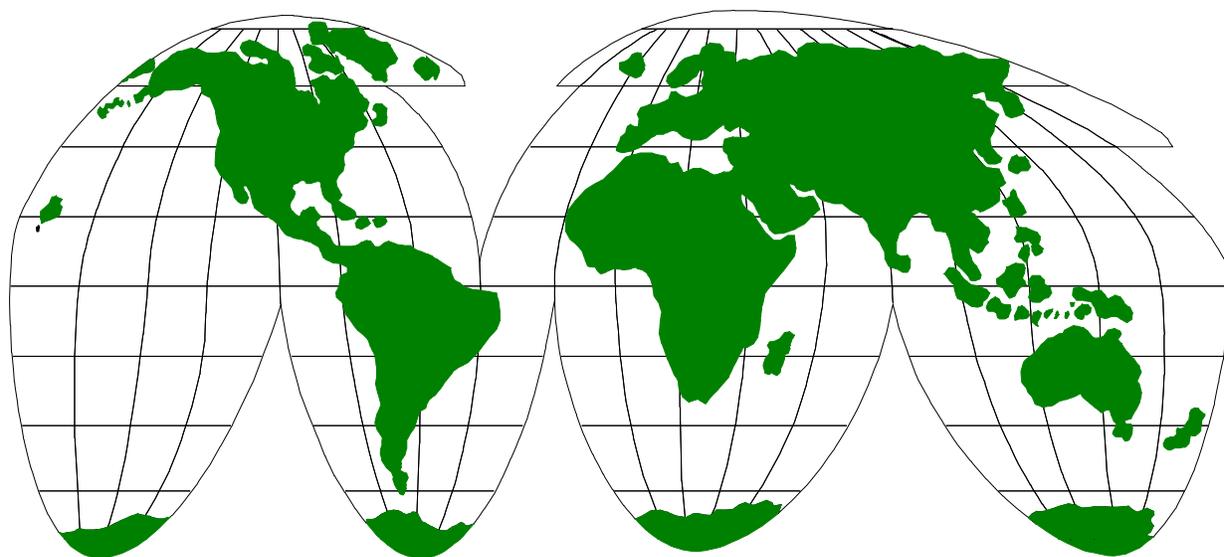


U.S. ARMY PUBLIC HEALTH COMMAND

INDUSTRIAL HYGIENE SAMPLING GUIDE

Serving Our Customers Worldwide

TECHNICAL GUIDE 141



May 2012

WAYS TO COMMUNICATE WITH AIPH LS

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CHAPTER 1 INTRODUCTION

1-1. PURPOSE

This technical guide (TG) provides information and guidance to industrial hygiene (IH) customers in using the services of the U.S. Army Public Health Command (USAPHC) laboratories. The information provided describes—

- The IH Air and Bulk Material Sample Collection.
- Factors to Consider Before Collecting Samples.
- Required USAPHC Army Institute of Public Health-Laboratory Sciences Shipping Documents: AIPH-LS Laboratory Information Documentation System (LIDS) 9, *Industrial Hygiene Sample Submission Form*.
- Submission of IH Samples to USAPHC laboratories, LIDS 330, *Request for Laboratory Services*.
- How to use LIDS 235, *Chain-of-Custody (COC) Record*.

1-2. SUGGESTED REFERENCES

Appendix A contains a list of references which provide information about regulatory requirements, reference methods, and sample collection techniques. The references listed include, but are not limited to, pertinent regulatory and Army documents, other USAPHC TGs, and selected scientific publications.

1-3. THE USAPHC CONTINENTAL U.S. CUSTOMER SUPPORT SERVICES AND INDUSTRIAL HYGIENE PROCEDURE LIST

Appendix B contains three sections—

Section B-1: Provides information about the Customer Support Services available at the USAPHC Continental U.S. (CONUS) laboratory.

Section B-2: Explains terms used in the listing of USAPHC CONUS laboratory sciences IH procedures.

Section B-3: Lists the USAPHC CONUS Laboratory Sciences IH test procedures and gives specific information about the sampling, collection, and special handling requirements for each analyte.

1-4. THE USAPHC OUTSIDE OF THE CONTINENTAL UNITED STATES CUSTOMER SUPPORT SERVICES

Appendix C provides information for outside the continental United States (OCONUS) customer support services.

1-5. INFORMATION ABOUT INDUSTRIAL HYGIENE MONITORING SUPPLIES

Appendix D contains two sections—

Section 1: Provides suggested sources for IH monitoring supplies.

Section 2: Offers examples of acceptable IH monitoring supplies.

1-6. AIRBORNE PARTICULATE SAMPLING

Appendix E provides information and examples dealing with particle size-selective particulate mass sampling.

1-7. AIPH-LS LIDS DOCUMENTS

Appendix G provides examples of AIPH-LS LIDS documents referenced in Section 1-1 and throughout this document. Reproducing these documents is permitted and encouraged.

1-8. ABBREVIATIONS AND TERMS

The Glossary explains the abbreviations and terms used in this document.

1-9. QUALITY ASSURANCE**A. The USAPHC QUALITY SYSTEMS**

All USAPHC laboratories maintain quality systems that meet the requirements of national and international laboratory accrediting bodies such as the American Industrial Hygiene Association (AIHA[®]), the American Association for Laboratory Accreditation (A2LA), and the International Organization for Standardization (ISO[®]). Check with the USAPHC laboratory you plan to use about their current accreditation status. All USAPHC laboratories are responsible for ensuring the quality of the work they perform. (AIHA is a registered trademark of the American Industrial Hygiene Association. ISO is a registered trademark of the International Organization for Standardization.)

B. CONTRACTED LABORATORY ANALYSES

- (1) When any customer decides to send samples to a commercial contract laboratory instead of a USAPHC laboratory, they must accept responsibility for ensuring the quality of the laboratory work in the same way they would other contracted work. The customer must specify the quality requirements for the deliverables to be completed for the project to maximize the laboratory's ability to perform quality work in addition to price and turnaround time.
- (2) The suggested practices that are the most effective means of ensuring the quality of laboratory work are—
 - (a) *Perform a laboratory audit.* This audit should be an onsite inspection of the facility, which includes a review of the entire laboratory quality system. Procedures, equipment, records, performance on evaluation samples, and the qualifications of staff members should all be carefully reviewed. This inspection is necessary to verify the ability of the laboratory to perform quality work. The audit must be done by a qualified and knowledgeable assessor.
 - (b) *Validate data.* Laboratory data should be reviewed thoroughly before use to ensure there are no gross errors in values or units.
 - (c) *Submit single- or double-blind performance evaluation (PE) samples.* The PE samples are quality assurance (QA) samples that look like routine samples but are samples spiked with a known concentration of a target contaminant. Results of the PE samples should be compared to the known spiked value to determine acceptability of other data reported by the laboratory. The results of the PE samples are an indication of the ability of the laboratory to produce accurate results.

1–10. COMMUNICATIONS WITH THE LABORATORY

Good communication is the key to customer satisfaction. It is critical for the success of a project for customers and laboratory staff members to work together from the earliest planning stages of a project until after the final reports have been issued. Means of communications with USAPHC laboratories are given in the following places within this guide:

- The inside front cover.
- Chapter 5, Table 5–1.
- Appendix B, Section B–1.
- Appendix C, Section C–2.

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CHAPTER 2
INDUSTRIAL HYGIENE AIR, WIPE, AND BULK MATERIAL SAMPLE COLLECTION

2-1. GENERAL INFORMATION**A. IH PROCEDURE LISTS**

The IH Procedure List for the USAPHC laboratory (AIPH-LS) is in Appendix B, Section B-3 of this guide. Appendix B provides guidelines for IH sample collection and shipment, summarizes recommended parameters for sampling, and indicates any special instructions or requirements for each analyte. Also, see Chapter 3 for detailed information to consider before collecting samples.

B. REFERENCE METHODS

The reference methods listed and the information and guidelines given in the AIPH-LS IH Procedure List are from documented procedures published by—

- The National Institute for Occupational Safety and Health (NIOSH).
- The Occupational Safety and Health Administration (OSHA).
- The U.S. Environmental Protection Agency (USEPA).
- The ASTM International.
- Manufacturers of sampling media.
- Professional scientific publications.

2-2. PURPOSE OF SAMPLING

Sampling is conducted to quantify occupational exposures to workplace stressors. In most cases, when a qualitative positive determination is made, sampling is necessary to determine the extent of the exposure, adequacy of the control measures in use, or additional controls required to eliminate or minimize the hazard. The exposure monitoring plan should be developed and implemented for those operations/processes needing further evaluation and those stressors for which periodic sampling is required by regulation or directive.

2-3. TYPES OF AIR SAMPLES

The following are two major types of air samples used to determine the airborne concentration of contaminants:

- A. Personal Samples. For stressors having Occupational Exposure Limits (OELs), for which

a decision to sample has been made, personal exposure is determined by collecting breathing zone (BZ) samples. To obtain the sample, air is collected from within the breathing zone of the employee, a hemisphere forward of the shoulders and centered at the nose, with a radius of about 6 to 9 inches. Breathing zone samples may be collected in the following two ways:

- (1) The sampling device is attached to the employee and worn continuously during the work shift or operation. This is the preferred method.
 - (2) The sampling device is held by a second individual within the breathing zone of the employee. For example, the IH may use a detector tube hand pump to collect one or a series of grab samples from within the breathing zone of the employee.
- B. General Area (GA) Samples.** The sampling equipment is placed in a fixed location in the work area. General area samples are not used to evaluate employee exposure. They may be used to determine whether reentry is warranted into a contaminated area, if there is potential contamination of adjacent work areas, or to verify the integrity of a negative pressure enclosure during asbestos rip out operations. They may not be used for OEL compliance determinations except in the rare instances where no feasible personal sampling method exists.

2-4. RECOMMENDED SAMPLE FLOW RATES AND AIR COLLECTION VOLUMES

- A.** The sampling parameters recommended in this technical guide IH Procedure List should be used whenever possible. When these parameters are used under normal sampling conditions—
- (1) The test result should be accurate for the sample being collected.
 - (2) The detection limit for the analytical measurement system (the instrumentation and the method used for testing) can be met.
 - (3) The possibility of sample breakthrough is minimized.
 - (4) The final sample concentration will usually range between 0.1 of a threshold limit value (TLV[®]) parameter and two times the TLV parameter for most analytes. (TLV[®] is a registered trademark of the American Conference of Governmental Industrial Hygienists.)
- B.** The air collection volumes recommended in the Procedure List include a safety factor that will usually minimize problems with sample breakthrough. However, it is important to keep in mind that—

- (1) Factors such as high humidity or the presence of adsorbing compounds may significantly reduce this safety factor. The sampling plan should take these factors into consideration.
- (2) Higher than recommended air collection volumes should be used only when required by an approved sampling plan because of the possibility that sample breakthrough or overloading may occur.
- (3) The sampling plan should be evaluated to help ensure, whenever possible, that sample volumes based on the mass reporting limit of the method will be a sufficient volume so that the concentration reporting limit will be one-tenth of the appropriate exposure limit.

2-5. DEPARTURES FROM RECOMMENDED SAMPLING PARAMETERS

- A. Sampling situations may arise where departures from the recommended sample flow rates and air collection volumes are necessary. When such departures are required, they should be used only when based on an approved sampling plan.
- B. Departures from recommended guidelines may be necessary if—
 - (1) The concentration of the analyte in question is expected to be high. An air collection volume at or near the lower limit of the recommended range should be used in this situation.
 - (2) Filter sampling in dusty areas is required. A lower than recommended total air collection volume should be used when sampling in this environment.
 - (3) The concentration of the analyte in question is expected to be much lower than the TLV or permissible exposure limit (PEL) parameter. An air collection volume at or near the upper limit of the recommended range should be used in this situation.
 - (4) The minimum air collection volume needed to obtain an adequate concentration of the desired analytes under these conditions can be calculated using the following formula:

$$\text{Minimum Air Collection Volume (in L)} = \frac{\text{RL}}{\text{E} * \text{F}}$$

Where: RL = Analytical Reporting Limit (micrograms (µg))
 E = Exposure Limit (milligram per cubic meter (mg/m³))
 F = Estimate of the Exposure Limit in the

Sampling Environment expressed as a percent (in decimal form) of the Standard TLV or PEL parameter. For example, if it is estimated that the sampling environment is 10 percent of the TLV, “0.1” would be used. The exposure limit is converted from mg/m³ to milligram per liter (mg/L) by the conversion factor noted in the equation (1 m³ = 1000 L).

For example:	The Minimum Air Collection Volume (in L) necessary for the Sampling Environment	=	4 Liters
	When: RL	=	2 µg
	E	=	5 mg/m ³
	F	=	0.1 (decimal) (an estimate of 10%); the reporting limit is converted from µg to mg by the conversion factor noted in the equation (1000 µg equals 1 mg)
	*	=	Multiplication
	4 L	=	2 micrograms * 1 mg <u>1000 µg</u>
			<hr/>
			5 mg * 0.1 * 1 m ³
			<hr/>
			m ³ 1000 Liters

C. Specific needs or considerations to use when sampling for different types of analytes are given in later sections of this chapter.

