted from the filter with ether, and the sample is separated and analyzed using a gas chromatograph with a flame photometric detector. The method has been validated over the range of 1.25-6.99 mg/cu m for a 100-liter sample at 24°C and 759 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three-piece cassette filter holder held together by tape or shrinkable band; and a 37 mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 100 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available,

record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and the sampling should be terminated at any evidence of a problem.

5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of 10 samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Triphenyl phosphate, NIOSH Method No. S210.

Sampling Data Sheet # S213

Substance:

1,1-Dichloro-1-nitroethane

Standard:

Ceiling: 10 ppm (60 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a charcoal tube to trap the 1,1-dichloro-1-nitroethane vapors present. The analyte is desorbed from the activated petroleum-based charcoal with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 27-115 mg/cu m for a 17-liter sample at 23°C and 763 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range 1.0 to 2.0 liters per minute, plus charcoal tube containing two sections of 20/40 mesh activated petroleum-based charcoal with the 100-mg front and 50-mg backup sections separated by a 2-mm portion of urethane foam.

Sample Size:

A sample size of 15 liters is recommended. This requires a sampling period of 15 minutes at a flow of 1.0 liters per minute.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a backup and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. If the low flow rate pump is used, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes

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times the cc/stroke factor. If the 1.0-liter per minute personal sampler pump is used, position the middle of the rotameter ball to the 1.0 liter per minute calibration mark as accurately as possible. Record the temperature and pressure of the atmosphere being sampled. If pressure reading is not available, record the elevation.

5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal and transport), except for the taking of an air sample. This tube should be labeled as a blank.

Special Consideration:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than 8 hours of sampling should be done without fully re-charging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

1,1-Dichloro-1-nitroethane, NIOSH Method No. 213

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S213-2

Sampling Data Sheet # S216

Substance:

Ethylene Glycol Dinitrate and/or Nitroglycerin

Standard:

Ceiling: 0.2 ppm (1.0 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a Tenax-GC tube to trap the nitroglycerin and ethylene glycol dinitrate vapors present. The analyte is desorbed from the resin with ethanol, and the sample is separated and analyzed using a gas chromatograph with a Ni-63 electron capture detector. For ethylene glycol dinitrate, the method has been validated over the range of 0.51-1.84 mg/cu m for a 15-liter sample at 24°C and 762 mm Hg atmospheric temperature and pressure. For nitroglycerin the method has been validated over the range of 0.56-3.21 cu m for a 15-liter sample at 22-24°C and 755-766 mm Hg atmospheric temperature and pressure range.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range 0.2 to 1.0 liters per minute, plus Tenax-GC tube, glass tube 7 cm long with 7-mm O.D. and 5-mm I.D. containing 35/60 mesh Tenax-GC with the 100-mg front and 50-mg backup in two separate tubes.

Note: The pressure drop of the packed Tenax-GC tube was 2.5 cm of water at 0.2 liter per minute.

Sample Size:

A maximum sample size of 15 liters is recommended. Sample at a flow rate of 1.0 liter per minute for 15 minutes only.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of Tenax-GC is used as a backup and should be positioned nearest the sampling pump. The Tenax-GC tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.

3. Air being sampled should not be passed through any hose or tubing before entering the Tenax-GC tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
5. The Tenax-GC tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One Tenax-GC tube should be handled in the same manner as the sample tubes (break, seal and transport), except for the taking of an air sample. This tube should be labeled as a blank. Submit one blank for every 10 samples.

Special Considerations:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance of the Tenax-GC tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than 8 hours of sampling should be done without fully recharging the battery.
3. The presence of high humidity or water mist will not interfere with the collection.
4. The desorption efficiency for Tenax-GC may vary from batch to batch. Therefore, all the tubes used to collect a set of samples should contain Tenax-GC from the same batch. Several unused Tenax-GC tubes should accompany the samples. Information on the batch number of the Tenax-GC must be supplied. These tubes will be used for desorption efficiency experiments.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped Tenax-GC tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tubes.

Reference:

Ethylene glycol dinitrate and/or Nitroglycerin, NIOSH Method No. S216.

Sampling Data Sheet # S217

Substance:

Nitrobenzene

Standard:

8-hour time-weighted average: 1 ppm (5 mg/cu m)-skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a silica gel tube to trap the nitrobenzene vapors present. The analyte is desorbed from the silica gel with methanol, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 3.11-12.45 mg/cu m for a 55-liter sample at 23°C and 765 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, at 1.0 liter per minute or less, plus silica gel tube (7 cm long by 4-mm I.D.) containing two sections of 20/40 mesh silica gel separated by a 2-mm portion of urethane foam. The adsorbing section contains approximately 150 mg of silica gel and the backup section contains approximately 75 mg.

Sample Size:

A sample size of 50 liters is recommended. Sample at a flow of 1.0 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of silica gel is used as a back-up and should be positioned nearest the sampling pump. The silica gel tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of nitrobenzene.
3. Air being sampled should not be passed through any hose or tubing before entering the silica gel tube.

Data Sheet #S217

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1 liter per minute personal sampler pump is used, position the middle of the rotameter ball to the 1 liter per minute calibration mark as accurately as possible.
5. The silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples, submit one tube from the same lot of tubes which was used for sample collection and is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance to flow of air through the silica gel tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. Silica gel has a high affinity for water so organic vapors may not be trapped efficiently in the presence of a high relative humidity. This effect may be important even though there is no visual evidence of condensed water in the silica gel tube.
4. The desorption efficiency of silica gel may vary from batch to batch. Therefore, all the tubes used to collect a set of samples should contain silica gel from the same batch. Several unused silica gel tubes should accompany the samples. Information on the batch number of the silica gel must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Data Sheet #S217

Shipping Instructions:

Capped silica gel tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Nitrobenzene, NIOSH Method No. S217.

Sampling Data Sheet # S218

Substance:

p-Nitrochlorobenzene

Standard:

8-hour time-weighted average: 1 mg/cu m - skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a silica gel tube to trap the p-nitrochlorobenzene vapors present. The analyte is desorbed from the silica gel with methanol, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 0.428-2.75 mg/cu m for a 50-liter sample at 22°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, at 1.0 liter per minute or less, plus silica gel tube (7 cm long by 4-mm I.D.) containing two sections of 20/40 mesh silica gel separated by a 2-mm portion of urethane foam. The adsorbing section contains approximately 150 mg of silica gel and the backup section contains approximately 75 mg.

Sample Size:

A sample size of 50 liters is recommended. Sample at a flow rate of 1.0 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of silica gel is used as a back-up and should be positioned nearer the sampling pump. The silica gel tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of p-nitrochlorobenzene.
3. Air being sampled should not be passed through any hose or tubing before entering the silica gel tube.

Data Sheet #S218

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1 liter per minute personal sampler pump is used, position the middle of the rotameter ball to the 1 liter per minute calibration mark as accurately as possible.
5. The silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples, submit one tube from the same lot of tubes which was used for sample collection and is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as blank.

Special Considerations:

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance to flow of air through the silica gel tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. Silica gel has a high affinity for water so organic vapors may not be trapped efficiently in the presence of a high relative humidity. This effect may be important even though there is no visual evidence of condensed water in the silica gel tube.
4. The desorption efficiency of silica gel may vary from batch to batch. Therefore, all the tubes used to collect a set of samples should contain silica gel from the same batch. Several unused silica gel tubes should accompany the samples. Information on the batch number of the silica gel must be supplied.

Shipping Instructions:

Capped silica gel tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping.

Reference:

p-Nitrochlorobenzene, NIOSH Method No. S218.

Sampling Data Sheet # S223

Substance:

Nitrotoluene

Standard:

8-hour time-weighted average: 5 ppm (30 mg/cu m) - skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a silica gel tube to trap the nitrotoluene vapors present. The analyte is desorbed from the silica gel with methanol, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated for o-nitrotoluene over the range of 11.35-58.2 mg/cu m for a 20-liter sample at 23°C and 765 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range of 0.05 to 0.20 liter per minute, plus silica gel tube (7 cm long by 4-mm I.D.) containing two sections of 20/40 mesh silica gel separated by a 2-mm portion of urethane foam. The adsorbing section contains approximately 150 mg of silica gel and the backup section contains approximately 75 mg.

Sample Size:

A sample size of 20 liters is recommended. Sample at a flow rate of 0.2 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of silica gel is used as a back-up and should be positioned nearest the sampling pump. The silica gel tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of nitrotoluene.
3. Air being sampled should not be passed through any hose or tubing before entering the silica gel tube.

Data Sheet #S223

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
5. The silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples, submit one tube from the same lot of tubes which was used for sample collection and is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance to flow of air through the silica gel tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. Silica gel has a high affinity for water so organic vapors may not be trapped efficiently in the presence of a high relative humidity. This effect may be important even though there is no visual evidence of condensed water in the silica gel tube.
4. The desorption efficiency of silica gel may vary from batch to batch. Therefore, all the tubes used to collect a set of samples should contain silica gel from the same batch. Several unused silica gel tubes should accompany the samples. Information on the batch number of the silica gel must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Data Sheet #S223

Shipping Instructions:

Capped silica gel tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Nitrotoluene, NIOSH Method No. S223.

Sampling Data Sheet # S224

Substance:

Tetranitromethane

Standard:

8-hour time-weighted average: 1 ppm (8 mg/cu m)

Reference: 29 CFR 1910.1000

Analytical Method:

A known volume of air is drawn through a midget impinger which contains 15 ml of ethyl acetate. An aliquot of this sample solution is injected into a gas chromatograph using an alkali-flame ionization detector. The method has been validated over the range of 2.7-11.5 mg/cu m for a 250-liter sample at 19°C and 763 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

An approved and calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, at 1.0 liter per minute for 250 minutes, plus standard midget impinger containing 15 ml ethyl acetate (nano-grade quality). The sampling pump is protected from splashover or water condensation by an adsorption tube loosely packed with a plug of glass wool and inserted between the exit arm of the impinger and the pump. The collected sample solutions are transferred to 20 ml polyethylene vials with screw caps for shipment to the laboratory.

Sample Size:

A sample of 250 liters is recommended. This requires a sampling period of 250 minutes at a flow of 1.0 liter per minute.

Sampling Procedure:

1. Connect the impinger to the sampling pump with a short piece of flexible tubing containing a glass wool plug to protect the pump.
2. The impinger must be maintained in a vertical position during sampling.
3. Air being sampled should not be passed through any hose or tubing before entering the impinger.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not

available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1-liter per minute personal sampler pump is used, position the middle of the rotameter ball to the 1 liter per minute calibration mark as accurately as possible.

5. Periodically refill the impinger with ethyl acetate and do not allow the ethyl acetate level to go down below 10 ml because this may lead to lower collection efficiency.
6. After sampling, the impinger top can be removed and cleaned. Tap the stem gently against the inside wall of the impinger bottom to recover as much of the sampling solution as possible. Transfer the sample solution into the 20-ml polyethylene vial. Rinse the stem of the impinger top and also the impinger bottom with 1-2 ml of ethyl acetate and transfer rinsing into the polyethylene vial. Repeat rinsing process 2-3 times to ensure complete sample transfer.
7. Care should be taken to minimize spillage or loss by evaporation at all times.
8. A "blank" impinger should be handled as the other samples (fill, seal and transport) except that no air is sampled through this impinger. Submit one "blank" for every 10 samples collected.

Special Considerations:

Where other organic compounds, particularly those containing nitrogen are known or suspected to be present in the air sampled, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes. Do not ship bulk sample with the collected samples.

Shipping Instructions:

Whenever possible, hand delivery of the samples is recommended. Otherwise, special shipping cases designed by NIOSH should be used to ship the samples.

Reference:

Tetranitromethane, NIOSH Method No. S224

Sampling Data Sheet # S225

Substance:

Tetryl (2,4,6-Trinitrophenylmethylnitramine)

Standard:

8-hour time-weighted average: 1.5 mg/cu m - skin

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a cellulose membrane filter to trap the tetryl particulate present. The analyte is extracted from the filter with N,N-diethylethanolamine to form a reddish-brown complex, and analyzed by a spectrophotometer at 420 nm. The method has been validated over the range of 0.882-4.51 mg/cu m at an atmospheric temperature and pressure of 23°C and 770 mm Hg.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ at 1.5 liters per minute; a 37-mm polystyrene three-piece cassette filter holder and a 37-mm/0.8-micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad. Do not use Tenite filter holders.

Sample Size:

A sample size of 100 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

Data Sheet #S225

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct the problem, terminate the sampling.
5. The filter should be removed from the cassette filter holder and cellulose backup pad and placed in a clean screw cap bottle within one hour of sampling. Care must be taken to handle the filter only with clean tweezers.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for the sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The screw cap bottles in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Tetryl, NIOSH Method No. S225.