2-6. SAMPLING PUMP FLOW RATE CALIBRATION AND REPORTING

The accuracy of a final laboratory result for an IH air sample is impacted by the accuracy of the air volume measurement used to collect the sample. Therefore, accurate calibration of the pump and the airflow through the sample collection device is an absolute necessity.

A. FLOW RATE PRE-USE-CALIBRATION ADJUSTMENTS AND POST-USE CHECKS—

- (1) The flow rate through the sample collection device must be determined for each individual sampling pump before field use (pre-calibration, same day) and after field use (post-use flow-rate check, same day).

- (2) Both pre-use and post-use flow-rate checks must be made using an unused sample device (tube or filter) from the same lot number used for the actual air samples. Only one tube needs to be checked since all tubes in a given lot number are packed to provide a uniform pressure drop at the prescribed flow rate.
- (3) Before pre-calibration adjustments, run a fully charged air sampling pump equipped with nickel-cadmium (NI-CAD) batteries for at least 10 minutes in order to achieve a normal, stable flow rate. This is necessary because fully charged NI-CAD batteries have an initial high voltage peak and the 10-minute operating time allows the battery voltage to stabilize.
- (4) After field use, determine the post-use flow rate before recharging the batteries. Record this reading.

B. FLOW RATE PRE-CALIBRATION AND POST-USE CHECK REPORTING—

- (1) If the difference between the pre-calibration flow rate and the post-use check is equal to or less than 5 percent, report the average of the pre-calibration reading and the post-use check.
- (2) If the difference between the flow rate is greater than 5 percent, use the lower flow rate (either pre-use or post-use). By using the lower flow rate, the concentration of the analyte(s) reported by the laboratory will ensure an overestimation of the airborne concentration in the sampling environment.

2-7. FIELD BLANKS

- A. Field blanks are quality control samples used in the sampling process, which are required for each set of samples and every type of IH collection media.
 - (1) Field blanks measure potential contamination from the collection media itself that can occur during shipping, handling, and storage.
 - (2) Field blanks must always be from the same lot number as the sample tubes, filters, or monitors used for sampling. If more than one lot number is used for sampling, then blanks from each lot number are required.
- B. A minimum of 1 field blank must be submitted for every 10 samples from the same sampling series, or any fraction thereof, even if there is only 1 sample in the set. All test procedures require an absolute minimum of one field blank.

***Note:** A set is one or more samples that are collected and submitted for analysis at the same time for the same contaminant(s). A sample set is also referred to as a sample batch.

- (1) Many analytes require a minimum of two or more blanks even if the number of samples in the set is less than 10.
 - (2) Always refer to the Special Instructions indicated for a specific analyte in the IH Procedure List (Appendix B) before collecting or submitting samples.
- c. Field blanks are clean sampling media taken to the sampling site that are handled in exactly the same manner as the air samples, except—
- (1) No air is drawn through them.
 - (2) They must be opened very quickly in the sampling area and then resealed immediately.

2–8. MEDIA BLANKS

- A. Media blanks are quality control samples which are simply new, unopened samplers that are sent to the laboratory with the exposed samplers. A minimum of one media blank is required in addition to field blanks.
- (1) Media blanks measure the potential contamination from the collection media itself.
 - (2) They may be needed as a reference for some analytical methods.
 - (3) They must always be from the same lot number as the sample tubes or monitors used for sampling. If more than one lot number is used for sampling, then blanks from each lot number are required.
- B. Always refer to the Special Instructions indicated for a specific analyte in the IH Procedure List (Appendix B) before collecting or submitting samples to determine if more than one media blank is required.
- C. Potential high background contamination from the collection media may require the submission of additional media blanks. This is of particular concern when lower air volumes are collected. The submission of at least three media blanks allows for the statistical analysis of the results to help determine if there is a significant difference between the blank collection media and the field samples.

- D. Media blanks are never opened by the IH or sample collector. They are opened by the laboratory performing the test procedure immediately before analysis.

2-9. FILTER SAMPLING

A. OVERVIEW

Filter sampling is used to evaluate potential airborne particulate hazards, such as dusts, fumes, mists, and aerosols. For filter sampling, a pump is used to actively pull a known volume of air through a filter appropriate for the hazard. After the particulate matter (PM) has been deposited on the filter, the concentration (mass) of the analyte of interest can be determined by analytical methods, which include microscopic counting, gravimetric analysis, atomic absorption, atomic emission, or mass spectrometric techniques.

B. DIFFERENT TYPES OF INDUSTRIAL HYGIENE FILTERS

There are several types of filters used for airborne hazard sampling. The type of filter required for a specific analyte for each test is given in the IH Procedure List in Appendix B. A list of suggested sources for collection filters can be found in Appendix D. Recent ACGIH development of particle-size selective TLVs for a wide range of contaminants has led to new sampling procedures for particulates (see Appendix E for detailed discussion).

C. METALS, PARTICULATE, AND OIL MIST SAMPLING

- (1) Use the appropriate sampling rate to meet or exceed the minimum recommended volume for reliable analysis.
- (2) Use care to prevent filter overloading when collecting air samples for metals during sanding and grinding operations because of the short-term generation of large volumes of particulate materials.

D. CONVERSION OF SAMPLE RESULTS FROM AN ELEMENT TO A COMPOUND CONTAINING THAT ELEMENT

In order to convert a sample result from an element to a compound containing that element, the following formula should be used:

$$RC = RR * \frac{MWC}{MWE}$$

Where:	RC	=	Result for Compound (mg/m ³)
	RR	=	Reported Result for Element (mg/m ³)
	MWC	=	Molecular Weight (MW) of Desired Compound
	MWE	=	Molecular Weight of Reported Element

For Example: To convert a Sodium (Na) result of 100 mg/m³ to a comparable result for Sodium Hydroxide (NaOH) in mg/m³, the calculation would be:

$$174 \text{ mg/m}^3 \text{ of NaOH} = \frac{100 \text{ mg/m}^3 \text{ Na}^+ * 40 \text{ (MW of NaOH)}}{23 \text{ (MW of Na)}}$$

Note: MW of Na⁺ is 23
MW of NaOH is Na (23) + O (16) + H (1) = 40

E. SIMULTANEOUS SAMPLING FOR MULTIPLE ANALYTES

Some air contaminants may be collected and analyzed on the same filter; however, there may be problems with interference or filter overload that may affect the analyses.

***Note:** Always contact the USAPHC IH laboratory where the samples are going to be analyzed before collecting samples for multiple analytes.

F. SINGLE ANALYTE SAMPLING

The Special Instructions in this technical guide IH Procedure List clearly indicate when single analyte filter sampling is required. Refer to the Procedure List in Appendix B for more information.

G. SPECIAL CONSIDERATIONS FOR TRACE ELEMENT ANALYSIS BY NIOSH METHOD 7300

There is a *potential* for erroneous trace element quantification when air samples are analyzed by NIOSH Method 7300 (NIOSH, 1994) using Inductively Coupled Plasma, Atomic Emission Spectroscopy (ICP-AES) as opposed to Inductively Coupled Plasma, Mass Spectrometry (ICP-MS). However, required correction factors have been greatly reduced or eliminated in recent years through instrument software improvements.

2-10. SOLID SORBENT TUBE SAMPLING**A. OVERVIEW**

Many gases and vapors are collected using solid sorbent sample tubes, which usually consist of a glass tube containing two sections of a solid adsorbent material. When air is actively pulled through the tube, airborne gases and vapors are adsorbed by the first sorbent section while the second section serves as a backup in case analyte breakthrough occurs. The first and second sections of the sorbent tube are analyzed separately in order to monitor breakthrough into the second section. Prior to laboratory analysis, the sorbent material is removed from the sampling tubes, and the analytes of interest are extracted and analyzed.

B. SAMPLING PROCEDURES

- (1) Organic vapors and gases are collected on activated charcoal, silica gel, or other adsorption tubes. Immediately before sampling, break off the ends of the adsorption tube to provide an opening approximately one-half the internal diameter of the tube. Do not use the charging inlet or the exhaust outlet of the pump to break ends off the sorbent tubes.
- (2) Position the adsorption tube with the direction of the arrow in the direction of the air flow, i.e., toward the sampling pump. To prevent injury to the worker, tubes should be placed in tube holders. (If there is no arrow on the adsorption tube, insert the tube so that the smaller of the two segments in the tube - the “backup” section - is closest to the pump).
- (3) The air to be sampled should be drawn directly into the inlet of the adsorption tube and not be passed through any hose or tubing before entering the tube. When air sampling methods require tubes in a series, as in ethylene oxide air sampling, they can be joined via the shortest practicable piece of tubing.
- (4) When sampling with tubes connected in a series, label each tube and any prefilter(s) with a single sample number.
- (5) Cap tubes with the supplied plastic caps immediately after sampling.

B. DIFFERENT TYPES OF SOLID SORBENT TUBES

There are several types of solid sorbent tubes used for IH sample collection. The specific type of tube required for each test is listed in the IH Procedure List, Appendix B. A list

of suggested sources for solid sorbent tubes can be found in Appendix D.

C. SIMULTANEOUS SAMPLING FOR MULTIPLE ANALYTES

Several air contaminants may be collected and analyzed on the solid sorbent tube; however, there may be problems with interference or sample overload that may affect the analyses.

***Note:** Always contact the IH laboratory where the samples are going to be analyzed before collecting samples for multiple analytes.

D. SINGLE ANALYTE SAMPLING

The Special Instructions in the IH Procedure List clearly indicate when single analyte sampling is required. Refer to the Procedure List in Appendix B for more information.

E. CAPACITY OF CHARCOAL TUBES AND PASSIVE MONITORS

- (1) The adsorptive capacity of charcoal tubes and passive monitors may be reduced by—
 - (a) High humidity (greater than 50 percent relative humidity) in combination with high ambient temperatures.
 - (b) Very high humidity (greater than 80 percent relative humidity) with normal ambient temperatures.
- (2) To reduce the probability of breakthrough and sample loss, do not exceed one-half of the recommended maximum sample volume under the above conditions.

2-11. IMPINGER SAMPLING

A. OVERVIEW

- (1) In this guide and in the IH Procedure List, impinger sampling generally indicates the use of midget impingers fitted with fritted bubbler nozzles. *One exception is ozone*, which requires a standard nozzle with a 1-mm internal diameter opening.
- (2) When this type of sampling is used, a known volume of air is bubbled through the impinger containing a liquid medium. The liquid chemically reacts with or physically dissolves the analyte of interest. The liquid in the impinger is then analyzed to determine airborne concentrations of the analyte of interest.

A. SAMPLING PROCEDURES

- (1) Add the specified amount of the appropriate reagent to the impinger flask either in the office or at the sampling location. If flasks containing the reagent are transported either to or from the sampling site, both the impinger stem and side arm should be sealed with caps or Parafilm[®]. (Parafilm[®] is a registered trademark of American Can Co.)
- (2) Collect impinge samples using a maximum flow rate of 1.0 L/min.
- (3) The impinger should be attached to the employee's clothing using an impinger holster. It is very important that the impinger does not tilt, causing the reagent to flow down the side arm to the hose and into the pump or to spill onto the worker's skin and clothing. Place trap in line after the impinger to protect the pump from the absorbing solution.
- (4) In some instances, it will be necessary to add reagent during the sampling period to prevent the amount of reagent from dropping below one half of the original amount. Always remove the impinger from the employee before adding reagent.
- (5) After sampling, remove the glass stopper and stem from the impinger flask.
- (6) In some instances, it will be necessary to add reagent during the sampling period to prevent the amount of reagent from dropping below one half of the original amount. Always remove the impinger from the employee before adding reagent.

B. SAMPLE TRANSFER AFTER COLLECTION

- (1) Rinse the absorbing solution adhering to the inside of the stem directly into the impinger flask with a small amount (1 or 2 mL) of the sampling reagent. Stopper the flask tightly with the plastic cap provided or pour the contents of the flask into a glass bottle.
- (2) Samples collected in glass-fritted bubblers should be transferred to clean glass-stoppered bottles with Teflon[®]-lined caps. Rinse the glass-fritted bubblers with a small amount of unused absorption solution and add the rinse to the sample. (Teflon[®] is a registered trademark of E.I. DuPont de Nemours and Co.)

***Note:** Samples collected for ozone analysis should be transferred to stoppered bottles with Teflon septum caps *without* rinsing.

C. SPECIAL PROCEDURES FOR SODIUM HYDROXIDE ABSORBENT

When sodium hydroxide is used as the absorbent, the ground-glass surfaces and fritted bubblers used for sampling should be thoroughly rinsed or purged with water after sampling. This prevents freezing or fusion of the ground glass.