Sampling Data Sheet # S227

Substance:

n-Propylnitrate

Standard:

8-hour time-weighted average: 25 ppm (110 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a charcoal tube to trap the n-propylnitrate vapors present. The analyte is desorbed from the activated coconut charcoal with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 50-209 mg/cu m for a 70-liter sample at 21°C and 771 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range 1.0 to 2.0 liters per minute, plus charcoal tube containing two sections of 20/40 mesh activated coconut charcoal with the 100-mg front and 50-mg backup sections separated by a 2-mm portion of urethane foam.

Sample Size:

A sample size of 70 liters is recommended. Sample at a flow rate of 1.0 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a backup and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere

sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.

5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport), except for the taking of an air sample. This tube should be labeled as a blank.

Special Consideration:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than 8 hours of sampling should be done without fully recharging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

n-Propylnitrate, NIOSH Method No. S227

Sampling Data Sheet # S229

Substance :

Arsine

Standard:

8-hour time-weighted average: 0.05 ppm (0.2 mg/cu m)
Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a charcoal tube to trap the arsine vapors present. The analyte is desorbed from the charcoal with 0.01M nitric acid and the sample is analyzed using a high temperature graphite furnace. The method has been validated over the range of 0.094-0.404 mg/cu m for a 10-liter sample at 27.6°C and 761 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range 0.05 to 0.2 liters per minute, plus charcoal tube containing two sections of 20/40 mesh activated coconut charcoal with the 100-mg front and 50-mg backup sections separated by a 2-mm portion of urethane foam.

Sample Size:

A sample size of 10 liters is recommended. Sample at a flow rate of 0.2 liters per minute or less. Higher sample flow rate, such as 1.0 liter per minute should not be used because a lower collection efficiency is obtained.

Sampling Procedure :

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a back-up and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the

approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.

5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport), except for the taking of an air sample. This tube should be labeled as a blank.

Special Considerations:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than 8 hours of sampling should be done without fully recharging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping.

Reference:

Arsine, NIOSH Method No. S229.

Sampling Data Sheet # S237

Substance:

Hydrazine

Standard:

8-hour time-weighted average: 1 ppm (1.3 mg/cu m) - skin

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a bubbler (midget bubbler with a fritted inlet), which contains 10 ml of 0.1 M hydrochloric acid. The solution is made alkaline and then reacted with p-dimethylamino-benzaldehyde solution to form a colored complex. The amount of complex is determined with a spectrophotometer to give a quantitative measure of hydrazine. The method has been validated over a range of 0.589-3.44 mg/cu m for a 100-liter sample at 22°C and 763 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

An approved and calibrated personal sampling pump whose flow can be determined accurately, +5%, at 1 liter per minute plus midget bubbler (fitted with a fritted glass inlet) containing 10 ml of the collection medium prepared according to the NIOSH method referenced below. The sampling pump is protected from splashover or water condensation by a 5-cm long x 6-mm I.D. glass splashover tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump. Twenty-five milliliters of the collection medium should accompany each set of bubblers for use in rinsing the bubbler stem after sampling.

Sample Size:

A 100-liter sample taken at a flow rate of 1.0 liter per minute or less is recommended.

Sampling Procedure:

1. Pipet 10 ml of 0.1 M hydrochloric acid into each bubbler and mark the liquid level.
2. Connect the bubbler (via splashover tube) to the sampling pump with a short piece of flexible tubing. The minimum amount of tubing should be used between the sampling pump and bubbler.

3. The bubbler must be maintained in a vertical position during sampling.
4. Air being sampled should not be passed through any hose or tubing before entering the bubbler.
5. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1 liter per minute personal sampler pump is used, position the middle of the rotameter ball to the 1 liter per minute calibration mark as accurately as possible.
6. After sampling, the bubbler stem may be removed and cleaned. If necessary, bring the volume of each sample to the 10-ml mark with 0.1 M hydrochloric acid. Wash the stem with approximately 1 ml of 0.1 M hydrochloric acid, adding the wash to the bubbler. The bubblers are sealed with a hard, non-reactive stopper (preferably Teflon or glass). Do not seal with rubber. The stoppers on the bubblers should be tightly sealed to prevent leakage during shipping.
7. Care should be taken to minimize spillage or loss by evaporation at all times.
8. With each batch of ten samples, submit one bubbler from the same lot of bubblers which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When other hydrazine derivatives are known or suspected to be present in the air sampled, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Whenever possible, hand delivery of the samples is recommended. Otherwise, special bubbler shipping cases designed by NIOSH should be used to ship the samples. Never transport, mail, or ship the bulk sample in the same container as the sample or blank bubbler.

Reference:

Hydrazine, NIOSH Method No. S237

442<

S237-2

Sampling Data Sheet # S246

Substance:

Hydrogen Chloride

Standard:

8-hour time-weighted average: 5 ppm (7 mg/cu m) - Ceiling

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a midget bubbler containing 10 ml of 0.5 M sodium acetate to trap hydrogen chloride. The resulting solution is diluted to 25 ml with distilled water. The sample is analyzed using a chloride ion specific electrode and an expanded scale millivolt/pH meter. The method has been validated over the range of 3.5-14 mg/cu m for a 15-liter sample at an atmospheric temperature and pressure of 22°C and 764 mm Hg.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, + 5%, at 1.0 liter per minute, plus midget bubbler, containing 10 ml of 0.5 M sodium acetate. The sampling pump is protected from splashover by a 5-cm long by 6-mm I.D. glass splashover tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump. (An additional 100 ml of collection medium should accompany each set of bubblers for use in rinsing the bubbler and bubbler stems after sampling.) Samples are shipped in polyethylene containers.

Sample Size:

A sample size of 15 liters, taken at a flow of 1.0 liter per minute for 15 minutes, is recommended.

Sampling Procedure:

1. Connect the midget bubbler (containing 10 ml of the collection medium) with a 5-cm glass splashover tube containing the glass wool plug to the personal sampling pump using short pieces of flexible tubing.
2. The bubbler must be maintained in a vertical position during sampling.
3. Air being sampled should not be passed through any hose or tubing before entering the bubbler.

Data Sheet #S246

4. Set the flow rate as accurately as possible using the manufacturer's directions. Position the middle of the rotameter ball of the personal sampling pump to the 1.0 liter per minute calibration mark as accurately as possible. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation.
5. After sampling remove the bubbler stem and transfer the contents of the bubbler to a polyethylene container. Rinse the bubbler and bubbler stem with 3-5 ml of collection medium, adding the rinse to a polyethylene container. Seal the polyethylene container with the associated caps just prior to shipment.
6. Care should be taken to minimize spillage or loss by evaporation.
7. A "blank" bubbler should be handled in the same manner as the bubblers containing the samples (fill, seal, and transport) except that no air is sampled through this bubbler.

Special Considerations:

1. Where interfering compounds such as chlorides are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Samples must be shipped in polyethylene containers instead of the bubbler bottoms. Samples stored in glass vials were found to be unstable after being stored for one week.

Shipping Instructions:

Whenever possible, hand delivery of the samples is recommended. Otherwise, special shipping cases designed by NIOSH should be used to ship the samples.

Reference:

Hydrogen Chloride, NIOSH Method No. S246.

Sampling Data Sheet # S248

Substance:

Carbon Disulfide

Standard:

Ceiling - 30 ppm

Peak - 100 ppm

8-hour time weighted average - 20 ppm

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a drying tube connected in series with a charcoal tube to trap the carbon disulfide vapors present. The drying tube is used to prevent moisture from entering the charcoal tube. The analyte is desorbed from the charcoal tube with benzene, and the sample is separated and analyzed using a gas chromatograph with a flame photometric detector with a sulfur filter. The method has been validated over the range of 14.7-58.8 ppm for a 6-liter sample at 22°C and 766 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range of 0.05-0.2 liter per minute, plus charcoal tube containing two sections of 20/40 mesh activated charcoal separated by a 2-mm portion of urethane foam. The charcoal tube is 7-cm long with a 4-mm I.D. The front section of the tube contains 100 mg of activated coconut charcoal and the backup section contains 50 mg. A drying tube is connected in series to the front section of the charcoal tube. The drying tube is 7-cm long with a 4-mm I.D. The drying tube contains 270 mg of granular anhydrous sodium sulfate. A plug of silylated glass wool is placed at each end of the tube.

Sample Size:

At the ceiling OSHA standard, a sample size of 6 liters is recommended. Sample for 30 minutes at a flow rate of 0.20 liter per minute.

At the 8-hour time weighted average concentration level, a sample size of 12 liters is recommended. Sample at a flow rate of 0.20 liter per minute.

Sampling Procedure:

1. Immediately before sampling, break the ends of the charcoal tube to provide an opening at least one-half the internal diameter of the tube (2 mm). Uncap both ends of the drying tube and connect this tube in series to the front section of the charcoal tube with 20 mm of Teflon tubing.
2. The smaller section of charcoal is used as a backup and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of carbon disulfide.
3. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
4. The drying tube should remain connected to the charcoal tube during shipping. Cap the open end of the drying tube with a plastic cap. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
5. With each batch of ten samples submit one tube from the same lot of tubes which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. When the amount of water in the air is so great that condensation actually occurs in the tube, carbon disulfide vapors may not be trapped efficiently. Experiments showed that there was increasing loss of carbon disulfide with an increase in relative humidity. In order to correct this problem, it is necessary to use a dessicant to remove the moisture.

4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.
5. It has been found that carbon disulfide tends to migrate within the charcoal tube from the front section to the backup section when held at ambient temperatures for prolonged periods of time. This migration can effectively be retarded by storing the samples at refrigerator temperatures. The tubes appear to be unaffected by short storage at elevated temperatures or by shipping under reduced pressures. It is recommended that the samples be refrigerated if sample analysis cannot be performed within one week.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Carbon Disulfide, NIOSH Method No. S248.

Sampling Data Sheet # S249

Substance:

Carbon Dioxide

Standard:

8-hour time-weighted average: 5000 ppm (9000 mg/cu m)

Analytical Method:

A known volume of air is collected in a five-layer gas sampling bag (Calibrated Instruments, Inc.) with the aid of a low flow rate personal pump capable of filling a bag. The sample is analyzed using a gas chromatograph with thermal conductivity detector. The method has been validated over the range of 2270-9990 ppm for a 3.5 liter sample at 28.5°C and 757 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

The sampling equipment needed includes a low flow rate personal sampling pump capable of filling a bag. The flow rate should be calibrated to within $\pm 5\%$.

The 5-liter gas aluminized five-layer sampling bag used to collect the sample is fabricated by Calibrated Instruments, Inc. (731 Saw Mill River Road, Ardsley, N.Y. 10502). The actual bag material composition is unknown. The bag is fitted with a metal valve and hose bib. Note that other sampling bags such as Saran and Tedlar give low sample recoveries when stored for one week.

Sample Size:

A sample size of 3-4 liters is recommended. Sample at a flow rate of 0.05 liter per minute or less, but no less than 0.01 liter per minute.

Sampling Procedure:

1. Before sampling, the gas sampling bags should be flushed with N_2 or filtered air free of carbon dioxide and evacuated. The bag can be evacuated manually by pressing the bag until it is completely flat or by using a vacuum pump.
2. The gas sampling bag valve is attached to the outlet of the sampling pump with a short piece of Tygon or plastic tubing.
3. Air being sampled will pass through the pump before entering the gas sampling bag. No tubing is attached to the inlet of the pump.

4. A low flow rate pump, capable of delivering 0.05 to 0.01 liter per minute into the bag, is used. Set the flow rate using the manufacturer's directions and determine flow rate to within $\pm 5\%$. Record the information necessary to determine volume and also record the initial and final sampling time. Collect a total sample volume equal to only 80% the volume capacity of the bag to avoid over-filling.
5. The gas sampling bag should be labeled properly and the valve sealed tightly immediately after sampling.

Special Considerations:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. No more than 8 hours of sampling should be done without first fully recharging the battery.

Shipping Instructions:

Sealed gas sampling bags should be packed loosely and padded before they are shipped to minimize the danger of getting punctured during shipping.

Reference:

Carbon Dioxide, NIOSH Method No. S249

Sampling Data Sheet # S250

Substance:

Cyanide (as CN)

Standard:

8-hour time-weighted average: 5.0 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter connected in series with an impinger containing 10 ml of 0.1N NaOH. The filter collects the particulate cyanide and the backup impinger collects any HCN present or formed during the sampling process. The sample filters are treated with 0.1N NaOH and the solutions are analyzed by direct potentiometry using the ion specific electrode. The impinger solutions are analyzed separately using the same analytical method described. The method has been validated over the range of 2.62-9.68 mg/cu m for a 90-liter sample at 24°C and 763 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm, 3-piece cassette filter holder held together by tape or shrinkable band; a 37-mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad; and a midget impinger containing 10 ml of absorbing solution prepared according to Section 7.3 of NIOSH Method No. S250. The sampling pump is protected from splashover or water condensation by an adsorption tube loosely packed with a plug of glass wool and inserted between the exit arm of the impinger and the pump.