D. ABSORBING SOLUTION CONSIDERATIONS

- (1) Reagent-grade chemicals and high-quality deionized or distilled water must be used in preparation of absorbing solutions.
- (2) One media blank must be submitted with each set of samples. The media blank is an aliquot, or separate portion, of the same absorbing solution that is used for the actual sampling event.

2-12. PASSIVE MONITOR SAMPLING**A. OVERVIEW**

Some gases and vapors can be sampled without a monitoring pump using special passive monitors or badges. Several different types of collection media can be used in these badges, including solid adsorbents, liquid medium, chemically impregnated tape, and reagent-filled tubes. No matter what kind of media is used, the analyte of interest is collected in the badge by diffusion when the air sample comes into contact with the collection media. Instructions and limitations of the monitors are described in the manufacturer's user's manual and should be carefully followed. Always record the manufacturer, model, series and serial number (if available) of the passive monitor on the sampling form, so that the appropriate sampling/uptake rates are used for concentration calculations for the particular chemicals being analyzed. Most monitors require a minimum air flowrate over the diffusion membrane to prevent creating an artificially low stressor concentration at the membrane, and may not be appropriate for area sampling. Consult the manufacturer for minimum required air flowrates and suitability for use as an area monitor. Several other points and precautions to note are:

- (1) Passive monitors are usually designed for full shift sampling of gases and vapors. Particulates, such as dust, may coat the monitor's diffusion membrane and invalidate the results.
- (2) In high humidity environments some organic vapor monitors may experience problems due to competition of water vapor for adsorption sites (on the charcoal, for example), leading to underestimation of the actual concentrations.

- (3) Ensure that the diffusion membranes are not torn during sampling, which invalidates the sample.
- (4) Since monitors are small and light-weight, they are easily turned over so that the sampling face is not exposed or may be covered by loose clothing, again invalidating the results.

B. ORGANIC SOLVENT VAPOR COLLECTION

- (1) Passive monitors are not recommended for ceiling or short-term exposure sampling.
- (2) Passive monitors should not be used for collecting unknown organic vapors.

C. SIMULTANEOUS SAMPLING FOR MULTIPLE ANALYTES

Mixtures of several solvents may be collected and analyzed by the same procedure if the same type of passive monitor and a similar sampling time are used. However, there may be problems with interference or sample overload that may affect the analyses.

***Note:** Always contact the IH laboratory where the samples are going to be analyzed before collecting samples for multiple analytes.

D. SINGLE ANALYTE SAMPLING

The Special Instructions in IH Procedure List in this technical guide clearly indicate when single analyte sampling is required. Refer to the Procedure List in Appendix B for more information.

E. ETHYLENE OXIDE SAMPLE COLLECTION

Passive monitors for organic solvent vapors cannot be used for Ethylene Oxide (ETO).

2-13. BULK SAMPLING

A. ORGANIC SOLVENT/METALS SIMULTANEOUS ANALYSES

When requesting an analysis for organic solvents and metals in the same sample (such as, a paint), submit two portions—one for solvents and one for metals.

B. BULK “UNKNOWN” COMPOSITION AND IDENTIFICATION

The composition of bulk “unknowns” can often be identified from the information in the Material Safety Data Sheets (MSDS). Submit the MSDS with the bulk sample whenever possible.

- (1) A database for MSDS information may be accessed on the Internet through the following AIPH-LS site address:
<http://phc.amedd.army.mil/topics/labsciences/lsm/Pages/RelatedSitesLSM.aspx>
- (2) If the National Stock Number (NSN) of the bulk sample is known, similar information on product composition may be available in the Military Item Disposal Instruction (MIDI).
- (3) For information on “unknowns” not found in the MSDS databases or the MIDI, it may be necessary to obtain the MSDS for the product from the manufacturer. If analysis is still required after review of the MSDS sample, include the MSDS when the samples are submitted for analysis.

2-14. SURFACE SAMPLING**A. OVERVIEW**

The collection of surface contaminants, generally referred to as “wipe sampling”, is an important IH technique to estimate contamination on a variety of surfaces, including those in work areas, homes, outdoor areas, and skin. When implemented following a validated method, the technique is a quick and easy means of assessing the level of contamination that may reside on the surface. Wipe samples can be taken to assess exposure to lead, chromium, and other metals, acids, and also a variety of organic compounds, including pesticides, diisocyanates, explosives, and other known toxic or irritant compounds. Procedures can vary widely, depending on the contaminant of interest and the surface sampled. The procedure used for a collecting a specific analyte on a given surface is an important part of whether or not the results generated will be representative of the contamination.

The National Lead Poisoning Prevention Program has documented procedures for wipes and sample collection (OSHA, 1999; ASTM, 2010; ASTM, 2011).

Prior coordination with the USAPHC laboratory where the samples are going to be analyzed is therefore needed before these types of samples are submitted. Please contact the IH Consultant in the LS Client Services Division at commercial (410) 436-2637 or DSN 584-2637 for guidance before collecting these types of samples.

B. SAMPLING PROCEDURES

- (1) **Wipe Sampling Media.** For metals sampling, individually wrapped, pre-moistened wipes/towelettes are recommended. For organics, cotton gauze pads or cotton balls are usually appropriate. In all cases, sampling media must be chosen (and precleaned if necessary) to minimize potential sample contamination (that could result from the presence of the contaminants of interest in the wipe media itself).
- (2) **Wipe Template.** A template of known dimensions should be used to outline the sample area. The template material (e.g. aluminum, plastic, disposable manila paper template) must be compatible with the wetting agent, and must not introduce contamination.
- (3) **Sample Collection.** Don a new pair of disposable gloves in collecting each sample. The total area of each sample wipe should be 100 cm². Dry wipes or filter paper wetted with deionized water should be used for metals, liquid residues, or for sampling on skin. Some solvents employed for selected organics include hexane, acetonitrile, or methylene chlorride/acetone. Contact the IH Consultant for more details on wipe sampling procedures.

2–15. CORRECTION OF AIR COLLECTION VOLUMES FOR SITE TEMPERATURE AND PRESSURE

- A. When workers are exposed to air contaminants at temperatures and atmospheric pressures that are substantially different from normal temperature and pressure (NTP), 25 ° Celsius (C) and 760 torr, care needs to be taken in comparing sampling results to applicable exposure standards. Sampling at atmospheric conditions as moderate as 30 °C and 670 torr, typical outdoor summertime sampling conditions encountered in intermountain areas of the western United States, can lead to a 15 percent error in assessing TLV compliance (Stephenson and Lillquist, 2001). In particular, extreme care should be exercised if workers are exposed to very high or very low ambient pressures. The topic is discussed in more detail in American Conference of Governmental Industrial Hygienists (ACGIH[®]), *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices*, under the topic, *Application of TLVs to Unusual Ambient Conditions* (ACGIH, 2011); in the OSHA Technical Manual, TED 01-001-015 (OSHA, 1999). (ACGIH[®] is a registered trademark of the American Conference of Governmental Industrial Hygienist.)

***Note:** These corrections only apply to gases and vapors and are not necessary for particulates.

- B. Correct the measured (calibration) volume to the actual volume only when temperature and/or atmospheric pressure at the sampling location are significantly different from those at the calibration location.

$$V_A = V_C (P_C/P_A) \times (T_A + 273)/T_C + 273)$$

V = Volume, P = Pressure, T = Temperature, °C
 A = actual, C = calibration

- C. For particulates, compare the mass per unit to actual volume (mg/m³) to the PEL or the TLV.
- D. For gases and vapors, convert the mass per unit of actual volume (mg/m³) to parts per million (ppm) at NTP using the following formula, and compare this result to the PEL or TLV:

$$\text{ppm}_{\text{NPT}} = (\text{mg/m}^3) \times 24.45/\text{molecular weight}$$

- E. The air collection volumes reported to the laboratory can be corrected to standard temperature and pressure (STP) using the following formula:

$$V_{\text{STP}} = V_m * [(P_{\text{bar}} - P_w)/760] * [298/(273 + T)]$$

- Where:
- V_{STP} = Volume of Air (in Liters) at Standard Temperature (0 °C) and Pressure (760 millimeter (mm) of mercury (Hg))
 - V_m = Volume of Air (in L) collected at site
 - P_{bar} = Barometric pressure (mm of Hg) at site
 - P_w = Partial pressure of water vapor at site (mm of Hg). The partial pressure of water is disregarded in most situations. However, such information can be obtained from a handbook of physical constants if desired.
 - T = Temperature (°C) at which the sample was collected
 - * = Multiplication

For Example:	V _{STP}	=	792 L
	When:		
	v _m	=	800 L
	P _{bar}	=	740 mm of Hg
	P _w	=	0 mg of Hg (Parameter Disregarded)
	T	=	20 °C
	*	=	Multiplication
	792 L	=	800 L * [(740-0)/760] * [298/(273 + 20)]

2-16. ASBESTOS SAMPLING AND OPTIMAL FILTER LOADING FOR FIBER COUNT ANALYSIS BY PHASE CONTRAST MICROSCOPY

A. OPTIMIZE THE SAMPLE FLOW RATE

The OSHA regulations specify a sample flow rate of 0.5 to 2.5 liters per minute (LPM). However, in order to obtain optimal fiber loading in clean work areas, higher sample flow rates (up to 16 LPM) are sometimes necessary. The higher flow rate is required to achieve an appropriate fiber density for counting the fibers under the microscope for the laboratory analysis. Refer to past sampling data, if available, to determine appropriate sample flow rates and sampling times.

B. OPTIMIZE THE SAMPLE LOADING

When a fiber density (E) between 100 to 1300 fibers per square millimeter (f/mm²) is achieved, then optimum sample loading has been accomplished. A fiber density in this range allows for more accurate counting of the asbestos fibers under the microscope. Using past data expressed as a fiber count (C) in fibers per cubic centimeter (f/cc), the optimum sample loading and/or the volume required to achieve it can be calculated using the following formula:

$$E = \frac{C * V * 1000}{Ac}$$

- Where:
- E = Fiber density (f/mm²)
 - C = Fiber concentration in f/cc (fiber count result from past data)
 - V = Volume sampled (L)
 - Ac = Collection area (A 25-mm filter has an effective collection area of 385 mm²)

For example:		E	=	102.3 f/mm²
	When:	C	=	0.0511f/cc (fiber count result from past data)
		V	=	770.8 L
		Ac	=	385 mm ²
		*	=	Multiplication
		102.3 f/mm²	=	$\frac{0.0511 * 770.8 * 1000}{385}$

C. OPTIMIZE THE SAMPLE FLOW RATES AND TIME FOR BEST FIBER DENSITY

Sampling should be done at a sample flow rate greater than 0.5 LPM. The sampling time necessary to produce a fiber density of 100 to 1300 f/mm² can be calculated using the formula below. This range for fiber density allows for optimum accuracy when performing the fiber count. The OSHA PEL time-weighted average (TWA) for asbestos is 0.1 f/cc.

$$t = \frac{Ac * E}{Q * C * 1000}$$

Where:

- t = Sampling Time (Minutes)
- Ac = Collection Area (A 25 mm filter has an effective collection area of 385 mm²)
- E = Fiber density (f/mm²)
- Q = Flow rate (LPM)
- C = Fiber concentration (f/cc)

For example:		t	=	385.4 Minutes
	When:	Ac	=	385 mm ²
		E	=	102.3 f/mm ²
		Q	=	2 LPM
		C	=	0.0511 f/cc
		*	=	Multiplication
				385 * 102.3
		385.4 Minutes	=	$\frac{385 * 102.3}{2 * 0.0511 * 1000}$

D. USE HIGH SAMPLE FLOW RATES AND SHORT SAMPLING TIMES FOR EPISODIC EXPOSURES

For episodic exposures, use high flow rates (7–16 LPM) over short periods of time to achieve appropriate filter loading.

E. OPTIMIZE THE AIR COLLECTION VOLUME

- (1) Use high-air collection volumes for very clean environments when necessary—

- (a) Usually, air collection volumes between 400 and 2000 L are adequate to achieve a suitable sample detection limit, which is above the PEL. However, if the sampling environment is very clean and the final air collection volume is too low, the fiber density obtained on the sample filter may not be adequate.
- i.* This means the sample result will not be representative of the environmental conditions.
 - ii.* The sample result may appear to be reportable as less than the detection limit, but the calculated detection limit for the sample may be higher than the OSHA PEL-TWA, which is 0.1 f/cc.
 - iii.* This situation occurs because the calculated detection limit for a sample is based on the air collection volume for that sample.
- (b) For expected low-fiber concentrations (significantly less than 0.1 f/cc), air collection volumes within a range of 3,000-10,000 L are often required to ensure a quantifiable fiber count on the fibers and to achieve a detection limit, which is lower than the OSHA PEL-TWA.
- (c) When using high-air collection volumes, care must be taken not to overload the filter with ambient background dust, which may bias the asbestos analysis and make it difficult to obtain accurate fiber counts.