Sample Size:

A sample size of 90 liters is recommended. This requires a sampling period of 60 minutes at a flow of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and 3-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Pipet 10 ml of 0.1N NaOH into the impingers.

3. Remove the cassette plugs and attach to the inlet of the midget impinger with flexible tubing. This tubing should be as short as possible in order to minimize sample contact with tubing material.
4. Attach the impinger to the sampling pump with a short piece of flexible tubing containing a glass wool plug to protect the pump. The impinger must be maintained in a vertical position during the sampling. Clip the cassette to the worker's lapel.
5. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
6. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
7. After sampling, disconnect the filter holder cassettes from the impingers and firmly seal the cassettes with the plugs in both the inlet and outlet. Separate filter holder and impinger immediately after sampling.
8. The sample impingers are then handled and shipped separately from the filters. The impinger stems can be removed and cleaned as follows. Tap the stem gently against the inside wall of the impinger bottom to recover as much of the sampling solution as possible and quantitatively transfer the total contents of the impinger bottom into a 20-ml polyethylene scintillation vial with screw cap. Wash the impinger stem with 2 ml of 0.1 N NaOH and add washing into the polyethylene vial. Close cap tightly and secure with plastic tape around edges to avoid sample loss during transit.
9. Care should be taken to minimize spillage or loss by evaporation at all times.
10. Carefully record sample identity of both filters and impingers and all relevant sample data.
11. Blank. With each batch of 10 samples, submit one filter and one impinger solution which is subjected to exactly the same handling as for the samples except that no air is drawn through them. Label these as blanks. Submit one blank filter and one blank impinger solution for every ten samples.

Data Sheet #S250

Special Considerations:

Where other metals or ionic species, particularly sulfides, are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The filter cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit. Similar shipping precautions should be used for the impinger solutions. Ship the filters and solution vials in separate containers.

Reference:

Cyanide (as CN), NIOSH Method No. S250.

Sampling Data Sheet # S254

Substance:

Dimethyl Acetamide

Standard:

8-hour time-weighted average: 10 ppm (35 mg/cu m) - skin

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a silica gel tube to trap the dimethyl acetamide vapors present. The analyte is desorbed from the silica gel with methanol, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 18.17-105.6 mg/cu m for a 45-liter sample at 24°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, at 1.0 liter per minute or less, plus silica gel tube (7 cm long by 4-mm I.D.) containing two sections of 20/40 mesh silica gel separated by a 2-mm portion of urethane foam. The adsorbing section contains approximately 150 mg of silica gel and the backup section contains approximately 75 mg.

Sample Size:

A sample size of 50 liters is recommended. Sample at a flow of 1.0 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening at least one-half the internal diameter of the tube.
2. The smaller section of silica gel is used as a back-up and should be positioned nearest the sampling pump. The silica gel tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of dimethyl acetamide.
3. Air being sampled should not be passed through any hose or tubing before entering the silica gel tube.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1 liter per minute personal sampler pump is used, position the middle of the rotameter ball to the 1 liter per minute calibration mark as accurately as possible.
5. The silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples, submit one tube from the same lot of tubes which was used for sample collection and which was subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations :

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance to flow of air through the silica gel tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. Silica gel has a high affinity for water so organic vapors may not be trapped efficiently in the presence of a high relative humidity. This effect may be important even though there is no visual evidence of condensed water in the silica gel tube.
4. The desorption efficiency of silica gel may vary from batch to batch. Therefore, all the tubes used to collect a set of samples should contain silica gel from the same batch. Several unused silica gel tubes should accompany the samples. Information on the batch number of the silica gel must be supplied.

Bulk Samples :

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Data Sheet #S254

Shipping Instructions:

Capped silica gel tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Dimethyl Acetamide, NIOSH Method No. S254.

Sampling Data Sheet # S255

Substance:

Dimethyl Formamide

Standard:

8-hour time-weighted average: 10 ppm (30 mg/cu m) - skin

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a silica gel tube to trap the dimethyl formamide vapors present. The analyte is desorbed from the silica gel with methanol, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 10.6l-61.1 mg/cu m for a 45-liter sample at 23°C and 761 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, at 1.0 liter per minute or less, plus silica gel tube (7 cm long by 4-mm I.D.) containing two sections of 20/40 mesh silica gel separated by a 2-mm portion of urethane foam. The adsorbing section contains approximately 150 mg of silica gel and the backup section contains approximately 75 mg.

Sample Size:

A sample size of 50 liters is recommended. Sample at a flow of 1.0 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening at least one-half the internal diameter of the tube.
2. The smaller section of silica gel is used as a back-up and should be positioned nearest the sampling pump. The silica gel tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of dimethyl formamide.
3. Air being sampled should not be passed through any hose or tubing before entering the silica gel tube.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1 liter per minute personal sampler pump is used, position the middle of the rotameter ball to the 1 liter per minute calibration mark as accurately as possible.
5. The silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples, submit one tube from the same lot of tubes which was used for sample collection and which was subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance to flow of air through the silica gel tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. Silica gel has a high affinity for water so organic vapors may not be trapped efficiently in the presence of a high relative humidity. This effect may be important even though there is no visual evidence of condensed water in the silica gel tube.
4. The desorption efficiency of silica gel may vary from batch to batch. Therefore, all the tubes used to collect a set of samples should contain silica gel from the same batch. Several unused silica gel tubes should accompany the samples. Information on the batch number of the silica gel must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Data Sheet #S255

Shipping Instructions :

Capped silica gel tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference :

Dimethyl Formamide, NIOSH Method No. S255.

Sampling Data Sheet # S262

Substance:

Carbon Black

Standard:

8-hour time-weighted average: 3.5 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a tared polyvinyl chloride membrane filter to trap the particulate carbon black present. The analyte is analyzed gravimetrically after drying the sample-containing filters over a desiccant to constant weight. The method has been validated over the range of 1.86-7.7 mg/cu m at an atmospheric temperature and pressure range of 18-25°C and 749-761 mm Hg, using a 210-liter sample.

Sampling Equipment :

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three-piece cassette filter holder sealed and held together by tape or shrinkable band; and a 37-mm/2.0 micrometer pore size polyvinyl chloride membrane filter (PVC) supported by a stainless steel screen.

Sample Size :

A sample size of 200 liters is recommended. Sample at a flow rate of 1.7 liters per minute for 120 minutes. Total collected sample should be equal to or less than 2.0 mg. If concentrations greater than 10 mg/cu m are suspected to be present, a smaller total volume should be collected by decreasing the sampling time or flow rate.

Sampling Procedure:

1. Assemble the tared, dried filter, stainless steel screen and three-piece filter cassette and close firmly to insure that the inner sides of the holder seal the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

Data Sheet #S262

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.7 liters per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and the sampling should be terminated at any evidence of a problem.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one tared and dried filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample. Since the method is purely gravimetric, any other particulate present in the air sampled will be a positive interference.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Carbon Black, NIOSH Method No. S262.

Sampling Data Sheet # S264

Substance:

Ethyl Silicate

Standard:

8-hour time-weighted average: 100 ppm (850 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a 4-mm I.D. glass tube which contains XAD-2 resin to collect the ethyl silicate. The ethyl silicate is desorbed from the resin with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 377-1620 mg/cu m for a 9-liter sample at 21°C and 771 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A personal sampling pump, calibrated with a representative XAD-2 tube in the line, whose flow can be determined accurately, $\pm 5\%$, at 0.05 liter per minute, plus a special sampling tube containing two sections of XAD-2 resin; the 100-mg front and 50-mg backup sections are separated by a plug of silylated glass wool.

Sample Size:

A maximum sample size of 9 liters is recommended. Sample at a flow rate of 0.05 liter per minute only. Otherwise the correction factors recommended in NIOSH Method S264 may not be applicable.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of XAD-2 resin is used as a backup and should be positioned nearest the sampling pump. The XAD-2 resin tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.
3. Air being sampled should not be passed through any hose or tubing before entering the XAD-2 resin tube.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation. Using a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
5. The XAD-2 resin tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One XAD-2 resin tube should be handled in the same manner as the sample tubes (break, seal, and transport) except for the taking of an air sample. This tube should be labeled as a blank.

Special Considerations:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance of the XAD-2 resin tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than 8 hours of sampling should be done without fully recharging the battery.
3. The presence of high humidity or water mist will not significantly decrease the breakthrough volume.
4. The desorption efficiency of XAD-2 resin varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain XAD-2 resin from the same batch. Several unused XAD-2 resin tubes should accompany the samples. Information on the batch number of the XAD-2 resin must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped XAD-2 resin tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping.

Reference:

Ethyl silicate, NIOSH Method No. S264

Sampling Data Sheet # S272

Substance:

Oil Mist, Mineral

Standard:

8-hour time-weighted average: 5.0 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the particulate oil mist present. The filter is extracted with chloroform and analyzed by fluorescence spectrophotometry to determine the oil mist concentration. The method has been validated over the range of 2.5-11.7 mg/cu m at an atmospheric temperature and pressure of 22°C and 755 mm Hg, using a 100-liter sample.

Sampling Equipment:

A personal sampling pump calibrated with a representative filter and whose flow can be determined to an accuracy of +5% over the range of 1.0 to 2.0 liters per minute; a 37-mm three-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 100 liters is recommended. Sample at a flow rate of 1.5 liters per minute for 66 minutes.

Sampling Procedures:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record

the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and the sampling should be terminated at any evidence of a problem.

5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

Where two or more contaminants are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample. Certain types of oils such as mineral oil (aromatic free) and paraffin oils do not fluoresce and cannot be analyzed by this method.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit. Bulk samples should be shipped in a container separate from the samples to prevent contamination.

Bulk Sample:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. This type of container is essential to avoid contaminating the bulk sample which is needed by the analyst to prepare a calibration curve. Label of the bulk sample should match air samples for identification purposes.

Reference:

Oil Mist, Mineral, NIOSH Method No. S272

Sampling Data Sheet # S273

Substance:

Carbaryl (Sevin)

Standard:

8-hour time-weighted average: 5 mg/cu m

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a glass fiber filter to trap the carbaryl particulate present. The analyte is extracted from the filter with methanolic KOH. The resulting solution is reacted with p-nitrobenzenediazonium fluoroborate to form a colored complex. The amount of complex formed is determined with a spectrophotometer to give a quantitative measure of carbaryl. The method has been validated over the range of 1.96-13.43 mg/cu m for a 90-liter sample at 24°C and 763 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of + 5%, at 1.5 liters per minute; a 37-mm two-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm diameter glass fiber filter. The filters must be free of organic binders. The filter holder should be made of polystyrene. Do not use Tenite filter holders.

Sample Size:

A sample size of 90 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and two-piece filter cassette and close firmly. Examine the holder for a good filter seal. The filter is held in place by a backup pad. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. The glass fiber filter should be removed from the cassette filter holder and placed in a clean screw cap bottle within 1 hour of sampling. Care must be taken to handle the filter only with clean tweezers.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The screw cap bottles in which the samples are collected should be shipped in a suitable container designed to prevent damage in transit. The bottle caps should be lined with Teflon for proper seal.

Reference:

Carbaryl, NIOSH Method No. S273.

Substance:

DDT [2,2-bis (p-chlorophenyl)-1,1,1-trichloroethane]

Standard:

8-hour time-weighted average: 1.0 mg/cu m - skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a glass fiber filter to trap the DDT particulate present. The analyte is extracted from the filter with iso-octane, and the analyte is separated and analyzed using a gas chromatograph with an electrolytic conductivity detector. The method has been validated over the range of 0.494-2.60 mg/cu m for a 90-liter sample at 26°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of +5%, at 1.5 liters per minute; a 37-mm two-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm diameter glass fiber filter similar to Gelman Type AE. The filter must be free of organic binders. The filter holder should be made of polystyrene. Do not use Tenite filter holders. The glass fiber filter should be at least 99.7% efficient against particles as small as 0.3 microns.

Sample Size:

A sample size of 90 liters is recommended. Sample at a flow of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and two-piece filter cassette and close firmly. Examine the holder for a good filter seal. The filter is held in place by a backup pad. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.

3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. The glass fiber filter should be removed from the cassette filter holder and placed in a clean screw cap bottle within 1 hour of sampling. Care must be taken to handle the filter only with clean tweezers.
6. Carefully record sample identity and all relevant sample data such as sampling rate and collection time.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The screw cap bottles in which the samples are collected should be shipped in a suitable container designed to prevent damage in transit. The bottle caps should be lined with Teflon for proper seal.

Reference:

DDT, NIOSH Method No. S274.