Table 2–1. EXAMPLES OF THE RELATIONSHIP BETWEEN THE SAMPLE VOLUME AND THE REPORTING LIMIT

AIR COLLECTION VOLUME (L)	CALCULATED RL AS FIBERS/CC	CALCULATED RL AS FIBERS/mm ²
16	0.1685	<7.0
100	0.0270	<7.0
300	0.0090	<7.0
1000	0.0027	<7.0

Legend:
mm - millimeter; mm² - millimeters squared.
Note:
For a Graticule Area of 0.0080119 mm² and an effective Collection Area of 385 mm² for the 25 mm filter.

- (2) Use low-air collection volumes for very dirty environments when necessary. When sampling in a very dirty environment, it may be necessary to collect a sample volume that is lower than the recommended minimum of 400 L. When this is necessary, it is advisable to collect several control samples using air collection

volumes in the recommended range in case environmental conditions are not as suspected.

2-17. RADIOCHEMICAL AND HEALTH PHYSICS LABORATORY ANALYSES

For questions regarding radiochemical, health physics, and ionizing radiation, please contact one of the programs listed below. The point of contact (POC) will provide the appropriate interaction needed with other USAPHC personnel.

- A. For nonionizing radiation concerns, contact the Program Manager for Laser/Optical Radiation at DSN 584-3932 or (410) 436-3932.
- B. For medical health physics concerns, contact the Program Manager for Health Physics at DSN 584-8396 or (410) 436-8396.
- C. For sampling and sample collection questions, contact the Division Chief, AIPH-LS Analysis Division Inorganic at DSN 584-3983 or (410) 436-3983.

CHAPTER 3 FACTORS TO CONSIDER BEFORE COLLECTING SAMPLES

3-1. OVERVIEW

A. FACTORS FOR LABORATORY ANALYSES

Several factors necessary for successful laboratory analyses should be considered *before samples are collected*. These factors include—

- The most appropriate analytes for the project.
- Special sampling or collection requirements.
- Special instructions, handling, or shipping requirements.
- Sample priority designations.
- Safety considerations.
- Sample or site history.

B. STATISTICAL EVALUATION

The number of samples required for compliance monitoring should be based on statistical evaluation of the worker exposure to hazardous material. A general discussion on statistics as they relate to sampling strategy can be found in NIOSH Occupational Exposure Sampling Strategy Manual (NIOSH, 1977):

<http://www.cdc.gov/niosh/docs/77-173/>. Questions concerning an individual analytical method's coefficient of variation should be directed to the AIPH-LS IH Technical Consultant.

C. ARMY GUIDANCE FOR AIR EXPOSURE LIMITS

The Army's guidance, as specified in Department of the Army Pamphlet (DA Pam) 40-11, *Preventive Medicine*, on exposure limits for hazardous materials in air is based on the most stringent limit. Where there is both an OSHA PEL and ACGIH TLV for a particular hazard, the more restrictive limit should be used for compliance monitoring.

***Note:** Exposure assessment planning guidance can be found by referring to the DOD Industrial Hygiene Exposure Assessment Model of January 2000.

3-2. INFORMATION ABOUT THE AIPH-LS INDUSTRIAL HYGIENE PROCEDURE LIST**A. CENTRALIZED SOURCE OF INFORMATION**

This IH Procedure List offers IH customers a correct, current, and centralized source of the information they need to know for proper sampling of the analytes tested at USAPHC laboratories.

B. AVAILABLE TEST METHODOLOGIES

USAPHC IH laboratories continually update the analyses available to IH customers. If the test methodology desired for a project is not on the USAPHC IH Laboratory Procedure List, please contact the IH Consultant at AIPH-LS or the Customer Support Services Division at the appropriate laboratory for updated information on test methodologies available. Some tests are not performed routinely but are available upon special request.

C. THE USAPHC IH PROCEDURE LIST

- (1) The CONUS Procedure List is in Appendix B, Section B-3 of this guide.
- (2) The OCONUS Procedure List can be found in the Public Health Command Region- (PHCR)-Europe DLS Customer Guide at:
<http://www.chppmeur.healthcare.hqusareur.army.mil/sites/dls/dls.aspx>.
- (3) The CONUS lists are available within TG-141 on the USAPHC Public Website at:
<http://phc.amedd.army.mil/topics/labsciences/lsm/Pages/ResourceMaterials.aspx>.

D. INFORMATION NOT CONTAINED IN USAPHC IH PROCEDURE LIST—

- (1) Pertinent references, such as the latest ACGIH publication on Threshold Limit Values and Biological Exposure Indices, should be consulted for this information (ACGIH, 2011).
- (2) The reference method noted for the analyte in the procedures list should be consulted for more detailed information on the procedure. Reporting limits and accuracy information for the procedure may also be found in the reference method. Any questions on the procedures should be directed to the IH Consultant at AIPH-LS.
- (3) The DA Pam 40-11, Chapter 5, describes the relevant Army occupational health standards.

- (a) In industrial Department of the Army (DA) military or civilian workplaces, the more stringent of the ACGIH TLV, OSHA PEL, Department of Defense (DOD), or DA exposure limit must be applied.
- (b) Other airborne exposure limits may be applicable to Soldiers during training/combat scenarios during use of military-unique tactical equipment, munitions, and weaponry. Consult USAPHC AIPH, Program 55, Industrial Hygiene Field Services Program concerning these types of situations at DSN 584-3118 or commercial (410) 436-3118.

3-3. THE IMPORTANCE OF THE AIPH-LS TEST CODE

- A. WHAT IS THE AIPH-LS TEST CODE?** The AIPH-LS Test Code is a unique four-digit number assigned to each laboratory procedure used by the laboratories. This code applies only to those procedures performed at USAPHC CONUS laboratories. It is indicated as the second item on the USAPHC CONUS IH Procedure List.
- B. WHY SHOULD THE TEST CODE BE USED?** This Test Code is the simplest and most accurate means of referencing and identifying a specific analyte test method. Occasionally, there are different methods available for the same analyte, or different tests for different forms of a given compound or analyte may exist. The Test Code offers a unique means of differentiating between these test methods or the compound form, and clearly indicates to the personnel at USAPHC IH laboratories exactly what the customer wants and needs. The Test Code is often the only unique identifying feature for each analyte listed.
- C. WHEN SHOULD THE AIPH-LS TEST CODE BE SELECTED AND USED?**
 - (1) The Test Code should be selected by the customer at the same time the analyte to be tested is determined. The AIPH-LS Laboratory IH Technical Consultant can assist customers in making their selection.
 - (2) The Test Code should be used as a point of reference for customers and the AIPH-LS laboratory in the communication and correspondence process associated with each project. Consistent use of a specific Test Code eliminates the possibility of miscommunications as to which test method is actually needed by the customer.

3-4. SAMPLE ANALYSIS PRIORITY DESIGNATIONS

Sample analysis priorities are critical in determining the turnaround times (TATs) and the cost for each analysis. Samples are assigned processing priority based on three assigned sample analysis priorities: Standard, High-Priority, and Top-Priority. Table 3-1 summarizes

the guidelines for AIPH-LS sample analysis priorities. Unless otherwise specified, all samples are assigned standard priority.

***Note:** High-priority and top-priority requests must be coordinated in advance with the laboratory that is going to perform the analyses.

TABLE 3–1. GUIDELINES FOR AIPHC-LS SAMPLE ANALYSIS PRIORITIES

	STANDARD	HIGH PRIORITY	TOP PRIORITY
BASIC SELECTION CRITERIA	Routine analytical response is involved	Rapid analytical response is desired	Fastest analytical response possible is needed
COSTS	AIPH-LS published fee	Fee surcharge applied	Fee surcharge applied
TAT	14 calendar days from receipt in the laboratory	7 calendar days from receipt in the laboratory	3-5 calendar days or less from receipt in the laboratory. Prior laboratory approval required

Notes:

1. The TAT for each analysis should be determined as part of the project requirements and by mutual agreement with USAPHC laboratory performing the analyses.
2. The specific TAT for each sample can be analysis and project dependent.
3. The TATs may be affected by the number of samples involved for each analysis.

3–5. SAMPLE SAFETY CONSIDERATIONS

- A. The laboratory personnel must be informed about samples that are known or suspected of containing hazardous materials, either chemical or biological. The laboratory must be informed before the samples are being submitted.
 - (1) Appropriate precautionary measures must be taken to protect everyone who will have any contact with these kinds of samples.
 - (2) Information concerning hazards, or possible hazards, must be part of the communication process with AIPH-LS and clearly indicated on all the paperwork (for example, LIDS 9) and on the samples.

B. A database for MSDS information may be accessed on the Internet through AIPH-LS at <http://phc.amedd.army.mil/topics/labsciences/lsm/Pages/RelatedSitesLSM.aspx>.

3–6. ADDITIONAL SAMPLE OR PROJECT CONSIDERATIONS

- A. **SAMPLE OR SITE HISTORIES.** Improved customer service and sample TAT is possible if the following sample or site information is provided:
 - (1) Known or suspected high concentrations of the analyte of interest.

- (2) Known or suspected interfering substances that may impede the analysis of the sample.

B. SPECIAL INSTRUCTIONS, HANDLING, OR SHIPPING REQUIREMENTS

These requirements are indicated on the USAPHC Laboratory IH Procedure List, Appendix B. The AIPH-LS IH Technical Consultant can be contacted for clarification and advice with respect to these requirements.

C. CHAIN-OF-CUSTODY REQUIREMENT

Chain-of-custody (COC) is a procedure that provides accountability and documentation of sample integrity from the receipt of the sample in AIPH-LS until disposal or consumption. A sample is usually handled under COC if there is a possibility that the results may be used in litigation. It is project specific and determined by the industrial hygienist performing the sampling. Appendix F contains a copy of the COC document, LIDS 235, which must be completed by the project officer. The document can also be accessed at <http://phc.amedd.army.mil/topics/labsciences/lsm/pages/lids.aspx>. The USAPHC TG 214, Chapter 7, contains detailed information concerning COC policy. Go to [http://phc.amedd.army.mil/phc resource library/tg214.pdf](http://phc.amedd.army.mil/phc_resource_library/tg214.pdf).

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CHAPTER 4**COMPLETING REQUIRED USAPHC SHIPPING DOCUMENTS**

4-1. REQUEST FOR SERVICES. We request that the project officer complete LIDS 330, *Request for Laboratory Services*, before submitting samples for analyses. A sample of this document can be found in Appendix F. For more detailed information, see TG 214 at http://phc.amedd.army.mil/phc_resource_library/tg214.pdf for completing a request for laboratory services. The information needed to complete this document should be established in the early stages of the project planning and communication process with AIPH-LS. The LIDS 330 is used to generate—

- A. A cost quote for analytical services.
- B. A Container and Preservative Requirement Report, which is used to prepare an Environmental Sample Collection Kit.

4-2. REQUIRED USAPHC SHIPPING DOCUMENTS. The following document must accompany IH samples when they are submitted to the laboratory:

LIDS 9, *Industrial Hygiene Sample Submission Form*
<http://phc.amedd.army.mil/topics/labsciences/lsm/pages/lids.aspx>.

4-3. ADVANCE NOTICE OF INCOMING SAMPLES TO AIPH-LS

- A. Advance notification of incoming samples to AIPH-LS is requested. IH Customers and other USAPHC laboratories should submit a duplicate copy of the completed LIDS 9 as soon as possible when samples are being sent to the AIPH-LS laboratory. The completed advance notification document can be submitted either—
 - (1) Electronically using the “sampnews” mailboxes. See Appendix B, Section B-1, Table B-1, for information on submitting notification for “sampnews.”
 - (2) Faxing or mailing a hard copy. See Appendix B, Section B-1, Table B-1, for the mailing address and the fax number.

***Note:** The original document must be sent with the sample shipment (see Chapter 5).

- B. See Chapter 5, Section 5-2, for additional information.

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CHAPTER 5**SUBMITTING SAMPLES TO THE LABORATORY****5-1. SAMPLE COORDINATION REQUIREMENTS****A. THE CONUS CUSTOMERS**

Refer to Appendix B, Section B-1, for information on Customer Support Services available at AIPH-LS.

B. THE OCONUS CUSTOMERS

Refer to Appendix C, Section C-1, for information on Customer Support Services available at the PHCR-Europe and PHCR-Pacific.

C. THE IH CUSTOMERS OUTSIDE OF THE ARMY MEDICAL DEPARTMENT CHANNELS

These customers should coordinate their sampling activities with their local installation industrial hygienist.

5-2. ADVANCE NOTICE OF INCOMING SAMPLES

Preparing and submitting requests for laboratory services should be an integral step of the sample process. The LIDS 330, *Request for Laboratory Services*, serves the purpose of identifying key aspects of the sampling effort and starting the communication process with AIPH-LS. The LIDS 330 is used to generate a cost quote for the requested analytical service and alerts us of the analysis requirement. It may also identify what supplies need to be provided to support the sampling. The LIDS 330 can be accessed electronically at: <http://phc.amedd.army.mil/topics/labsciences/lsm/pages/lids.aspx>. Detailed information on how to complete the document can be found in TG 214, which is available electronically at: [http://phc.amedd.army.mil/phc resource library/tg214.pdf](http://phc.amedd.army.mil/phc_resource_library/tg214.pdf).

A. ADVANCE NOTICE OF INCOMING SAMPLES TO AIPH-LS IS REQUESTED

- (1) Advance notification of incoming samples allows AIPH-LS personnel to review the information concerning the samples and to address any questions concerning the samples or the shipment immediately and allows us to address and solve any problems prior to the receipt of the samples themselves.

- (2) IH customers and other USAPHC laboratories should submit a duplicate copy of a completed LIDS 9 as soon as possible for samples being sent to the AIPH-LS laboratory. The original document must be sent with the sample shipment.

B. SUBMISSION OF COMPLETED DOCUMENT

- (1) Forward document electronically using the “sampnews” mailbox. See Appendix B, Section B-1, for information about, and the addresses for, “sampnews.”
- (2) Fax or mail a hard copy. See Appendix B, Section B-1, for the mailing address and the fax number.

5-3. MODIFYING REQUESTS FOR LABORATORY SERVICES

- A. Contact AIPH-LS immediately for any change to a processed LIDS 9.
- B. Submit all changes through “sampnews.” This e-mail system is the most effective means of communicating with us because all AIPH-LS staff members have access to this mailbox.

5-4. SAMPLE REJECTION

- A. Samples that do not meet the acceptance criteria for a valid sample will be rejected. Sample management and technical staff members have the authority to reject samples. The laboratory will initiate contact with the appropriate project officer or industrial hygienist resource. At AIPH-LS, a sample rejection document is used for documentation and states—
 - (1) Who rejected the sample.
 - (2) The reason for the rejection.
 - (3) When the project officer was notified.
- B. When a project officer or other approving authority makes a decision to reject samples analyzed, the request will be documented (at AIPH-LS), and the report for the sample will be qualified.
- C. Rejected samples will either be properly disposed of or returned to the customer by laboratory personnel. The disposition or return is documented on the sample rejection document and/or other applicable documents.

5-5. REQUIRED SHIPMENT DOCUMENTS

A. The following document listed below *must* accompany the samples when they are submitted:

LIDS 9, *Industrial Hygiene Sample Submission Form*.

B. See Appendix F for sample AIPH-LS documents.

5-6. SAMPLE FIELD IDENTIFICATION AND LABELING

A. Identify each sample with the unique field identification (ID) number assigned locally, at the time of collection, by the industrial hygienist resource or the sample collector.

(1) A consecutive numbering system should be used to avoid duplication of numbers from batch to batch of samples.

(2) Number all samples and clearly indicate field blank, media blank, and duplicate samples.

(3) Accurately reference each sample on the paperwork included in the shipment.

B. Complete each sample label as required. Figure 5-1 outlines the information needed on each sample label.

<p style="text-align: center;">PRINT EACH LABEL NEATLY USE PERMANENT WATERPROOF INK</p> <p style="text-align: center;">(1) SAMPLE FIELD ID NUMBER (MAXIMUM OF 15 CHARACTERS)</p> <p style="text-align: center;">(2) COLLECTOR'S INITIALS</p> <p style="text-align: center;">(3) DATE OF COLLECTION</p>
--

FIGURE 5-1. REQUIRED INFORMATION FOR EACH FIELD SAMPLE LABEL

C. If the samples are placed in a plastic bag or other container before shipment, the bag or container holding the samples can be labeled with additional information. Figure 5-2 outlines this supplementary information.

<p>PRINT NEATLY USE PERMANENT WATERPROOF INK</p> <p>(1) PROJECT NUMBER (2) INSTALLATION OR SITE NAME (3) PROJECT OFFICER'S NAME OR INITIALS (4) LS-MAIN TEST CODE(S)</p>
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FIGURE 5–2. SUPPLEMENTARY INFORMATION REQUESTED FOR EACH SAMPLE

5–7. SAMPLE PACKING INSTRUCTIONS

- A. Contact the Support Services at the appropriate USAPHC IH laboratory facility prior to shipping samples if there are any concerns about proper packing or shipping of samples.
- B. Know which types of samples require special handling, packing, or shipment. The Special Instructions in the Procedure List indicates any special sample requirements.
- C. Verify that all sample collection tubes or impingers are capped tightly.
- D. Never ship bulk liquid samples in the same shipping container as air samples. This is necessary to avoid contamination of the air samples.
- E. Mark the liquid level in sample containers (such as bulk samples) with indelible ink. If a sample leaks during shipment, the project officer will be contacted, and a decision will be made as to whether the sample needs to be recollected.
- F. Place an absorbent in the shipping container if liquid samples are being shipped. This is absolutely necessary if any samples contain, or are suspected of containing, hazardous material. Be sure to include enough material to absorb all the liquid in the shipment if sample leakage occurs. Any leakage from the container will halt the transportation by the carrier.
- G. Use suitable packing materials to prevent breakage of samples.
 - (1) Wrap each glass container with enough packing material to prevent contact with other containers or the outer box. The samples should be packed to withstand a 6-foot drop.
 - (2) Seal small vessels containing liquids in plastic bags or aluminum foil depending on the analysis requested. This practice ensures sample integrity and prevents contamination of an entire shipment if a sample leaks.

- H. Use refrigerants and a cooler or Styrofoam[®] box, when necessary, to maintain the samples at the temperature required for special handling and shipping. The Special Instructions in the Procedure List indicate this requirement. (Styrofoam[®] is a registered trademark of the Dow Chemical Company.)
- (1) Store samples in refrigerator until just before packing. If samples must be frozen, store in the freezer.
 - (2) Pre-cool shipping containers to 4 °C before shipping if possible.
 - (3) Use pre-frozen gel blocks whenever possible. Do not allow blocks to come in direct contact with the samples. Keep samples and gel blocks sealed in one or more plastic bags. Always send for next-day delivery (a.m. is better than p.m.). Any leakage from the container will halt the transport by the carrier, so be careful to seal well.
 - (4) Use dry ice only when special sample requirements require its use. Verify shipping regulations before shipping samples.
 - (5) Use ice as a refrigerant only when gel blocks are not available. When ice is used, it must be sealed in heavy double-layered plastic bags to prevent leakage as the ice melts. Zip-Lock[®] freezer bags are recommended because of their extra thickness. (Zip-Lock[®] is a registered trademark of A.C. United Corps.)

5–8. SHIPMENT REQUIREMENTS AND SPECIFICS

Table 5–1 outlines shipment requirements and specifics.

TABLE 5–1. SHIPMENT REQUIREMENTS AND SPECIFICATIONS

<p>1. STANDARD ANALYSIS SAMPLES</p> <p>For U.S. Mail Correspondence or Shipments:</p> <p>Commander, USAPHC ATTN: MCHB-IP-LSM (Sample Management Laboratory) 5158 Blackhawk Road APG, MD 21010-5403</p>	<p>CAN BE SENT BY:</p> <ul style="list-style-type: none"> • Priority First Class Mail • Certified U.S. Mail <p>* NOTE:</p> <ol style="list-style-type: none"> (1) Do Not Send Hazardous Materials by U.S. Mail. Consult with carrier and reference Department of Transportation (DOT) shipping requirements when applicable. (2) Do Not Use Registered Mail. It is not delivered directly to Building E-2100. <ul style="list-style-type: none"> • Commercial carriers such as FedEx or UPS. Hand carried to Building E-2100, APG, Edgewood Area (Sample Management Laboratory).
<p>2. PRIORITY SAMPLES OR SHIPMENTS WITH SAMPLES THAT REQUIRE SPECIAL HANDLING</p>	<p>MUST BE:</p> <ul style="list-style-type: none"> • Shipped by Overnight Express (e.g., FedEx or UPS). • Hand carried to Building E-2100, APG, Edgewood Area.
<p>3. FEDEX/COMMERCIAL CARRIER SPECIFICS</p> <p>For Shipments by FedEx, UPS, or other Commercial Carriers:</p> <p>Commander, USAPHC ATTN: MCHB-IP-LSM (Sample Management Laboratory) Building E-2100 APG, MD 21010-5403</p>	<ul style="list-style-type: none"> • Packages shipped overnight arrive by 1200 the next day. • Samples cannot be picked up on Sunday. • Samples sent on Friday will be delivered Monday unless the shipment is clearly marked “Saturday Delivery.”
<p>4. SHIPMENTS ARRIVING OUTSIDE NORMAL DUTY HOURS (0700–1600)</p>	<p>Require advance arrangements with the Sample Management Laboratory before the samples are shipped. This is necessary to ensure samples are properly received and processed.</p>
<p>5. SHIPMENTS MUST COMPLY WITH ALL APPLICABLE REGULATIONS</p>	<ul style="list-style-type: none"> • The DOT • State and local governments • Hazardous waste • Radiochemical • Biohazard • U.S. Customs Declarations

APPENDIX A
RECOMMENDED REFERENCES
AND
INTERNET ADDRESSES OF INTEREST

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A-1. RECOMMENDED REFERENCES

ACGIH. *Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)*, (2011). (This publication is available from American Conference of Governmental Industrial Hygienists, Kemper Woods Center, 1330 Kemper Meadow Drive, Cincinnati, OH 45240.)

ASTM International. American Society for Testing and Materials (ASTM). ASTM Method E-1728-10, *Standard Practice for Field Collecting of Settled Dust Samples Using Wipe Sampling Methods for Lead Determination*, 2010.

ASTM International. ASTM Method E-1792-03, *Standard Specification of Wipe Sampling Materials for Lead in Surface Dust*, 2011.

DA Pamphlet 40-11, *Preventive Medicine*, 22 July 2005 (Rapid Action Revision: 19 October 2009).

DOD 6050.5-LR, *DOD Hazardous Materials Information System Hazardous Item Listing*. 2002. (This listing is for U.S. Government use only limited because it contains proprietary (hunted rights) data.) (Copies are available from the U.S. Army AG Publication Center, 2800 Eastern Blvd., Baltimore, MD 21220-2896.)

DOD 6050.5-L, *DOD Hazardous Materials Information System Hazardous Item Listing*. 2002. (Copies are available from the U.S. Army AG Publication Center, 2800 Eastern Blvd., Baltimore, MD 21220-2896.)

DOD. Industrial Hygiene Working Group, *DOD Industrial Hygiene Exposure Assessment Model Report 2000-1*, January 2000.

EURACHEM/CITAC (Co-operation on International Traceability in Analytical Chemistry) Guide CG 4, *Quantifying Uncertainty of Measurement, Second Edition*. 2000. (Available at: <http://www.measurementuncertainty.org>. Printed hard copy will be available at Eurachem Secretariat, eurachem@bam.de or the Office of Reference Materials, Laboratory of the Government Chemist (LGC), uk@lgcpromochem.com.)

ISO. 1994. ISO 5725-1. *Accuracy (Trueness and Precision) of Measurement Methods and Results - Part 1. General Principles and Definitions*. Geneva Switzerland: International Organization for Standardization (ISO).

ISO. 1995. *Harmonized Guidelines for Internal Quality Control in Analytical Chemistry Laboratories*, International Union of Pure and Applied Chemistry (IUPAC), and ISO/REMCO.

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- ISO. 1992. The International Electrotechnical Commission (IEC), the International Organization of Legal Metrology (OIML), and the International Bureau of Weights and Measures, *Guide to the Expression of Uncertainty in Measurement*, First Edition.
- NIOSH. *Pocket Guide to Chemical Hazards*, NIOSH Publication No. 2005-149. 2005.
- NIOSH. *NIOSH Manual of Analytical Methods*, 4th Edition, 1994, Peter M. Eller, Editor. (This publication is available from Publications Dissemination, DTS, NIOSH, 4676 Columbia Parkway, Cincinnati, OH 45226.) NIOSH Publication No. 94-113. 1994.
- NIOSH. *A Model for the Identification of High Risk Occupational Groups Using RTECS and DOHS DATA*. U.S. Department of Health and Human Services (DHHS), Public Health Service, Centers for Disease Control, NIOSH Publication No. 83-117. 1983.
- NIOSH. *Occupational Exposure Sampling Strategy Manual*, U.S. Department of Health, Education and Welfare (DHEW), Public Health Service, Centers for Disease Control and Prevention, NIOSH Publication No. 77-173. 1977.
- NIOSH. *Exposure Measurement Action Level and Occupational Variability*, DHEW, NIOSH Publication No. 76-131. 1976.
- NIOSH. *Handbook of Statistical Tests for Evaluating Employee Exposure to Air Contaminants*, DHEW, NIOSH Publication No. 75-147. 1975a.
- NIOSH. *Statistical Methods for the Determination of Noncompliance with Occupational Health Standards*, DHEW, NIOSH Publication No. 75-159. 1975b.
- National Institute of Standards and Technology (NIST). *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, NIST Technical Note 1297, 1994 Edition.
- NIST. *Standard Reference Materials: Handbook for SRM User*. NIST Special Publication No. 260-100. 1993.
- NIST. *Use of NIST Standard Reference Materials for Decisions on Performance of Analytical Chemical Methods and Laboratories*, NIST Special Publication 829, January 1992.
- OSHA. *OSHA Technical Manual*. TED 01-00-015, January 20, 1999.
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Stephenson, D.J., and Lillquist, D.R. *The Effects of Temperature and Pressure on Airborne Exposure Concentrations When Performing Compliance Evaluations Using ACGIH TLVs and OSHA PELs*. Applied Occupational and Environmental Hygiene, Volume 16, 482-486, 2001.