Sampling Data Sheet # S275

Substance :

Aldrin

Standard:

8-hour time-weighted average: 0.25 mg/cu m - skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a glass fiber filter connected in series with a midget bubbler containing 15 ml of iso-octane to trap the aldrin present. The solution in the midget bubbler is transferred to a 20-ml scintillation vial and the filter is added. The analyte is separated and analyzed using a gas chromatograph with an electrolytic conductivity detector. The method has been validated over the range of 0.149-0.495 mg/cu m for a 165-liter sample at 25°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$, at 1.0 liter per minute; a 37-mm two-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm diameter glass fiber filter connected in series with a midget bubbler. The filter holder should be made of polystyrene. Do not use Tenite filter holders. The filters should be free of organic binders and should be at least 99.7% efficient against particles as small as 0.3 micron. The sampling pump is protected from splashover or solvent condensation by a 5-cm long X 6-mm I.D. glass tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump. (One hundred milliliters of iso-octane should accompany each set of samples for rinsing the bubbler stems and transferring the contents of the bubblers to the scintillation vials. Additional iso-octane is needed to refill the bubblers periodically during sampling. The scintillation vials which are used for shipping should be marked at 15 ml.

Sample Size:

A sample size of 180 liters, taken at a flow rate of 1.0 liter per minute, is recommended.

Sampling Procedure:

1. Assemble the filter in the two-piece filter cassette holder and close firmly. Pipet 15 ml of the collection medium (iso-octane)

into each bubbler and mark the liquid level. The liquid level in the bubbler must be checked frequently. If the liquid level is lowered by an appreciable amount (to less than 10 ml) from evaporation, the bubbler must be refilled with additional iso-octane. The final refilling of iso-octane into the bubbler should be done at approximately 15 minutes before the end of sampling. The final volume of the bubbler at the end of sampling should be 12 ml or less.

2. Remove the cassette plugs and attach the outlet of the filter cassette to the inlet arm of the midjet bubbler using a short piece of flexible tubing. Connect the outlet arm of the midjet bubbler with a 5-cm glass splashover tube (6-mm I.D.) containing the glass wool plug, then to the personal sampling pump, using short pieces of flexible tubing. The bubbler must be maintained in a vertical position during sampling.
3. Air being sampled should not pass through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.0-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. After sampling, remove the bubbler stem and tap the stem gently against the inside wall of the bubbler bottle to recover as much of the sampling solution as possible. Rinse the bubbler stem with 1 ml of iso-octane into the midjet bubbler.
6. Transfer the contents of the midjet bubbler to the scintillation vial which has been marked at 15 ml. Rinse the bubbler with 2 ml of iso-octane, adding rinse to the vial. Bring the volume in the vial to the 15-ml mark with iso-octane.
7. Remove the glass fiber filter from the cassette filter holder and place into the scintillation vial. Care must be taken to handle the filter only with clean tweezers. Cap the scintillation vial with an appropriate cap with a Teflon cap liner.
8. Carefully record the sample identity and all relevant sampling data such as sampling rate and collection time.
9. With each batch of ten samples submit one filter and midjet bubbler which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The scintillation vials in which the samples are stored should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Aldrin, NIOSH Method No. S275.

Sampling Data Sheet # S281

Substance:

p-Dichlorobenzene

Standard:

8-hour time-weighted average: 75 ppm (450 mg/cu m)

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a charcoal tube to trap the p-dichlorobenzene vapors present. The analyte is desorbed from the charcoal tube with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 183.2-777 mg/cu m for a 3-liter sample at 23°C and 761 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, at 0.05 liter per minute, plus charcoal tube containing two sections of 20/40 mesh activated charcoal separated by a 2-mm portion of urethane foam. The charcoal tube is 7 cm long with a 4-mm I.D. The front section of the charcoal tube contains 100 mg of charcoal, and the backup section contains 50 mg.

Sample Size:

A sample size of 3 liters is recommended. Sample at a flow rate of 0.05 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening at least one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a back-up and should be positioned nearer the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of p-dichlorobenzene.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's

directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.

5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples submit one tube from the same lot of tubes which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

1. Where interfering compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

p-Dichlorobenzene, NIOSH Method No. S281.

Sampling Data Sheet # S283

Substance:

Dieldrin

Standard:

8-hour time-weighted average: 0.25 mg/cu m - skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a glass fiber filter to trap the dieldrin particulate present. The analyte is extracted from the filter with iso-octane, and the analyte is separated and analyzed using a gas chromatograph with an electrolytic conductivity detector. The method has been validated over the range of 0.122-0.587 mg/cu m for a 170-liter sample at 22°C and 759 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$, at 1.5 liters per minute; a 37-mm two-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm diameter glass fiber filter similar to Gelman Type AE. The filter must be free of organic binders. The filter holder should be made of polystyrene. Do not use Tenite filter holders. The glass fiber filter should be at least 99.7% efficient against particles as small as 0.3 micron.

Sample Size:

A sample size of 180 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and two-piece filter cassette and close firmly. Examine the holder for a good filter seal. The filter is held in place by a backup pad. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.

3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. The glass fiber filter should be removed from the cassette filter holder and placed in a clean screw cap bottle within 1 hour of sampling to avoid loss of the analyte. Care must be taken to handle the filter only with clean tweezers.
6. Carefully record sample identity and all relevant sample data such as sampling rate and collection time.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The screw cap bottles in which the samples are collected should be shipped in a suitable container designed to prevent damage in transit. The bottle caps should be lined with Teflon for proper seal.

Reference:

Dieldrin, NIOSH Method No. S283.

Sampling Data Sheet # S285

Substance:

EPN (O-Ethyl-O-p-nitrophenyl phenylphosphonothioate)

Standard:

8-hour time-weighted average: 0.5 mg/cu m - skin

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a glass fiber filter to trap the EPN particulate present. The analyte is extracted from the filter with iso-octane, and the analyte is separated and analyzed using a gas chromatograph with a flame photometric detector. The method has been validated over the range of 0.295-1.156 mg/cu m for a 115-liter sample at 20°C and 759 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$, at 1.5 liters per minute; a 37-mm two-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm diameter glass fiber filter. The filter must be free of organic binders. The filter holder should be made of polystyrene. Do not use Tenite filter holders.

Sample Size:

A sample size of 120 liters is recommended. Sample at a flow of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and two-piece filter cassette and close firmly. Examine the holder for a good filter seal. The filter is held in place by a backup pad. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. The glass fiber filter should be removed from the cassette filter holder and placed in a clean screw cap bottle within 1 hour of sampling. Care must be taken to handle the filter only with clean tweezers.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The screw cap bottles in which the samples are collected should be shipped in a suitable container designed to prevent damage in transit. The bottle caps should be lined with Teflon for proper seal.

Reference:

EPN, NIOSH Method No. S285.

Sampling Data Sheet # S286

Substance:

Ethylene Oxide

Standard:

Ceiling: 50 ppm (90 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through two charcoal tubes connected in series to trap the ethylene oxide vapors present. The analyte is desorbed from the charcoal with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 41-175.9 mg/cu m for a 5-liter sample at 25.7°C and 761 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range of 0.05 to 0.2 liter per minute and a charcoal sampling tube.

The sampling tube series consists of two separate large charcoal tubes. The tubes are glass tubes with both ends flame-sealed, 10-cm long with an 8-mm O.D. and a 6-mm I.D. Each tube contains the appropriate amount of 20/40 mesh activated coconut charcoal. The front tube contains 400 mg of charcoal; the backup tube 200 mg. A plug of silylated glass wool is placed at each end of the charcoal tubes. The pressure drop across the tubes must be less than one inch of mercury at a flow rate of 1 liter per minute.

The sampling tube series can be prepared by modifying commercially available large charcoal tubes as follows. To prepare the front tube, break off exit end of a large tube and use pointed tweezers to remove glass wool plug and the backup charcoal section; then push in snugly remaining plug and charcoal to minimize channeling. To prepare the backup tube, break off inlet end of a second large tube and remove retaining glass wool plug and the front charcoal section; again push together remaining plug and charcoal to prevent channeling. The front tube is connected to the backup tube with a minimal piece of tygon or rubber tubing. This sampling tube scheme is necessary in order to minimize any sample migration effects upon storage.

Sample Size:

A sample size of 5 liters is recommended. Sample at a flow of 0.05 liter per minute.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken so as to provide openings approximately one-half the internal diameters of the tubes. Prepare and assemble tubes as described in sampling equipment section. Connect the front 400-mg tube to the 200-mg backup tube with a short piece of tubing.
2. The tube containing 200 mg of charcoal is used as a backup and should be positioned nearest the sampling pump. The charcoal tube series should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tubes.
4. If the low flow rate pump is used, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. Record the temperature and pressure of the atmosphere being sampled. If pressure reading is not available, record the elevation.
5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used. The two tubes must be separated and each tube recapped tightly.
6. One set of charcoal tubes (a 400-mg tube and a 200-mg backup tube) should be handled in the same manner as the sample tubes (break, seal and transport), except for the taking of an air sample. This set of tubes should be labeled as a blank. Submit one blank for every 10 samples.

Special Considerations:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than 8 hours of sampling should be done without fully recharging the battery.

3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of the charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Ethylene Oxide, NIOSH Method No. S286

Substance:

Lindane

Standard:

8-hour time-weighted average: 0.5 mg/cu m - skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a glass fiber filter connected in series with a midget bubbler containing 15 ml of iso-octane to trap the lindane present. The solution in the midget bubbler is transferred to a 20-ml scintillation vial and the filter is added. The analyte is separated and analyzed using a gas chromatograph with an electrolytic conductivity detector. The method has been validated over the range of 0.278-1.662 mg/cu m for a 90-liter sample at 24°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$, at 1.5 liters per minute; a 37-mm two-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm diameter glass fiber filter connected in series with a midget bubbler. The filter holder should be made of polystyrene. Do not use Tenite filter holders. The filters should be free of organic binders and should be at least 99.7% efficient against particles as small as 0.3 micron. The sampling pump is protected from splashover or solvent condensation by a 5-cm long X 6-mm I.D. glass tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump. (One hundred milliliters of iso-octane should accompany each set of samples for rinsing the bubbler stems and transferring the contents of the bubblers to the scintillation vials. Additional iso-octane is also needed for refilling the bubblers periodically during sampling. The scintillation vials which are used for shipping should be marked at 15 ml.

Sample Size:

A sample size of 90 liters, taken at a flow rate of 1.5 liters per minute, is recommended.

Sampling Procedure:

1. Assemble the filter in the two-piece filter cassette holder and close firmly. Pipet 15 ml of the collection medium (iso-octane)

- into each bubbler and mark the liquid level. The liquid level in the bubbler must be checked frequently. If the liquid level is lowered by an appreciable amount (to less than 10 ml) from evaporation, the bubbler must be refilled with additional iso-octane. The final refilling of iso-octane into the bubbler should be done at approximately 15 minutes before the end of sampling. The final volume of the bubbler at the end of sampling should be 12 ml or less.
2. Remove the cassette plugs and attach the outlet of the filter cassette to the inlet arm of the midget bubbler using a short piece of flexible tubing. Connect the outlet arm of the midget bubbler with a 5-cm glass splashover tube (6-mm I.D.) containing the glass wool plug, then to the personal sampling pump, using short pieces of flexible tubing. The bubbler must be maintained in a vertical position during sampling.
 3. Air being sampled should not pass through any hose or tubing before entering the filter cassette.
 4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
 5. After sampling, remove the bubbler stem and tap the stem gently against the inside wall of the bubbler bottle to recover as much of the sampling solution as possible. Rinse the bubbler stem with 1 ml of iso-octane into the midget bubbler.
 6. Transfer the contents of the midget bubbler to the scintillation vial which has been marked at 15 ml. Rinse the bubbler with 2 ml of iso-octane, adding rinse to the vial. Bring the volume in the vial to the 15-ml mark with iso-octane.
 7. Remove the glass fiber filter from the cassette filter holder and place into the scintillation vial. Care must be taken to handle the filter only with clean tweezers. Cap the scintillation vial with an appropriate cap with a Teflon cap liner.
 8. Carefully record the sample identity and all relevant sampling data such as sampling rate and collection time.
 9. With each batch of ten samples submit one filter and midget bubbler which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The scintillation vials in which the samples are stored should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Lindane, NIOSH Method No. S290.

Sampling Data Sheet # S292

Substance:

Naphthalene

Standard:

8-hour time-weighted average: 10 ppm (50 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a charcoal tube to trap the naphthalene vapors present. The analyte is desorbed from the charcoal with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 19.3-83 mg/cu m for a 200-liter sample at 21°C and 774 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A personal sampling pump, calibrated with a representative charcoal tube in the line, whose flow can be determined accurately, $\pm 5\%$, over the range 0.05 to 0.2 liters per minute, plus charcoal tube containing 20/40 mesh activated coconut charcoal with the 100-mg front and 50-mg backup in two separate tubes.