USAPHC. *U.S. Army Institute of Public Health-Laboratory Sciences Quality Assurance Manual*.

USAPHC. Europe, *DLS Customer Guide*, Version 4, Revision 1, August 2011.

USAPHC. TG 214, *Army Institute of Public Health-Laboratory Sciences Customer Service Manual*, March 2012.

USAPHC. TG 211, *Radiobioassay Collection, Labeling, and Shipping Requirements*, March 2012.

USAPHC. TG 230, *Chemical Exposure Guidelines for Deployed Military Personnel*, June 2010.

Wang, Jin, Kevin Ashley, et. al., *Determination of Hexavalent Chromium in Industrial Hygiene Samples by Flow Injection Analysis*, U.S. Department of Health and Human Services, Public Health Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH 45226, 1997.

3M Organic Vapor Monitor Sampling and Analysis Guide for Organic Vapor Monitors 3500/3510 and Organic Vapor Monitors 3520/3530, October 1993.

Title 49, Code of Federal Register (49 CFR), Chapter 1, Subchapter C: Hazardous Materials Regulations, October 2009.

Title 29 CFR Part 1910.1001: Occupational Safety and Health Standards, July 2011.

Title 40 CFR Part 763: Asbestos, July 2008.

A-2. INTERNET ADDRESSES OF INTEREST

a. FEDERAL GOVERNMENT SITES—

- (1) Army Industrial Hygiene
<http://phc.amedd.army.mil/organization/institute/DOHS/pages/armyIH.aspx>

- (2) AIPH-LS Public Website
<http://phc.amedd.army.mil/ORGANIZATION/INSTITUTE/pages/default.aspx>
- (3) NIOSH
<http://www.cdc.gov/niosh/>
- (4) OSHA
<http://www.osha.gov/>
- (5) USAPHC Public Website
<http://phc.amedd.army.mil/Pages/default.aspx>
- (6) USEPA
<http://www.epa.gov/>
- (7) U.S. Air Force School of Aerospace Medicine
<http://www.wpafb.af.mil/afrl/711hpw/usafsam.asp>
- (8) U.S. Navy Environmental Health Center
<http://www-nehc.med.navy.mil/>

b. OTHER HELPFUL SITES—

- (1) ACGIH Home Page
<http://www.acgih.org/>
- (2) American Chemical Society Division of Chemical Health and Safety
<http://portal.acs.org/portal/acs/corg/>
- (3) AIHA
<http://www.aiha.org/>
- (4) American College of Occupational and Environmental Medicine
<http://www.ocoem.org/>

APPENDIX B

**THE USAPHC CONTINENTAL U.S. LABORATORY SUPPORT SERVICES
AND
INDUSTRIAL HYGIENE PROCEDURE LIST**

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B-1. THE USAPHC CONTINENTAL U.S. LABORATORY SUPPORT SERVICES

A. The AIPH-LS CUSTOMER SUPPORT SERVICES

- (1) Table B-1 lists various means of communicating with AIPH-LS Laboratory staff members. Please consult USAPHC TG 214, *AIPH-LS Customer Service Manual*, for additional information on our laboratory Services.

TABLE B-1. MEANS OF COMMUNICATING WITH THE AIPH-LS-MAIN LABORATORY

WAYS TO COMMUNICATE WITH AIPH-LS	
	<p>TELEPHONE: DSN: 584-2208 Commercial: (410)436-2208</p>
	<p>“SAMPNEWS” MAILBOX IS AVAILABLE VIA E-Mail:</p> <ul style="list-style-type: none"> • INTERNAL CUSTOMERS: In Outlook, click on “New.” In the “To” block type USAPHC-DLS-SampNews. • ALL CUSTOMERS: Send an e-mail message to USAPHC-DLSSampNews@amedd.army.mil
 <p>Internet</p>	<p>For information, see the AIPH-LS Public Website Home Page at: http://phc.amedd.army.mil/topics/labsciences/pages/default.aspx</p> <p>To submit an analytical request: http://phc.amedd.army.mil/topics/labsciences/lsm/Pages/LIDS.aspx</p>
	<p>FAX: DSN: 584-4108 Commercial: (410)436-4108</p>
	<p>FOR ROUTINE CORRESPONDENCE/SAMPLES: Commander, USAPHC ATTN: MCHB-IP-LSM (Sample Management Laboratory) 5158 Blackhawk Road Aberdeen Proving Ground, MD 21010-5403</p>
 <p>FedEx UPS</p>	<p>FOR SAMPLE SHIPMENTS: Commander, USAPHC ATTN: MCHB-IP-LSM (Sample Management Laboratory) Building E-2100 Aberdeen Proving Ground, MD 21010-5403</p>

- (2) To provide the best customer service possible, AIPH-LS has established support service designed to help IH customers with the technical and administrative matters relating to their projects.

B. THE AIPH-LS INDUSTRIAL HYGIENE CONSULTANT

- (1) The AIPH-LS Client Services Division (CSD) offers customers the assistance they need to make sound decisions concerning the analytical and technical aspects of their projects.
 - (a) This assistance involves sampling and collection advice, as well as information concerning proper quality assurance factors, such as ensuring appropriate field blanks are collected and special handling and shipping requirements are met.
 - (b) The IH Technical Consultant should also be involved in coordinating special and priority projects.
- (2) Acts as the liaison between customers and AIPH-LS and interacts with installation IH personnel.

C. "SAMPNEWS": AN E-MAIL MAILBOX

- (1) "Sampnews" is an e-mail mailbox established to offer AIPH-LS customers a convenient, effective, and efficient way to exchange information with the laboratory.
- (2) The use of this mailbox facilitates the communication process with AIPH-LS because messages on "sampnews" can be—
 - (a) Accessed simultaneously by all appropriate AIPH-LS staff members. Responses can be made quickly and directly.
 - (b) Sent 24 hours a day. Worldwide time zones are not restrictive.
 - (c) Answered quickly. Questions about the status of samples and laboratory reports are addressed promptly.
 - (d) Used to contact the laboratory about incoming samples. Duplicate copies of a completed LIDS 9 can be electronically submitted.

TABLE B-2. AIPH-LS INDUSTRIAL HYGIENE CUSTOMER SUPPORT SERVICES

CUSTOMERS NEED	IH CONSULTANT	SAMPNEWS E-MAIL MAILBOX
Selection of the proper AIPH-LS TEST CODE.	X	
Choice of the most appropriate SAMPLE ANALYSIS PRIORITY.	X	
Technical information on analyses.	X	
Coordination of priority, complex, or special projects.	X	
Guidance pertaining to requirements for sample collection or shipping.		X
Advance notification of incoming samples by submission of a duplicate LIDS 9 document.		X
Notification of PROJECT modifications after a LIDS 9 has been received or processed.		X
Details concerning sample processing and status reports.		X

D. DUTY HOURS FOR THE LS-MAIN LABORATORY

- (1) Technical Information and Routine Sample Receipt. Routine duty hours are from 0700 to 1600 hours Eastern Time, Monday through Friday, except for federal holidays.
- (2) Sample Receipt Outside of Normal Duty Hours. Special arrangements must be made with the Sample Management Laboratory prior to the shipment of any samples that will arrive outside of AIPH-LS routine duty hours. These arrangements are necessary to ensure appropriate AIPH-LS personnel will be available to receive, process, and preserve the samples.

E. CUSTOMER INFORMATION NEEDED WHEN CORRESPONDING WITH THE LABORATORY

- (1) Date of request or communication.
- (2) Necessary customer information—
 - (a) Full name of customer.
 - (b) Commercial telephone number and/or DSN.
 - (c) Mailing address.
 - (d) E-mail address.

- (e) Fax number.
- (3) Installation or project site.
- (4) Project number (if applicable).
- (5) Brief description of services or information being requested.

B-2. CONTINENTAL UNITED STATES INDUSTRIAL HYGIENE PROCEDURE LIST EXPLANATION OF TERMS

AIR COLLECTION VOLUME:	The recommended range (minimum-maximum) for the total volume of air in liters (L) to be collected during the sampling process. See Chapter 2 for a detailed discussion concerning air sample collection.
ANALYTE NAME:	The name of the chemical as it appears in the Reference Method. Most synonyms are listed and cross-referenced in this list.
CHEMICAL ABSTRACTS SERVICE (CAS) NUMBER	A number assigned by the CAS, which offers a concise, unique means of material identification. It identifies specific chemicals except when followed by an asterisk (*), which signifies a compound (often naturally occurring) of variable composition.
COLLECTION MEDIA:	The type of collection media required and detailed information concerning the specific requirements for the listed analyte.
LS TEST CODE:	The unique three- or four-digit number assigned by AIPH-LS to each laboratory procedure. These codes only apply to procedures done at AIPH-LS laboratories. The AIPH-LS Test Code should be selected by the customer at the same time the analyte to be tested is determined, and it should be used as a point of reference in communications associated with each project. See Chapter 3 for details concerning the AIPH-LS Test Code and its importance.
REFERENCE METHOD:	The analytical methodology used for sample analysis. Information from the Reference Method serves as the basis for the other parameters in the Procedure List. (See Chapter 2 for more information.)
REPORTING LIMIT:	The “expected” limit that can be reliably achieved within specified limits of precision and accuracy during routine sample analyses, by the reference method, usually listed in micrograms per sample.

Other reporting limit units may be fibers per square millimeter (asbestos) or micrograms per gram or liter for bulk samples.

SAMPLE FLOW RATE: The recommended range (minimum-maximum) in liters of air per minute, which can be used in collection of the sample. After the sample flow rate has been selected, the appropriate sampling time should be determined by dividing the recommended collection volume by the sampling rate. See Chapter 2 for a detailed discussion concerning air and bulk material sample collection.

SPECIAL INSTRUCTIONS: Any comments or special requirements necessary when collecting, handling or shipping samples that are to be tested for the selected analyte.

***NOTES:**

For questions regarding non-ionizing radiation, health physics, and radiochemical analyses, please contact one of the programs listed below.

- a. Non-ionizing Radiation: contact the Program Manager for Laser/Optical Radiation at DSN 584-3932 or (410) 436-3932.
- b. Medical Health Physics: contact the Program Manager for Health Physics at DSN 584-3502 or (410) 436-3502.
- c. Sampling and Sample Collection: contact the Division Chief Inorganic, AIPH-LS, at DSN 584-3983 or (410) 436-3983.

TRADEMARKED NAMES USED IN THIS PROCEDURE LIST

3M[®] is a registered trademark of Minnesota Mining and Manufacturing Co., St Paul, Minnesota.

Anasorb[®] is a registered trademark of SKC, Inc. Eighty Four, Pennsylvania.

Cellosolve[®] is a registered trademark of Union Carbide Corp., 270 Park Ave, New York, New York.

Chromosorb[®] is a registered trademark of Johns-Manville Products Corp., Denver, Colorado.

Dursban[®] is a registered trademark of Dow Chemical Co., Midland, Michigan.

Florisil[®] is a registered trademark of Floridin Company, ITT System, Pittsburgh, Pennsylvania.

Freon[®] is a registered trademark of E. I. DuPont de Nemours and Co., Wilmington, Delaware.

Ghost Wipes[®] is a registered trademark of Environmental Express, Mt. Pleasant, South Carolina.

ORBO[®] is a registered trademark of Supelco, Inc., Sigma Aldrich/Supelco, Bellefonte, Pennsylvania.

Tenax[®] is a registered trademark of GC-Enka N.V., The Netherlands.

Teflon[®] is a registered trademark of E.I. DuPont de Nemours and Co., Wilmington, Delaware.

XAD-2[®] is a registered trademark of Rohm and Hass, Philadelphia, Pennsylvania.

Zefluor[®] is a registered trademark of Pall Corporation, East Hills, New York.