Sample Size:

A sample size of 200 liters is recommended. Sample at a flow rate of 1.0 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a back-up and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the

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approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.

5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport), except for the taking of an air sample. This tube should be labeled as a blank. Submit one blank for every 10 samples.

Special Considerations:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than 8 hours of sampling should be done without fully recharging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Naphthalene, NIOSH Method No. S292

Sampling Data Sheet # S293

Substance:

Nicotine

Standard:

8-hour time-weighted average: 0.5 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a glass tube which contains XAD-2 resin to collect the nicotine. The nicotine is desorbed from the resin with ethyl acetate, and the sample is separated and analyzed using a gas chromatograph with an alkali-flame ionization detector. The method has been validated over the range 0.295-1.195 mg/cu m for a 100-liter sample at 23°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range 0.2 to 1.0 liter per minute, plus a sampling tube (glass tubing 7 cm long x 6 mm O.D., 4 mm I.D.) containing two sections of XAD-2 resin, the 100-mg front and 50-mg backup sections are separated by a plug of silylated glass wool.

Sampling Size:

A sample size of 100 liters is recommended. Sample at a flow rate of 1.0 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of XAD-2 resin is used as a backup and should be positioned nearest the sampling pump. The XAD-2 resin tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.
3. Air being sampled should not be passed through any hose or tubing before entering the XAD-2 resin tube.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
5. The XAD-2 resin tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One XAD-2 resin tube should be handled in the same manner as the sample tubes (break, seal, and transport), except for the taking of an air sample. This tube should be labeled as a blank.

Special Considerations:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance of the XAD-2 resin tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than 8 hours of sampling should be done without fully recharging the battery.
3. The presence of high humidity or water mist will not significantly decrease the breakthrough volume.
4. The desorption efficiency of XAD-2 resin varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain XAD-2 resin from the same batch. Several unused XAD-2 resin tubes should accompany the samples. Information on the batch number of the XAD-2 resin must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped XAD-2 resin tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping.

Reference

Nicotine, NIOSH Method No. S293

Substance:

Parathion

Standard:

8-hour time-weighted average: 0.11 mg/cu m - skin

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a glass fiber filter to trap the parathion particulate present. The analyte is extracted from the filter with iso-octane, and the analyte is separated and analyzed using a gas chromatograph with a flame photometric detector. The method has been validated over the range of 0.0726-0.2643 mg/cu m for a 115-liter sample at 20°C and 762 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of + 5%, at 1.5 liters per minute; a 37-mm two-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm diameter glass fiber filter. The filter must be free of organic binders. The filter holder should be made of polystyrene. Do not use Tenite filter holders.

Sample Size:

A sample size of 120 liters is recommended. Sample at a flow of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and two-piece filter cassette and close firmly. Examine the holder for a good filter seal. The filter is held in place by a backup pad. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. The glass fiber filter should be removed from the cassette filter holder and placed in a clean screw cap bottle within 1 hour of sampling. Care must be taken to handle the filter only with clean tweezers.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The screw cap bottles in which the samples are collected should be shipped in a suitable container designed to prevent damage in transit. The bottle caps should be lined with Teflon for proper seal.

Reference:

Parathion, NIOSH Method No. S295

Sampling Data Sheet # S306

Substance:

Thallium, Soluble Compounds (as Tl)

Standard:

8-hour time-weighted average: 0.1 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the particulate thallium present. The filter is digested with nitric acid to remove the organic matrix, diluted, and aspirated into an atomic absorption spectrophotometer for determination of thallium concentration. The method has been validated over the range of 0.034-0.150 mg/cu m at an atmospheric temperature and pressure of 22°C and 759 mm Hg, using a 540-liter sample.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three-piece cassette filter holder held together by tape or shrinkable band; and a 37 mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 540 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record

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the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and the sampling should be terminated at any evidence of a problem.

5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

Where two or more compounds, especially an insoluble thallium compound, are known or suspected to be present in the air; such information, including their suspected identities, should be transmitted with the sample.

Bulk Sample:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes. This bulk sample is used to determine the presence of a soluble thallium compound.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Thallium, Soluble Compounds as Tl, NIOSH Method No. S306.

Sampling Data Sheet # S309

Substance:

Arsenic and Compounds (as As)

Standard:

8-hour time-weighted average: 0.5 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the arsenic (including arsenic compounds) present. The filter is digested with nitric and perchloric acids to destroy the filters and any organic material. The analyte is then solubilized in a nitric acid solution, and pipetted into a graphite furnace of an atomic absorption spectrophotometer for determination of concentration. The method has been validated over the range of 0.198-0.903 mg/cu m using an 85-liter sample at 24.5°C and 743 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three-piece cassette filter holder and a 37-mm diameter/0.8-micrometer pore size, mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 90 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

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4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. Cassettes containing collected samples should be firmly sealed with the plugs in both the inlets and outlets.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Arsenic and Compounds (as As), NIOSH Method No. S309.

Sampling Data Sheet # S310

Substance:

Aniline

Standard:

8-hour time-weighted average: 5 ppm (19 mg/cu m) - skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a silica gel tube to trap the aniline vapors present. The analyte is desorbed from the silica gel with 95% ethanol, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 9.54-38.2 mg/cu m for a 20-liter sample at 22°C and 759 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range of 0.05-0.20 liter per minute, plus silica gel tube (7 cm long by 4-mm I.D.) containing two sections of 20/40 mesh silica gel separated by a 2-mm portion of urethane foam. The adsorbing section contains approximately 150 mg of silica gel and the backup section contains approximately 75 mg.

Sample Size:

A sample size of 20 liters is recommended. Sample at a flow of 0.20 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of silica gel is used as a back-up and should be positioned nearest the sampling pump. The silica gel tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of aniline.
3. Air being sampled should not be passed through any hose or tubing before entering the silica gel tube.

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4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
5. The silica gel tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples, submit one tube from the same lot of tubes which was used for sample collection and which is subjected to exactly the same handling as the samples, except that no air is drawn through it. Label this as a blank.

Special Considerations:

1. Where interfering compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance to flow of air through the silica gel tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. Silica gel has a high affinity for water so organic vapors may not be trapped efficiently in the presence of a high relative humidity. This effect may be important even though there is no visual evidence of condensed water in the silica gel tube.
4. The desorption efficiency of silica gel may vary from batch to batch. Therefore, all the tubes used to collect a set of samples should contain silica gel from the same batch. Several unused silica gel tubes should accompany the samples. Information on the batch number of the silica gel must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped silica gel tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Aniline, NIOSH Method No. S310.

Sampling Data Sheet # S311

Substance:

Benzene

Standard:

Ceiling - 25 ppm

Peak - 50 ppm

8-hr. T.W.A. - 10 ppm

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a charcoal tube to trap the benzene vapors present. The analyte is desorbed from the charcoal tube with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 13-51.8 ppm for a 2-liter sample at 24°C and 762 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range of 0.05-0.2 liter per minute, plus charcoal tube containing two sections of 20/40 mesh activated charcoal separated by a 2-mm portion of urethane foam. The charcoal tube is 7 cm long with a 4-mm I.D. The front section of the tube contains 100 mg of charcoal and the backup section contains 50 mg.

Sample Size:

At the OSHA ceiling standard concentration, a sample size of 2 liters is recommended. Sample for 10 minutes at a flow rate of 0.20 liter per minute.

At the 8-hour time weighted average concentration, a sample size of 12 liters is recommended. Sample at a flow rate of 0.20 liter per minute.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening at least one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a back-up and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of benzene.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere

being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.

5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples submit one tube from the same lot of tubes which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Benzene, NIOSH Method No. S311.

Sampling Data Sheet # S312

Substance

Cadmium Dust

Standard

8-hour time-weighted average: 0.2 mg/cu m

Acceptable Ceiling Concentration: 0.6 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method

A known volume of air is drawn through a mixed cellulose ester membrane filter to trap the cadmium dust present. The sample filters are digested in concentrated nitric acid and the cadmium is solubilized by heating with hydrochloric acid. The quantity of analyte present is determined by atomic absorption spectrophotometry at 228.8 nm, using an air-acetylene flame. The method has been validated over the range of 0.12-0.98 mg/cu m for a 25-liter sample at 23°C and 759 mm Hg atmospheric temperature and pressure.

Sampling Equipment

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$, over the range of 1.0 to 2.0 liters per minute; a 37-mm three-piece cassette filter holder held together by tape or shrinkable band; and a 37-mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size

Cadmium dust has a ceiling value and a maximum sampling period of 15 minutes is recommended. Sample at a flow rate of 1-2 liters per minute (15-30 liters).

Sampling Procedure

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the required sample flow rate calibration mark as accurately as possible. A flow rate of 1-2 liters per minute is recommended. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank. Submit one blank filter for every ten samples.

Special Considerations

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference

Cadmium Dust, NIOSH Method No. S312

Sampling Data Sheet # S313

Substance:

Cadmium Fume

Standard:

8-hour time-weighted average: 0.1 mg/cu m

Ceiling Value: 0.3 mg/cu m

Analytical Method:

A known volume of air is drawn through a mixed cellulose ester membrane filter to trap the cadmium fume present. The sample filters are digested in concentrated nitric acid and the cadmium is solubilized by heating with hydrochloric acid. The quantity of analyte present is determined by atomic absorption spectrophotometry at 228.8 nm, using an air-acetylene flame. The method has been validated over two concentration ranges: 0.12-0.57 mg/cu m for a 25-liter sample at 24°C and 759 mm Hg atmospheric temperature and pressure, and 0.042-0.175 mg/cu m for a 140-liter sample at 20°C and 770 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

The following items are needed: a calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$, at a flow rate of 1.5 liters per minute; a 37-mm three piece cassette filter holder held together by tape or shrinkable band; and a 37-mm/0.8 micrometer pore size mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

Cadmium fume has a ceiling value and a maximum sampling period of 15 minutes is recommended. Sample at a flow rate of approximately 1.5 liters per minute for the collection of 25 liters. This sample size is also adequate for the determination at the OSHA TWA concentration.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.

3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record all the necessary information to determine flow rate or volume and record also the initial and final sampling time. Record the temperature and pressure of the atmosphere being sampled.
5. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air as evidenced by filter caking, the pump rotameter should be observed frequently, and readjusted as needed. If the flow rate cannot be readjusted to 1.5 liters per minute, terminate the sampling.
6. After sampling, cassettes should be firmly sealed with plugs in both the inlet and outlet.
7. Carefully record sample identity and all relevant sample data.
8. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank. Submit one blank for every ten samples.

Special Considerations:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample. Silicon is an interference as well as cadmium dust and other particulate cadmium compounds. The sample source and the particle size can be used as a guideline to distinguish cadmium fume and cadmium dust. An acceptable particle size cut-off designation is: (fumes) < 1 micrometer > (dust). In terms of source, fumes usually result from chemical reactions, such as oxidation, or from sublimation or distillation processes followed by condensation while dusts are generally formed by disintegration processes, such as those typically found in mining and ore-reduction operations.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Cadmium Fume, NIOSH Method No. S313

Sampling Data Sheet #S314.01 Class B

February 5, 1976

Substance:

Carbon Tetrachloride

Standard:

Ceiling: 25 ppm (160 mg/cu m)

Peak: 200 ppm (1260 mg/cu m); maximum duration - 5 minutes in any 4 hours

8-hour time-weighted average: 10 ppm (65 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

1. To evaluate time weighted average concentrations, a sample size of 15 liters is recommended. Sample at a rate of 0.2 liters per minute or less.
2. To evaluate ceiling concentrations, a sample volume of 15 liters is recommended. Sample for 15 minutes at a rate of 1.0 liters per minute.
3. To evaluate peak concentrations, a sample size of 5 liters is recommended. Sample for 5 minutes at a rate of 1.0 liter per minute.

Sampling Procedure :

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.
3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Data Sheet #S314.01

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S315

Substance:

Silica, crystalline

Standard:

<u>Form</u>	<u>8-hour Time-weighted Average</u>
Quartz (respirable)	$\frac{10 \text{ mg/cu m}}{\% \text{ SiO}_2 + 2}$
Quartz (total)	$\frac{30 \text{ mg/cu m}}{\% \text{ SiO}_2 + 2}$
Tridymite and cristobalite	Use 1/2 the value calculated for quartz

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a silver membrane filter to trap the crystalline silica present. The samples are analyzed by X-ray diffraction to quantitatively determine the polymorphs of crystalline silica (quartz, tridymite, cristobalite).

In order to determine the polymorphs of silica in the respirable dust, a bulk respirable air sample is collected. Some of the bulk air sample is scraped from the filter, weighed and analyzed for crystalline silica to determine % SiO₂. The method has been validated by using a Granite dust sample known to contain 29.35% SiO₂ as quartz. These validation studies were conducted over the concentration range of 0.17-0.85 mg/cu m for a 200-liter sample at an atmospheric temperature and pressure which varied within the range of 24-28°C and 760-764 mm of Hg.

Sampling Equipment (for personal sampling):

Pump. A calibrated personal sampler pump whose flow rate can be determined to an accuracy of $\pm 5\%$ at 1.7 liters per minute. The pump must have a pulsation dampener and be part of unit certified under 30 CFR 74. Pumps of certified units have NIOSH and MESA approval labels. The pumps must be calibrated with a representative sampling train in line.

Filter. A 25-mm, 1.2 micrometer pore size silver membrane filter.

Filter Holder. A two-piece 25-mm filter holder. The filter holder has a support screen and gasket.

Cyclone: A 10-mm nylon cyclone.

Sample Size (for personal sampling):

A sample size of at least 200 liters is recommended. At least 0.1 milligrams of silica must be collected. However, no more than 2 milligrams of total material should be collected on the silver membrane filter. Sample at a rate of 1.7 liters per minute.

Sampling Procedure (for personal sampling):

1. Assemble the filter and two-piece filter cassette and tighten firmly to insure that the gasket seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded.
2. Remove the cassette's plugs and attach the outlet of the cyclone to the inlet of the cassette. The cyclone's body, the cyclone's vortex finder and the filter cassette must remain aligned and firmly in contact. The outlet of the filter holder is connected to the pump by a short piece of flexible tubing.
3. Air being sampled should only be passed through the cyclone before entering the filter cassette. The cyclone acts as a particle size separator and will allow only the respirable particles to pass through and collect on the filter.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.7 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit twelve filters from the same lot as that used for sampling and which are subjected to exactly the same handling as for the samples except that no air is drawn through these filters. Label these as blanks or clean filters. These clean filters are necessary for proper sample analysis.

Bulk Sample:

Two bulk samples must be collected--a "rafter or settled dust" bulk sample and a respirable bulk air sample.

1. To collect the "rafter or settled dust" bulk sample, fill a 20-ml glass vial with dust found on rafters or any other place within the premises being sampled.
2. To collect the respirable bulk air samples the following items are needed: a vacuum pump with a capacity of 75 liters per minute at 15 inches of Hg vacuum; a 75 liter per minute critical flow orifice; a 47-mm diameter Teflon filter with a pore size of 1.0 micrometer; a 47-mm diameter filter holder; a 1-inch diameter HASL cyclone (Bendix No. 240 cyclone or equivalent); and 1/2-inch diameter vacuum tubing. The critical flow orifice must have been calibrated with a representative sampling train in line.
3. Select a sampling site that is representative of the workers' environment.
4. After assembling filter and filter holder, connect the inlet of the filter holder to the cyclone's outlet with a short piece of tubing. The critical flow orifice is inserted in the vacuum tubing between the pump and the filter.
5. Turn the pump on and sample at a rate of 75 liters per minute. At least 2 milligrams of respirable dust must be collected. Consequently, the filter must be overloaded and sampling is not terminated when a prefilter cake is formed. Therefore, a sampling time of at least 6 hours is recommended.

Special Considerations :

1. Report the presence and identities of other suspected air contaminants. In particular, minerals such as potash, zircon, sillimanite, graphite, iron carbide, iron, mica (biotite, muscovite) and feldspar (microcline, plagioclase) interfere with the major peak for quartz. Consequently a secondary peak is used with a decrease in precision and accuracy.
2. The 10-mm cyclone interior must be inspected before use. The cyclones must be cleaned before use to prevent reentrainment of collected dust. If the interior of the cyclone is visibly scored, the cyclone should be discarded since its size-selective characteristics may be changed.
3. The efficiency of cyclone preselectors is affected by pulsating air flow. Therefore, critical flow orifices must be used to collect the bulk respirable air sample. Personal sampler pumps certified under 30 CFR 74 are the only suitable pumps for personal sampling

Shipping Instructions :

Ship all samples in containers designed to prevent damage in transit.

Reference :

Crystalline Silica, NIOSH Method S315

Sampling Data Sheet # S317

Substance:

Chromic Acid and Chromates

Standard:

Ceiling: 0.1 mg/cu m (as CrO_3)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a 5-micron polyvinyl chloride filter to trap chromic acid particulates. The analyte is extracted from the filter with 0.25 M sulfuric acid, coupled with diphenyl-carbazide, and analyzed by spectrophotometric determination of the colored solution at 540 nm. The method has been validated over the range of 0.052-0.204 mg/cu m for a 15-minute sample at 22°C and 761 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$, at 1.5 liter per minute; a 37-mm two or three piece cassette filter holder held together by tape or shrinkable band; and a 37-mm/5.0-micrometer polyvinyl chloride filter supported by a cellulose backup pad.

Sample Size:

A 15-minute sample at a flow of 1.5 liter per minute is recommended.

Sampling Procedure:

1. Assemble the filter and filter cassette. Close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

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4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct the problem, terminate the sampling.
5. The polyvinyl chloride filter should be removed from the cassette filter holder and cellulose backup pad and placed in a clean screw cap bottle within one hour of sampling. Care must be taken to handle the filter only with clean tweezers.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for the sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Consideration:

When interfering hexavalent chromium containing compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The screw cap bottles in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Chromic Acid and Chromates, NIOSH Method No. S317.

Sampling Data Sheet # S318

Substance:

Xylene (Xylol)

Standard:

8-hour time-weighted average: 100 ppm (435 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a charcoal tube to trap the xylene vapors present. The analyte is desorbed from the charcoal tube with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 218-870 mg/cu m for a 12-liter sample at 24°C and 761 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range of 0.05 to 0.20 liter per minute, plus charcoal tube (7 cm long by 4-mm I.D.) containing two sections of 20/40 mesh activated coconut charcoal separated by a 2-mm portion of urethane foam. The adsorbing section contains 100 mg of charcoal, and the backup section contains 50 mg.

Sample Size:

A sample size of 12 liters is recommended. Sample at a flow rate of 0.2 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening at least one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a backup and should be positioned nearer the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of xylene.

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3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples submit one tube from the same lot of tubes which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Xylene, NIOSH Method No. S318.

Sampling Data Sheet # S323

Substance:

Chromium, Soluble Chromic and Chromous Salts as Cr

Standard:

8-hour time-weighted average: 0.5 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the soluble chromic and chromous salts present. The filter is digested with nitric acid to destroy the filters and any other organic material. The analyte is then solubilized in nitric acid solution and aspirated into an atomic absorption spectrophotometer for determination of concentration. The method has been validated over the range of 0.282-0.947 mg/cu m using a 90-liter sample at 22°C and 759 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ at approximately 1.5 liters per minute; a 37-mm three piece cassette filter holder and a 37-mm/0.8-micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 90 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Chromium, Soluble Chromic and Chromous Salts as Cr, NIOSH Method No. S323.

December 19, 1975

Substance:

Methyl Chloroform

Standard:

8-hour time-weighted average: 350 ppm (1900 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 6 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

February 5, 1976

Substance:

Methylene Chloride

Standard:

Ceiling: 1000 ppm (3475 mg/cu m)

Peak: 2000 ppm (6950 mg/cu m); maximum duration - 5 minutes in any 2 hours

8-hour time-weighted average: 500 ppm (1740 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm$ 5% at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

1. To evaluate time weighted average concentrations, a sample size of 2 liters is recommended. Sample at a rate of 0.2 liters per minute or less.
2. To evaluate ceiling concentrations, a sample volume of 1 liter is recommended. Sample for 15 minutes at a rate of 0.067 liters per minute.
3. To evaluate peak concentrations, a sample size of 1 liter is recommended. Sample for 5 minutes at a rate of 0.2 liters per minute.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.
3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S330

Substance:

Phenol

Standard:

8-hour time-weighted average: 5 ppm (19 mg/cu m)--skin

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a midjet bubbler containing 15 ml of 0.1 N sodium hydroxide to trap phenol vapors. The resulting solution is acidified with sulfuric acid, and the sample is analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 9.46-37.8 mg/cu m for a 100-liter sample at an atmospheric temperature and pressure of 22°C and 760 mm Hg.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately (+ 5%) at 1 liter per minute, plus standard midjet bubbler containing 15 ml of the collection medium. The sampling pump is protected from splashover or solvent condensation by a 5-cm long X 6-mm I.D. glass tube loosely packed with a plug of glass wool and inserted between the exit arm of the bubbler and the pump. (Twenty milliliters of distilled or deionized water should accompany each set of bubblers for use in washing out the bubbler stem after sampling).

Sample Size:

A sample size of 100 liters, taken at a flow rate of 1 liter per minute, is recommended.

Sampling Procedure:

1. Connect the midjet bubbler (containing 15 ml of the collection medium) in series with the glass tube containing the glass wool plug, and the personal sampling pump using short pieces of flexible tubing.
2. The bubbler must be maintained in a vertical position during sampling.
3. Air being sampled should not be passed through any hose or tubing before entering the bubbler.

Data Sheet #S330

4. Set the flow rate as accurately as possible using the manufacturer's directions. Position the middle of the rotameter ball of the personal sampling pump to the 1.0 liter per minute calibration mark as accurately as possible. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation.
5. After sampling, the bubbler stems may be removed and cleaned. Tap the stems gently against the inside walls of the bubbler bottles to recover as much of the sampling solution as possible. Wash the stem with 1 ml of distilled water, adding the wash to bubbler. The bubbler should be sealed with a hard, non-reactive stopper (preferably Teflon or glass). Do not seal with rubber. The stoppers on the bubblers should be tightly sealed to prevent leakage during shipping.
6. Care should be taken to minimize spillage or loss by evaporation.
7. A "blank" bubbler should be handled in the same manner as the bubblers containing samples (fill, seal, and transport) except that no air is sampled through this bubbler.

Special Consideration:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Whenever possible, hand delivery of the samples is recommended. Otherwise, special bubbler shipping cases designed by NIOSH should be used to ship the samples. Never transport, mail, or ship the bulk sample in the same container as the sample or blank bubbler.

Reference:

Phenol, NIOSH Method No. S330.

February 5, 1976

Substance:

Tetrachloroethylene (Perchloroethylene)

Standard:

Ceiling: 200 ppm (1375 mg/cu m)

Peak: 300 ppm (2035 mg/cu m); maximum duration - 5 minutes in any 3 hours

8-hour time-weighted average: 100 ppm (680 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

1. To evaluate time weighted average concentrations, a sample size of 10 liters is recommended. Sample at a rate of 0.2 liters per minute or less.
2. To evaluate ceiling concentrations, a sample volume of 3 liters is recommended. Sample for 15 minutes at a rate of 0.2 liters per minute.
3. To evaluate peak concentrations, a sample size of 1 liter is recommended. Sample for 5 minutes at a rate of 0.2 liters per minute.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.
3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Data Sheet #S335.01

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet #S336.01 Class B

February 5, 1976

Substance:

Trichloroethylene

Standard:

Ceiling: 200 ppm (1075 mg/cu m)

Peak: 300 ppm (1610 mg/cu m); maximum duration - 5 minutes in any 2 hours

8-hour time-weighted average: 100 ppm (535 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

1. To evaluate time weighted average concentrations, a sample size of 10 liters is recommended. Sample at a rate of 0.2 liters per minute or less.
2. To evaluate ceiling concentrations, a sample volume of 3 liters is recommended. Sample for 15 minutes at a rate of 0.2 liters per minute.
3. To evaluate peak concentrations, a sample size of 1 liter is recommended. Sample for 5 minutes at a rate of 0.2 liters per minute.

Sampling Procedure :

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.
3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations :

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Data Sheet #S336.01

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S339

Substance:

Beryllium and Beryllium Compounds (as Be)

Standard:

Ceiling: 5 $\mu\text{g}/\text{cu m}$

Peak: 25 $\mu\text{g}/\text{cu m}$

8-hour time-weighted average: 2 $\mu\text{g}/\text{cu m}$

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the beryllium (including beryllium compounds) present. The filter is digested with nitric, sulfuric, and perchloric acids to destroy the filters and any organic material. The analyte is then solubilized in a hydrochloric acid solution, and pipetted into a graphite furnace of an atomic absorption spectrophotometer for determination of concentration. The method has been validated over the range of 2.68-11.84 $\mu\text{g}/\text{cu m}$ using a 40-liter sample at 23.5°C and 749 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three piece cassette filter holder and a 37-mm diameter/0.45 micrometer pore size mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

To determine if the concentration of interest exceeds the ceiling OSHA standard, a sample size of 45 liters is recommended. Sample for 30 minutes at a flow rate of 1.5 liters per minute.