B-3. CONTINENTAL UNITED STATES INDUSTRIAL HYGIENE PROCEDURE LIST

ACETIC ACID [CAS # 64-19-7]**Test Code:** 7200**Reference Method:** OSHA-PV2119**Reporting Limit:** 10 µg/sample**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal, 100mg/50mg]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.2 (No Range Given in Reference Method)**Air Collection Volume - Minimum-Maximum (L):** 48 (No Range Given in Reference Method)**Special Instructions:** *Do not ship acetic acid samples in the same container as hydroquinone samples that have been preserved in 1percent acetic acid.*

ACETONE [CAS # 67-64-1]**Test Code:** 5046**Reference Method:** NIOSH 1300, 4th Edition**Reporting Limit:** 30 µg/sample**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.01-0.2**Air Collection Volume - Minimum-Maximum (L):** 0.5-3**Special Instructions:** *Sample stability unknown.*

ACETONITRILE [CAS # 75-05-8]**Test Code:** To be assigned.**Reference Method:** NIOSH 1606, 4th Edition**Reporting Limit:** 40 µg/sample**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal, 400 mg/200 mg]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.01-0.2**Air Collection Volume - Minimum-Maximum (L):** 1-25**Special Instructions:** *Sample stability not determined.*

ACID GASES:

Acid Gas	CAS Number	Test Code	Reporting Limit (µg/sample)
Hydrogen Bromide	7726-95-6	5064	1
Hydrogen Chloride	7647-01-0	5060	2
Hydrogen Cyanide	74-90-8	See Hydrogen Cyanide	2
Hydrogen Fluoride	7664-39-3	5062	2
Nitric Acid	7697-37-2	5063	5
Phosphoric Acid	7664-38-2	5066	5
Sulfuric Acid	7664-93-9	5065	1

Reference Method: NIOSH 7903, 4th Edition

Collection Media: Solid Sorbent Tube [High-Purity Washed Silica Gel, 400/200 mg, ORBO 53 tube, SKC-226-10-03, or equivalent]

Sample Flow Rate - Minimum-Maximum (LPM): 0.2-0.5

Special Instructions: *Stable at least 21 days at 25 °C.*

ACROLEIN [CAS # 107-02-8]

Test Code: 7260

Reference Method: OSHA 52

Reporting Limit: 1 µg/sample

Collection Media: Solid Sorbent Tube [2-hydroxymethyl] piperidine on XAD-2, 120 mg/60 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.1

Air Collection Volume - Minimum-Maximum (L): 3-48

Special Instructions: *Sample stable at least 18 days at ambient temperature.*

**Note: NIOSH method 2016 (modified) can also be used to monitor for acrolein and other low molecular weight aldehydes.*

ALKALINE DUSTS

Alkaline Dust	CAS Number	Test Code	Reporting Limit (µg /sample)	Air Collection Volume (L)
Potassium Hydroxide	1310-58-3	To be assigned	30	70-1000 L
Sodium Hydroxide	1310-65-2	To be assigned	30	70-1000L

Reference Method: NIOSH 7401

Collection Media: Filter [1µm PTFE membrane]

Sample Flow Rate - Minimum-Maximum (LPM): 1-4 L/min

Special Instructions: *Provide 2 to 10 field blanks per set.*

ALUMINUM - SEE "METALS"

AMMONIA [CAS # 7644-41-71]

Test Code: To be assigned.

Reference Method: NIOSH 6015 or OSHA 188 (by contract)

Reporting Limit: 25 µg/sample

Collection Media: Solid Sorbent Tube [Sulfuric Acid-Treated Silica Gel]

A 0.8-micron Mixed Cellulose Ester (MCE) prefilter may be used to remove particulate interferences

Sample Flow Rate Minimum - Maximum (LPM): 0.1-0.2

Air Collection Volume - Minimum-Maximum (L): 0.1-96

Special Instructions: *None*

n-AMYL ACETATE (N-PENTYL ACETATE) [CAS # 628-63-7]

Test Code: To be assigned.

Reference Method: NIOSH 1450, 4th Edition

Reporting Limit: 40 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

Air Collection Volume: Minimum-Maximum (L): 1-10

Special Instructions:

n-AMYL ACETATE (N-PENTYL ACETATE) [CAS # 628-63-7] (CONTINUED)

1. *Store and ship refrigerated.*
2. *Sample stability not determined.*

sec-AMYL ACETATE (SEC-PENTYL ACETATE) [CAS # 626-38-0]

Test Code: To be assigned.

Reference Method: NIOSH 1450, 4th Edition

Reporting Limit: 20 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate: Minimum-Maximum (LPM): 0.01-0.2

Air Collection Volume: Minimum-Maximum (L): 1-10

Special Instructions:

1. *Store and ship refrigerated.*
2. *Sample stability not determined.*

ANESTHETIC GASES:

Anesthetic Gas	CAS Number	Test Code	Reporting Limit (µg /sample)	Air Collection Volume (L)
Desflurane	57041-67-5	5023	5	3
Forane	2667-54-67	5022	5	12
Enflurane	13838-16-9	To be assigned		
Halothane	151-67-7	To be assigned		
Sevoflurane	28523-86-6	5021	5	12

Reference Methods: Modified OSHA 103 or OSHA 106 (Desflurane)

Collection Media: Solid Sorbent Tube [Anasorb 747, 140 mg/70 mg, SKC tube 226-81 or equivalent]

Sample Flow Rate (LPM): 0.05 (No Range Given in Reference Method)

Air Collection Volume (L): 12 (No Range Given in Reference Method)

Special Instructions: *Samples stable at least 15 days at ambient temperature.*

ANTIMONY - SEE "METALS"

AROMATIC HYDROCARBONS:

Aromatic Hydrocarbon	CAS Number	Test Code	Reporting Limit (µg /sample)	Air Collection Volume (L)
Benzene	71-43-2	5025	5	5-30
Ethyl Benzene	100-41-4	5028	10	1-24
Styrene	100-42-5	5030	10	1-14
Toluene	108-88-3	5026	10	1-8
o-Xylene	95-47-6	5116	20	2-23
m-Xylene	108-38-3	5117	20	2-23
p-Xylene	106-42-3	5115	20	2-23
Xylenes (Total)	1330-20-7	5029	20	2-23

Reference Method: NIOSH 1501, 4th Edition

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): Equal to or Less Than 0.2

Special Instructions: *None*

ARSENIC - SEE "METALS"

**ASBESTOS FIBER COUNT - AIR SAMPLE - BY PHASE CONTRAST
MICROSCOPY [CAS # - VARIOUS]**

Test Code: 7079

Reference Method: NIOSH 7400, Revision 4, Issue 2, 15 Aug 94

Reporting Limit: 5.0 fibers/mm²

Collection Media: Filter [0.45 to 1.2 micron CE Membrane, 25 mm, in Open-faced Cassette with 50 mm Conductive Extension Cowl]

Sample Flow Rate - Minimum-Maximum (LPM): 0.5-16

Air Collection Volume - Minimum-Maximum (L): See NIOSH METHOD 7400 (Page 3 and 4, Paragraphs 4, 5, and 6 under "Sampling" and Chapter 2, Section 2-8 of this guide for detailed discussions on Asbestos Sample Collection).

Special Instructions:

1. A minimum of two field blanks or 10 percent of the total samples (whichever is greater) must be submitted with each set of samples.
2. Collect samples with the open end of the sampler facing downward.
3. Ship samples in a rigid container with sufficient packing material to prevent jostling or damage to the cassettes.

ASBESTOS BULK SAMPLE IDENTIFICATION [CAS # - VARIOUS]

Test Code: 7083

Reference Method: EPA 600.0/R93/116

Collection Media: Bulk Material

Sample Flow Rate (LPM): N/A

Air Collection Volume (L): N/A

Special Instructions:

1. *Samples should be shipped in double plastic bags or containers.*
 2. *Enough samples should be collected to represent the tested matrices and to cover all the matrices present in the environment to be tested. Contact the IH Technical Consultant for information or guidance.*
-

ASBESTOS-BY TEM [CAS # - Various]

Test Code: 7327

Reference Method: NIOSH 7402, Revision 4, Issue 2, 15 Aug 94

Reporting Limit: 2.4 fibers/mm²

Collection Media: Filter [0.45 to 1.2 micron Mixed Cellulose Ester (MCE) or Polycarbonate (PC), 25 or 37 mm, or PM-10, Quartz or Teflon, 8 x 10 square inches]

Sample Flow Rate - Minimum-Maximum (LPM): For MCE or PC Filters: 0.5-16
For PM-10 Filter: 100 for up to 24 Hours

Air Collection Volume - Minimum-Maximum (L):

For MCE or PC Filters: 400-3000

For Particulate Matter-10 Filter: Up to 14,400

Special Instructions:

1. *Optimum number of samples to collect: five samples inside; five samples outside; two field blanks.*
 2. *Use gloves when handling filters. Filters should be reverse-flushed before analysis.*
 3. *Ship samples in partitioned cardboard boxes to prevent damage to the cassettes.*
-

BARIUM - SEE "METALS"

BENZENE - SEE "AROMATIC HYDROCARBONS"

1,4-BENZENEDIOL - SEE HYDROQUINONE

BENZENE SOLUBLES - SEE "COAL TAR PITCH VOLATILES"

BERYLLIUM AND COMPOUNDS - SEE "METALS"

BULK AND SPECIAL ANALYSES

Test Code: To be assigned.

Special Instructions: *Contact the LS IH Technical Consultant for information.*

tert-BUTANOL (tert-BUTYL ALCOHOL, 2-METHYL-2-PROPANOL) [CAS # 75-65-0]

Test Code: 7138

Reference Method: NIOSH 1400, 4th Edition

Reporting Limit: 20 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

Air Collection Volume - Minimum-Maximum (L): 1-10

Special Instructions:

1. *Store in freezer and ship refrigerated.*
2. *Single analyte sample tube required.*

**Note: The analytical protocol for this contaminant requires the use of a modifier to the desorption solvent. Because of this requirement, use a separate sampling tube if other analyses are desired.*

3. *Sample stability unknown.*
-

2-BUTANONE - SEE METHYL ETHYL KETONE

**2-BUTOXYETHANOL (BUTYL CELLOSOLVE, ETHYLENE GLYCOL MONOBUTYLEETHER, EGBE)
[CAS # 111-76-2]**

Test Code: 7130

Reference Method: NIOSH 1403, 4th Edition

Reporting Limit: 20 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.05

Air Collection Volume - Minimum-Maximum (L): 2-10

Special Instructions:

1. *Store in freezer and ship refrigerated.*
 2. *Single analyte sample tube required.*
-

2-BUTOXYETHANOL (BUTYL CELLOSOLVE, ETHYLENE GLYCOL MONOBUTYLEETHER, EGBE)
[CAS # 111-76-2] (CONTINUED)

**Note: The analytical protocol for this contaminant requires the use of a modifier to the desorption solvent. Because of this requirement, use a separate sampling tube if other analyses are desired.*

3. *Sample stability unknown.*

n-BUTYL ACETATE [CAS # 123-86-4]

Test Codes: 5059,

Reference Method: NIOSH 1450, 4th Edition

Reporting Limit: 50 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

Air Collection Volume - Minimum-Maximum (L): 1-10

Special Instructions:

1. *Store and ship refrigerated.*
 2. *Sample stability not determined.*
-

sec-BUTYL ACETATE [CAS # 105-46-4]

Test Code: To be assigned.

Reference Method: NIOSH 1450, 4th Edition

Reporting Limit: 20 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

Air Collection Volume - Minimum-Maximum (L): 1-10

Special Instructions:

1. *Store and ship refrigerated.*
 2. *Sample stability not determined.*
-

BUTYL CELLOSOLVE – SEE 2-BUTOXY ETHANOL

CADMIUM - SEE “METALS”

CARBINOL - SEE METHANOL

CARBON DISULFIDE (CS₂, DITHIOCARBONIC ANHYDRIDE) [CAS # 75-15-0]

Test Code: To be assigned.