To determine if the concentration of interest exceeds the T.W.A. OSHA standard, a sample size of 90 liters is recommended. Sample at a flow rate of 1.5 liters per minute for one hour.

Sampling Procedure :

1. Assemble the filter and three piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the

cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.

2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. Cassettes containing collected samples should be firmly sealed with the plugs in both the inlets and outlets.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Beryllium and Beryllium Compounds (as Be), NIOSH Method No. S339.

Sampling Data Sheet # S341

Substance:

Lead and Inorganic Lead Compounds

Standard:

8-hour time-weighted average: 0.2 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the lead (including lead compounds) present. The filter is digested with nitric acid to remove the organic matrix, then solubilized in a nitric acid solution, and aspirated into an atomic absorption spectrophotometer for determination of concentration. The method has been validated over the range of 0.128-0.399 mg/cu m using a 180-liter sample at 22°C and 761 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ at approximately 1.5 liters per minute; a 37-mm three piece cassette filter holder and a 37-mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 180 liters is recommended at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

Data Sheet #S341

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

Where interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Lead and Inorganic Lead Compounds, NIOSH Method No. S341.

Substance:

Toluene

Standard:

Ceiling - 300 ppm
Peak - 500 ppm
8-hr. T.W.A. - 200 ppm

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a charcoal tube to trap the toluene vapors present. The analyte is desorbed from the charcoal tube with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 145.5-582 ppm for a 2-liter sample at 22°C and 766 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range of 0.05-0.2 liter per minute, plus charcoal tube containing two sections of 20/40 mesh activated charcoal separated by a 2-mm portion of urethane foam. The charcoal tube is 7 cm long with a 4-mm I.D. The front section of the tube contains 100 mg of charcoal and the backup section contains 50 mg.

Sample Size:

At the ceiling concentration, a sample size of 2 liters is recommended. Sample for 10 minutes at a flow rate of 0.20 liter per minute.

At the 8-hour time weighted average concentration, a sample size of 12 liters is recommended. Sample at a flow rate of 0.20 liter per minute.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening at least one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a back-up and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of toluene.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.

Data Sheet #S343

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples submit one tube from the same lot of tubes which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Toluene, NIOSH Method No. S343.

Sampling Data Sheet # S349

Substance:

Boron Oxide

Standard:

8-hour time-weighted average: 15 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a tared polyvinyl chloride membrane filter to trap the particulate boron oxide present. The analyte is analyzed gravimetrically after drying the sample-containing filters over a desiccant to constant weight. The basic gravimetric method has been validated over the range of 7.8-27.7 mg/cu m at an atmospheric temperature and pressure range of 18-25°C and 749-761 mm Hg, using carbon black as representative particulate compound and collecting a 100-liter sample.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three-piece cassette filter holder sealed together and secured by tape or shrinkable band; and a 37-mm, 2.0 micrometer pore size polyvinyl chloride membrane filter (PVC) supported by a stainless steel screen.

Sample Size:

A sample size of 60 liters is recommended. Sample at a flow rate of 1.0 liter per minute for 60 minutes. This sample volume and sampling flow rate is recommended to prevent collection of more than 2 mg of particulate on the filter.

Sampling Procedure:

1. Assemble the tared, dried filter, stainless steel screen and three-piece filter cassette and close firmly to insure that the inner sides of the holder seal the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the

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elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.0 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and the sampling should be terminated at any evidence of a problem.

5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one tared and dried filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample. Since the method is purely gravimetric, any other particulate present in the air sampled will be a positive interference.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Boron Oxide, NIOSH Method No. S349.

December 19, 1975

Substance:

Chloroform

Standard:

Ceiling: 50 ppm (240 mg/cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 15 liters. Sample at a rate of 1.0 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S352

Substance:

Chromium, Metal and Insoluble Compounds

Standard:

8-hour time-weighted average: 1 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose ester membrane filter to trap the chromium metal and insoluble chromium compounds present. The filter and sample are digested with hydrochloric and nitric acids to solubilize the sample and destroy the filters and any organic material. The analyte is then dissolved in a nitric acid solution, and aspirated into an atomic absorption spectrophotometer for determination of concentration. The method has been validated over the range of 0.493-1.830 mg/cu m using a 90-liter sample at 26°C and 761 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of + 5% at 1.5 liters per minute; a 37-mm three piece cassette filter holder and a 37-mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 90 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

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4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. After termination of sample collection, the cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Chromium, Metal and Insoluble Compounds, NIOSH Method No. S352.

Sampling Data Sheet # S357

Substance:

Dichloroethyl Ether

Standard:

15 ppm (90 mg/cu m) - Ceiling

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a charcoal tube to trap the dichloroethyl ether vapors present. The analyte is desorbed from the charcoal tube with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 45-180 mg/cu m for a 15-liter sample at 24°C and 762 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, at 1.0 liter per minute, plus a charcoal tube (7 cm long by 4-mm I.D.) containing two sections of 20/40 mesh activated coconut charcoal separated by a 2-mm portion of urethane foam. The adsorbing section contains 100 mg of charcoal, and the backup section contains 50 mg.

Sample Size:

A sample size of 15 liters is recommended. Sample at a flow rate of 1 liter per minute for 15 minutes.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening at least one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a back-up and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of dichloroethyl ether.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.

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4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball to the 1.0-liter per minute calibration mark as accurately as possible.
5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples submit one tube from the same lot of tubes which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Dichloroethyl Ether, NIOSH Method No. S357.

Sampling Data Sheet # S358

Substance:

Diisobutyl Ketone

Standard:

8-hour time-weighted average: 50 ppm (290 mg/cu m) - skin

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a charcoal tube to trap the diisobutyl ketone vapors present. The analyte is desorbed from the charcoal tube with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 145.5-582 mg/cu m for a 12-liter sample at 23°C and 762 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range of 0.05 to 0.20 liter per minute, plus charcoal tube (7 cm long by 4-mm I.D.) containing two sections of 20/40 mesh activated charcoal separated by a 2-mm portion of urethane foam. The front section of the charcoal tube contains 100 mg of charcoal, and the backup section contains 50 mg.

Sample Size:

A sample size of 12 liters is recommended. Sample at a flow of 0.2 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening at least one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a back-up and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of diisobutyl ketone.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.
5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples submit one tube from the same lot of tubes which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Diisobutyl Ketone, NIOSH Method No. S358

Sampling Data Sheet # S360

Substance:

Dioxane

Standard:

8-hour time-weighted average: 100 ppm (360 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a charcoal tube to trap the dioxane vapors present. The analyte is desorbed from the charcoal with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 155 - 651 mg/cu m for a 10 liter sample at 21.5°C and 754 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, +5%, over the range 0.05 to 0.2 liters per minute, plus charcoal tube containing two sections of 20/40 mesh activated charcoal separated by a 2-mm portion of urethane foam.

Sample Size:

A sample size of 10 liters is recommended. Sample at a flow rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a back-up and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.

5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport), except for the taking of an air sample. This tube should be labeled as a blank.

Special Consideration:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method placed a heavy load on the sampling pump. Therefore, no more than ten charcoal tube samples should be taken without fully recharging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Dioxane, NIOSH Method No.S360

Sampling Data Sheet # S367

Substance:

Isophorone

Standard:

8-hour time-weighted average: 25 ppm (140 mg/cu m)

Reference: 29 CFR 1910.93

Method:

A known volume of air is drawn through a charcoal tube (charcoal Lot 104, supplied by SKC, Inc. or equivalent) to trap the isophorone vapors present. The analyte is desorbed from the charcoal tube with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 67.5-283 mg/cu m for a 12-liter sample at 23°C and 764 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range of 0.05-0.20 liter per minute, plus charcoal tube containing two sections of 20/40 mesh activated petroleum-based charcoal separated by a 2-mm portion of urethane foam. The charcoal tube is 7 cm long with a 4-mm I.D. The front section of the charcoal tube contains 100 mg of charcoal and the backup section contains 50 mg.

Sample Size:

A sample size of 12 liters is recommended. Sample at a flow of 0.20 liter per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening at least one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a back-up and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of isophorone.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the

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approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.

5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. With each batch of ten samples, submit one tube from the same lot of tubes which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations :

1. When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than eight hours of sampling should be done without fully recharging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Isophorone, NIOSH Method No. S367

Sampling Data Sheet # S368

Substance :

Isopropyl Ether

Standard:

8-hour time-weighted average: 500 ppm (2100 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a charcoal tube to trap the isopropyl ether vapors present. The analyte is desorbed from the activated coconut charcoal with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 992-4260 mg/cu m for a 3-liter sample at 29°C and 764 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A personal sampling pump calibrated with a representative charcoal tube in the line and whose flow can be determined accurately $\pm 5\%$ over the range 0.05 to 0.2 liter per minute, plus charcoal tube containing two sections of 20/40 mesh activated coconut charcoal with the 100-mg front and 50-mg backup sections separated by a 2-mm portion of urethane foam.

Sample Size:

A sample size of 3 liters is recommended. Sample at a flow rate of 0.05 liter per minute.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a backup and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere

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sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.

5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube for every 10 samples submitted should be handled in the same manner as the sample tubes (break, seal, and transport), except for the taking of an air sample. This tube should be labeled as a blank.

Special Considerations:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than 8 hours of sampling should be done without fully recharging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Isopropyl Ether, NIOSH Method No. S368

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Sampling Data Sheet # S369

Substance:

Magnesium Oxide Fume

Standard:

8-hour time-weighted average: 15 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the magnesium oxide present. The filter is digested with nitric acid to destroy the filter and any other organic material. The analyte is then solubilized in nitric acid and aspirated into an atomic absorption spectrophotometer for determination of concentration. The method has been validated over the range of 7.48-28.6 mg/cu m using a 150-liter sample at 23°C and 764 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ at approximately 1.5 liters per minute; a 37-mm three piece cassette filter holder and a 37-mm/0.8-micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 150 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.

3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5-liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. After termination of sample collection, the cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of ten samples, submit one filter from the same lot of filters which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

Special Considerations:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Magnesium Oxide Fume, NIOSH Method No. S369.

Sampling Data Sheet # S370

Substance:

Malathion

Standard:

8-hour time-weighted average: 15 mg/cu m - skin

Analytical Method:

A known volume of air is drawn through a glass fiber filter to trap malathion. Malathion is extracted from the filter with iso-octane, and the sample is separated and analyzed using a gas chromatograph with a flame photometric detector. The method has been validated over the range of 7.96-35.2 mg/cu m for a 106-liter sample at 20°C and 760 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

Sampling equipment includes a calibrated personal sampling pump whose flow can be determined accurately (+5%) at 1.0 liter per minute, a 37-mm two-piece cassette filter holder held together by tape or shrinkable band, and a 37-mm diameter glass fiber filter. The filter must be free of organic binders. The filter holder should be made of polystyrene. Do not use filter holders made of Tenite.

Sample Size:

A sample size of 120 liters is recommended. Sample at a flow rate of 1.0 liter per minute.

Sampling Procedure:

1. Assemble the filter and two-piece filter cassette and close firmly. Examine the holder for a good filter seal. The filter is supported by a stainless steel support screen. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or a shrinkable band.
2. Remove the cassette plugs and attach the cassette to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Also report the type of sampling pump used. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and the flow rates readjusted as needed. If the flow rate cannot be adjusted to correct the problem, terminate sampling.
5. Remove the glass fiber filter from the cassette filter holder and place it in a clean scintillation vial within one hour of sampling. Care must be taken to handle the filter with clean tweezers.
6. Pipet 15 ml of iso-octane into the screw cap bottle, and screw the cap securely. Mark the liquid level on the bottle with a china marker.
7. Record sample identity and all relevant sample data such as sample flow rate and collection time.
8. With each batch of ten samples, submit one filter from the same lot of filters used for sample collection. This filter must be subjected to exactly the same handling as the samples except that no air is drawn through it. Label this filter as a blank.

Special Consideration:

When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples:

A bulk sample of the malathion should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

The scintillation vials in which the samples are collected should be shipped in a suitable container designed to prevent damage in transit. The bottle caps should be lined with Teflon for proper seal. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Malathion, NIOSH Method No. S370.

Sampling Data Sheet # S372

Substance:

Methyl Bromide

Standard:

Ceiling: 20 ppm (80 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through two charcoal tubes connected in series to trap the methyl bromide vapors present. The analyte is desorbed from the charcoal with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 35-150 mg/cu m for an 11-liter sample at 24.2°C and 767 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range of 0.2 to 1.0 liter per minute and a charcoal sampling tube.

The sampling tube series consists of two separate large charcoal tubes. The tubes are glass tubes with both ends flame-sealed, 10-cm long with an 8-mm O.D. and a 6-mm I.D. Each tube contains the appropriate amount of 20/40 mesh activated charcoal (petroleum-based). The front tube contains 400 mg of charcoal; the backup tube 200 mg. A plug of silylated glass wool is placed at each end of the charcoal tubes. The pressure drop across the tubes must be less than one inch of mercury at a flow rate of 1 liter per minute.

This tube series can be prepared by modifying commercially available large charcoal tubes as follows. For the front tube--break off exit end of a large tube and using pointed tweezers remove glass wool plug and the backup charcoal section; push in snugly remaining plug and charcoal to minimize channeling. For the backup tube--similarly break off inlet end of a second large tube and remove retaining plug and the front charcoal section; again push together remaining plug and charcoal. The front tube is connected to the backup tube with a minimal piece of tygon or rubber tubing.

Note: This sampling tube scheme is necessary to minimize observed sample migration effects upon storage.

Sample Size:

A sample size of 11 liters is recommended. This requires a sampling period of 15 minutes at a flow of 0.75 liter per minute or sample for 11 minutes at 1 liter per minute.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken so as to provide openings approximately one-half the internal diameters of the tubes. Prepare and assemble tubes as described in sampling equipment section. Connect the front 400-mg tube to the 200-mg backup tube with a short piece of tubing.
2. The tube containing 200 mg of charcoal is used as a backup and should be positioned nearest the sampling pump. The charcoal tube series should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tubes.
4. If the low flow rate pump is used, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor. If the 1.0 liter per minute personal sampler pump is used, position the middle of the rotameter ball to the 0.75 liter per minute calibration mark as accurately as possible. Record the temperature and pressure of the atmosphere being sampled. If pressure reading is not available, record the elevation.
5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used. The two tubes must be separated and each tube recapped tightly.
6. One set of charcoal tubes (a 400-mg tube and a 200-mg backup tube) should be handled in the same manner as the sample tubes (break, seal, and transport), except for the taking of an air sample. This set of tubes should be labelled as a blank.

Special Considerations:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method places a heavy load on the sampling pump. Therefore, no more than 8 hours of sampling should be done without fully re-charging the battery.

3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of the charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Methyl Bromide, NIOSH Method No. S372

Sampling Data Sheet # S376

Substance:

Molybdenum, Insoluble Compounds

Standard:

8-hour time-weighted average: 15.0 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the molybdenum-containing aerosol present. The analyte is recovered from the filter by digestion with nitric and perchloric acid for acid soluble compounds; a modified procedure is used for base soluble compounds. Sulfuric acid is added to dissolve any precipitate formed and aluminum is added. The solutions are analyzed by atomic absorption spectrophotometry at 313.3 nm. The method has been validated over the range 6.3-30.6 mg/cu m for a 90-liter sample at 19°C and 767 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ over the range of 1.0 to 2.0 liters per minute; a 37-mm three-piece cassette filter holder held together by tape or shrinkable band; and a 37 mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 90 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with shrinkable band or tape such as vinyl electrical tape.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank. Submit one blank filter for every 10 samples.

Special Considerations:

Where other inorganic compounds or ions are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Bulk Samples:

A bulk sample of the suspected compound must be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes. This bulk sample is to be used to determine the solubility characteristics of the suspected molybdenum compound. This determination is necessary to determine the procedure which must be used to analyze the sample.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Molybdenum, Insoluble Compounds, NIOSH Method No. S376.

Sampling Data Sheet # S378

Substance:

Octane

Standard:

8-hour time-weighted average: 500 ppm (2350 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a charcoal tube to trap the octane vapors present. The analyte is desorbed from the charcoal with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 1050 - 4403 mg/cu m for a 4-liter sample at 20°C and 758 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, +5%, over the range 0.05 to 0.2 liters per minute, plus charcoal tube containing two sections of 20/40 mesh activated charcoal separated by a 2-mm portion of urethane foam.

Sample Size:

A sample size of 4 liters is recommended. Sample at a flow rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a back-up and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.

5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport), except for the taking of an air sample. This tube should be labeled as a blank.

Special Consideration:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method placed a heavy load on the sampling pump. Therefore, no more than ten charcoal tube samples should be taken without fully recharging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Octane, NIOSH Method No. S378

December 19, 1975

Substance:

Pentane

Standard:

8-hour time-weighted average: 1000 ppm (2950 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 2 liters. Sample at a rate of 0.05 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

December 19, 1975

Substance:

Petroleum Distillate (Boiling range: 120-147 C)

Standard:

8-hour time-weighted average: 500 ppm (2000 mg/ cu m)

Analytical Method:

A known volume of air is drawn through charcoal to trap the contaminant vapors present. The analyte is desorbed with carbon disulfide; the sample is separated with a gas chromatograph and analyzed with a flame ionization detector.

Sampling Equipment:

Charcoal Tube: The charcoal tube has an inside diameter of 4-mm and contains two sections of 20/40 mesh charcoal. The first section contains 100 mg of activated charcoal while the backup section contains 50 mg of activated charcoal. The two sections are separated by a spacer.

Pump: A personal sampler pump whose flow rate can be determined accurately $\pm 5\%$ at the recommended flow rate. The pump must be calibrated with a representative charcoal tube in line.

Sample Size:

The recommended sample volume is 4 liters. Sample at a rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tubes should be broken to provide a minimum opening approximately one-half the internal diameter of the tube.
2. The smaller section of the charcoal is used as a backup section and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and premature breakthrough of contaminant vapors. Normally, the tube is placed in the worker's breathing zone.

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3. Air being sampled should not pass through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled.
5. Charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport) with one exception: no air is drawn through the blank.

Special Considerations:

1. Where two or more compounds are known or are suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.
2. The high resistance of the charcoal tube places a heavy load on the pump. Therefore, sample for no more than eight hours without recharging the pump.
3. If high humidity or water mist is present, the breakthrough volume may be severely reduced. If water condenses on the charcoal, the contaminants will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all tubes used to collect a set of samples should contain charcoal from the same batch. Information on the batch number of the charcoal must be supplied.

Bulk Sample:

A bulk sample of the suspected compounds should be submitted to the laboratory in a glass container with a Teflon-lined cap. The label of the bulk sample should match the air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before shipping to minimize breakage. Never transport, mail, or ship bulk samples in the same package with solid sorbent tubes.

Sampling Data Sheet # S382

Substance:

Stoddard Solvent (Boiling range: 159-176°C)

Standard:

8-hour time-weighted average: 500 ppm (2950 mg/cu m)

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a charcoal tube to trap the Stoddard Solvent vapors present. The analyte is desorbed from the charcoal with carbon disulfide, and the sample is separated and analyzed using a gas chromatograph with a flame ionization detector. The method has been validated over the range of 1417-5940 mg/cu m for a 3-liter sample at 24°C and 749 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined accurately, $\pm 5\%$, over the range 0.05 to 0.2 liters per minute, plus charcoal tube containing two sections of 20/40 mesh activated charcoal separated by a 2-mm portion of urethane foam.

Sample Size:

A sample size of 3 liters is recommended. Sample at a flow rate of 0.2 liters per minute or less.

Sampling Procedure:

1. Immediately before sampling, the ends of the tube should be broken so as to provide an opening approximately one-half the internal diameter of the tube.
2. The smaller section of charcoal is used as a back-up and should be positioned nearest the sampling pump. The charcoal tube should be placed in a vertical position during sampling to avoid channeling and subsequent premature breakthrough of the analyte.
3. Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.
4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere sampled. If the pressure reading is not available, record the elevation. If the pump is a low flow rate pump, set the approximate flow rate and record the initial and final counter reading. The sample volume is obtained by multiplying the number of counter strokes times the cc/stroke factor.

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5. The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Masking tape is the only suitable substitute for sealing the tubes. Under no circumstances should rubber caps be used.
6. One charcoal tube should be handled in the same manner as the sample tubes (break, seal, and transport), except for the taking of an air sample. This tube should be labeled as a blank.

Special Consideration:

1. Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities should be transmitted with the sample.
2. Due to the high resistance of the charcoal tube, this sampling method placed a heavy load on the sampling pump. Therefore, no more than ten charcoal tube samples should be taken without fully recharging the battery.
3. If high humidity or water mist is present, breakthrough volume can be severely reduced. If condensation of water occurs in the tube, the substance will not be trapped quantitatively.
4. The desorption efficiency of charcoal varies from batch to batch. Therefore, all the tubes used to collect a set of samples should contain charcoal from the same batch. Several unused charcoal tubes should accompany the samples. Information on the batch number of the charcoal must be supplied.

Bulk Samples:

A bulk sample of the suspected compound should be submitted to the laboratory in a glass container with a Teflon-lined cap. Label of the bulk sample should match air samples for identification purposes.

Shipping Instructions:

Capped charcoal tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping. Never transport, mail, or ship the bulk sample in the same container as the sample or blank tube.

Reference:

Stoddard Solvent, NIOSH Method No. S382

Sampling Data Sheet # S385

Substance:

Titanium Dioxide Dust

Standard:

8-hour time-weighted average: 15 mg/cu m

Reference: 29 CFR 1910.93

Analytical Method:

A known volume of air is drawn through a cellulose membrane filter to trap the titanium dioxide dust present. The sample filters are digested in concentrated nitric acid and the titanium dioxide is solubilized by heating with a mixture of sulfuric acid and ammonium sulfate. The quantity of analyte present is determined by atomic absorption spectrophotometry at 364.3 nm, using a nitrous oxide-acetylene flame. The method has been validated over the range of 8.1-29.5 mg/cu m for a 100-liter sample at 23°C and 767 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

A calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$, over the range of 1.0 to 2.0 liters per minute; a 37-mm three-piece cassette filter holder held together by tape or shrinkable band; and a 37 mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose backup pad.

Sample Size:

A sample size of 100 liters is recommended. Sample at a flow rate of 1.5 liters per minute.

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Position the middle of the rotameter ball of the personal sampling pump to the 1.5 liter per minute calibration mark as accurately as possible. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the rotameter cannot be adjusted to correct a problem, terminate the sampling.
5. Collected sample cassettes should be firmly sealed with the plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank. Submit one blank filter for every ten samples.

Special Considerations:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Titanium Dioxide Dust, NIOSH Method No. S385.

Sampling Data Sheet # S391

Substance:

Vanadium, V_2O_5 Dust

Standard:

Ceiling Value: 0.5 mg/cu m

Analytical Method:

A known volume of air is drawn through a mixed cellulose ester membrane filter to trap the V_2O_5 dust present. The sample filters are placed in 0.1 N NaOH and the V_2O_5 is solubilized by heating at 50°C for 15 minutes. The quantity of analyte present is determined by flameless atomic absorption spectrophotometry at 318.4 nm, using a high temperature graphite atomizer. The method has been validated over the concentration range of 0.24 - 0.90 mg/cu m for a 25-liter sample at 23°C and 765 mm Hg atmospheric temperature and pressure.

Sampling Equipment:

The following items are needed: a calibrated personal sampling pump whose flow can be determined to an accuracy of $\pm 5\%$ at a flow rate of approximately 1.7 liters per minute, a 37-mm three piece cassette filter holder held together by tape or shrinkable band, and a 37-mm/0.8 micrometer mixed cellulose ester membrane filter (MCEF) supported by a cellulose back-up pad.

Sample Size:

V_2O_5 dust has a ceiling value and a maximum sampling period of 15 minutes is recommended. Sample at a flow rate of about 1.7 liters per minute for 15 minutes (25 liters).

Sampling Procedure:

1. Assemble the filter and three-piece filter cassette and close firmly to insure that the center ring seals the edge of the filter. Examine the holder for a good filter seal. If the cassette will not seal tightly, it should be discarded. Secure the cassette holder together with tape or shrinkable band.
2. Remove the cassette plugs and attach to the personal sampling pump tubing. Clip the cassette to the worker's lapel.
3. Air being sampled should not be passed through any hose or tubing before entering the filter cassette.

4. Set the flow rate as accurately as possible using the manufacturer's directions. Record all the necessary information to determine flow rate or volume and record also the initial and final sampling time. Record the temperature and pressure of the atmosphere being sampled. If the pressure reading is not available, record the elevation. Since it is possible for the filter to become plugged by heavy particulate loading or by the presence of oil mists or other liquids in the air, the pump rotameter should be observed frequently, and readjusted as needed. If the flow rate cannot be adjusted to correct a problem, terminate the sampling.
5. Collected sample cassettes should be firmly sealed with plugs in both the inlet and outlet.
6. Carefully record sample identity and all relevant sample data.
7. Blank. With each batch of samples, submit one filter which is subjected to exactly the same handling as for the samples except that no air is drawn through it. Label this as a blank. Submit one blank for every ten samples.

Special Considerations:

Where two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

Shipping Instructions:

The cassettes in which the samples are collected should be shipped in a suitable container, designed to prevent damage in transit.

Reference:

Vanadium, V_2O_5 Dust, NIOSH Method No. S391