Reference Method: NIOSH 1600, 4th Edition

Reporting Limit: 20 µg/sample

CARBON DISULFIDE (CS₂, DITHIOCARBONIC ANHYDRIDE) [CAS # 75-15-0] (CONTINUED)

- Collection Media:** Solid Sorbent Tube and Dying Tube
[Coconut Shell Charcoal, 100 mg/50 mg, and Sodium Sulfate (Drying Tube),
270 mg]
- Sample Flow Rate - Minimum-Maximum (LPM):** 0.01-0.2
- Air Collection Volume - Minimum-Maximum (L):** 2-25
- Special Instructions:**
1. *Store and ship refrigerated with dryer tube attached to charcoal tube.*
 2. *Stable 1 week at 25 °C; and 6 weeks, at 0 °C.*
-

CARBON, ELEMENTAL [CAS 7440-44-0] (DIESEL PARTICULATE MATTER)

- Test Code:** 7229
- Reference Method:** NIOSH 5040, 4th Edition
- Reporting Limit:** 0.3 µg/sample
- Collection Media:** Filter, quartz, 37-mm, heat-treated
- Sample Flow Rate - Minimum-Maximum (LPM):** 2-4
- Air Collection Volume - Minimum-Maximum (L):** 140-960
- Special Instructions:** *None*
-

CARBON TETRACHLORIDE - SEE "HALOGENATED HYDROCARBONS"**CELLOSOLVE - SEE 2-ETHOXYETHANOL****CELLOSOLVE ACETATE - SEE 2-ETHOXYETHYL ACETATE**

CHLORDANE (TOXICHLOR, OCTACHLOR) [CAS # 57-74-9]

- Test Code:** To be assigned.
- Reference Method:** NIOSH 5510, 4th Edition
- Reporting Limit:** 0.1 µg/sample
- Collection Media:** Filter and Solid Sorbent Tube [0.8 micron CE membrane and
Chromosorb 102, 100 mg/50 mg]
- Sample Flow Rate - Minimum-Maximum (LPM):** 0.5-1
- Air Collection Volume - Minimum-Maximum (L):** 10-200
- Special Instructions:**
1. *Each set of samples should be accompanied by 2 media blanks.*
 2. *Sample stable greater than 1 week at 25 °C.*
-

CHLOROBENZENE - SEE "HALOGENATED HYDROCARBONS"

o-CHLOROBENZYLIDENE MALONITRILE (CS) [CAS # 2698-41-1]

Test Code: To be assigned.

Reference Method: NIOSH P&CAM 304, 2nd Edition

Reporting Limit: 50 µg/sample

Collection Media: Filter and Solid Sorbent Tube [37-mm, 1.0 micron polymer of tetrafluoroethylene (PTFE) Membrane and Tenax-GC, 70 mg/35 mg]

Sample Flow Rate (LPM): 1.5 (No Range Given in Reference Method)

Air Collection Volume (L): 90 (No Range Given in Reference Method)

Special Instructions: *None*

CHLOROFORM - SEE "HALOGENATED HYDROCARBONS"

CHLORPYRIFOS (DURSBAN) - SEE "ORGANOPHOSPHORUS PESTICIDES"

CHROMIUM - SEE "METALS"

CHROMIUM, HEXAVALENT (Cr⁺⁶) [CAS #18540-29-9]

Test Code: 5031

Reference Method: OSHA ID-215 (Version 2)

Reporting Limit: 0.045 µg/sample

Collection Media: Filter [Pure homopolymer of polyvinyl chloride (PVC), low ash, low moisture pickup, suitable for chromic acid, chromates, and chromium hexavalent: 37 mm, 5 micron]

Sample Flow Rate (LPM): 2.0 (No Range Given in Reference Method)

Air Collection Volume (L): 960 (No Range Given in Reference Method)

Special Instructions: *A significant (2006) modification promulgated in version 2 of the method relates to sample collection and requires that when using the 37- or 25-mm PVC filter with cellulose back-up pad for welding operations, or chromium plating operations, special handling requirements have been added. These are—*

- 1. Samples collected on PVC filters must be shipped overnight to the laboratory within 24 hours of sampling to ensure the samples arrive at the laboratory with adequate time to meet the stated holding times for the following operations.*
- 2. Samples collected on PVC filters from welding operations must be analyzed within 8 days of sampling.*
- 3. Samples collected on PVC filters from chromium plating operations must be analyzed within 6 days of sampling or be stabilized at the laboratory upon receipt.*
- 4. Samples collected on PVC filters from painting operations must be analyzed within 14 days of sampling.*

***Note:** *See Chapter 2 for a discussion of the Analytical Limitations of the Test Method*

COAL TAR PITCH VOLATILES (BENZENE SOLUBLES)

Coal Tar Pitch Volatile	CAS Number	Test Code	Reporting Limit (µg /sample)	Air Collection Volume (L)
Anthracene	120-12-7	7173	0.1	960
Benzo(a)pyrene	50-32-8	7174	0.3	960
Chrysene	218-01-9	7175	0.3	960
Phenanthrene	85-01-8	7177	1	960
Pyrene	129-00-0	7178	1	960
Coal Tar Pitch Volatile	CAS Number	Test Code	Reporting Limit (ug/sample)	Air Collection Volume (L)
Benzene Solubles	All of the above	7179	50	960

Reference Method: OSHA 58

Reporting Limit: 50 µg/sample

Collection Media: Glass Fiber Filter 225-7

Sample Flow Rate - Minimum-Maximum (LPM): 2 (Recommended)

Air Collection Volume - Minimum-Maximum (L): 960 (Recommended)

Special Instructions: *Sample stability unknown.*

COBALT - SEE "METALS"

COPPER - SEE "METALS"

CRESOL, ALL ISOMERS [CAS # 1319-77-3 (MIXTURE)]

Test Code: To be assigned.

Reference Method: OSHA 32

Reporting Limit: 1.1 µg/sample

Collection Media: Solid Sorbent Tube [XAD-7,100 mg/50 mg]

Sample Flow Rate (LPM): 0.1 (No Range Given in Reference Method)

Air Collection Volume (L): 24 (No Range Given in Reference Method))

Special Instructions: *Stable at least 15 days at ambient temperature.*

CS - SEE O-CHLOROBENZYLIDENE MALONITRILE

CS2 - SEE CARBON DISULFIDE

CYANIDES (AEROSOL AND GAS) [CAS # 74-90-8]

TEST CODE: To be assigned.

Reference Method: NIOSH 7904, 4th Edition

Reporting Limit: 2.5 µg/sample

Collection Media: Filter and Bubbler [0.8 micron CE membrane + 15 ml
0.1N KOH]

Sample Flow Rate - Minimum-Maximum (LPM): 0.5 - 1.0

Air Collection Volume - Minimum-Maximum (L): 10 – 180

Special Instructions:

1. Analyze within 5 days.
 2. Particulate on fiber may liberate HCN gas.
-

CYANIDE [CAS # 74-90-8]

TEST CODE: To be assigned.

Reference Method: NIOSH 6010, 4th Edition

Reporting Limit: 1 µg/sample

Collection Media: Solid Sorbent Tube [Soda Lime, 600 mg/200 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.05-0.2

Air Collection Volume - Minimum-Maximum (L): 2-90

Special Instructions: *Stable at least 2 weeks at 25 °C.*

CYCLONITE - SEE RDX

DESFLURANE (SUPRANE) - SEE "ANESTHETIC GASES"

DIACETONE ALCOHOL [CAS #123-42-2]

Test Code: 7222

Reference Method: NIOSH 1402, 4th Edition

Reporting Limit: 10 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

Air Collection Volume - Minimum-Maximum (L): 1-10

Special Instructions:

1. Store in freezer.
 2. Stability unknown.
-

DIAZINON - SEE "ORGANOPHOSPHORUS PESTICIDES"

1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE) [CAS # 106-93-4]

Test Code: To be assigned.

Reference Method: NIOSH 1008, 4th Edition

Reporting Limit: 0.01 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.02 - 0.2

Air Collection Volume - Minimum-Maximum (L): 0.1 - 25

Special Instructions:

1. Ship frozen in insulated container in dry ice.
2. Store in freezer. Stable 2 weeks at minus 25 °C or below.

o-DICHLOROBENZENE (1,2-DICHLOROBENZENE) - SEE "HALOGENATED HYDROCARBONS"

p-DICHLOROBENZENE (1,4-DICHLOROBENZENE) - SEE "HALOGENATED HYDROCARBONS"

1,1-DICHLOROETHANE - SEE "HALOGENATED HYDROCARBONS"

1,2-DICHLOROETHANE (ETHYLENE DICHLORIDE) - SEE "HALOGENATED HYDROCARBONS"

DICHLOROMETHANE (METHYLENE CHLORIDE , METHYLENE DICHLORIDE) [CAS # 75-09-2]

TEST Codes: 7105

Reference Method: NIOSH 1005, 4th Edition

Reporting Limit: 20 µg/sample

Collection Media: TWO Solid Sorbent Tubes in Series
[Coconut Shell Charcoal, 100/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

Air Collection Volume - Minimum-Maximum (L): 0.5-2.5

Special Instructions:

1. Separate the front and back tubes and cap each tube before shipment to prevent migration of methylene chloride between tubes.
2. Sample stability not determined.

1,2-DICHLOROPROPANE (PROPYLENE DICHLORIDE) [CAS # 78-87-5]

Test Code: To be assigned.

Reference Method: Modified NIOSH 1003, 4th Edition

Reporting Limit: 10 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

1,2-DICHLOROPROPANE (PROPYLENE DICHLORIDE) [CAS # 78-87-5] (CONTINUED)**Air Collection Volume - Minimum-Maximum (L):** 1-50**Special Instructions:** *Sample stability not determined.*

DICHLORVOS (DDVP) - SEE "ORGANOPHOSPHORUS PESTICIDES"

DIESEL EXHAUST – PLEASE CALL the LS IH TECHNICAL CONSULTANT FOR INFORMATION

DIISOCYANATES:

Diisocyanate	CAS Number	Test Code	Reporting Limit (µg /sample)	Air Collection Volume (L)
1,6-HDI	822-06-0	7157	0.1	15
HMDI	5124-30-1	7159	0.1	15
IPDI	4098-71-9	7160	0.1	15
MDI	101-68-8	7158	0.1	15
2,4-TDI	584-84-9	7155	0.1	15
2,6-TDI	91-08-7	7156	0.1	15
Bundle of the Above	Multiple	7161	Same as above	15

Test Code: 7157**Reference Method:** OSHA 42/47**Collection Media:** Treated Filter [ORBO 80 Filter or equivalent]**Sample Flow Rate (LPM):** 1.0 (No Range Given in Reference Method)**Air Collection Volume (L):** 15 (No Range Given in Reference Method)**Special Instructions:** *Sampling media must be stored in refrigerator prior to use*

DIISOCYANATES – MONOMERS AND OLIGOMERS - ISO-CHEK**Test Codes:** 7184-7194**Reference Methods:** ASTM D5932-96; D6561-00; D6562-00**Reporting Limit:** 0.03-0.1 µg/sample**Collection Media:** Three-piece cassette with a 5-um PTFE membrane and glass fiber filter impregnated with 9-(N-methylaminomethyl) anthracene (MAMA)**Sample Flow Rate (LPM):** 1**Air Collection Volume (L):** 15**Special Instructions:** *Can be stored at 4C for 10 days. Analyze as soon as possible*

DIMETHYLDINITROBUTANE (DMDNB) [CAS # 3964-18-9]**Test Code:** 5055**Reference Method:** LS 511**Reporting Limit:** 0.066 µg/sample**Collection Media:** Solid Sorbent Tube [Tenax-GC 100 mg/50 mg]**Sample Flow Rate (LPM):** 0.2 (No Range Given in Reference Method)**Air Collection Volume (L):** 10 (No Range Given in Reference Method)**Special Instructions:** *None*

DITHIOCARBONIC ANHYDRIDE - SEE CARBON DISULFIDE

DMDNB - SEE DIMETHYLDINITROBUTANE

DURSBAN - SEE "ORGANOPHOSPHORUS PESTICIDES"

DUST, NUISANCE (RESPIRABLE) – SEE PARTICULATES NOT OTHERWISE REGULATED (NOR), RESPIRABLE

DUST, NUISANCE (TOTAL) - SEE PARTICULATES NOT OTHERWISE REGULATED (NOR), TOTAL

EGBE - SEE 2-BUTOXYETHANOL

EGDN - SEE ETHYLENE GLYCOL DINITRATE

EGEE - SEE 2-ETHOXYETHANOL

ENDRIN [CAS # 72-20-8]**Test Code:** To be assigned.**Reference Method:** NIOSH 5519, 4th Edition**Reporting Limit:** 0.02 µg/sample**Collection Media:** Filter and Solid Sorbent Tube [0.8 micron CE membrane and Chromosorb 102 tube, 100mg/50 mg]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.5-1.0**Air Collection Volume - Minimum-Maximum (L):** 12-400**Special Instructions:** *Sample stable at least 1 week at 25 °C.*

ENFLURANE (ETHRANE) - SEE "ANESTHETIC GASES"

EPICHLOROHYDRIN [CAS # 106-89-8]**Test Code:** To be assigned.**Reference Method:** NIOSH 1010, 4th Edition**Reporting Limit:** 1 µg/sample**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.01-0.2**Air Collection Volume - Minimum-Maximum (L):** 2-30

EPICHLOROHYDRIN [CAS # 106-89-8] (CONTINUED)

Special Instructions: *Sample stable at least 2 weeks at 25 °C.*

ETHANOL (ETHYL ALCOHOL) [CAS # 64-17-5]

Test Codes: 5164

Reference Method: NIOSH 1400, 4th Edition

Reporting Limit: 30 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): Equal to or Less than 0.05

Air Collection Volume - Minimum-Maximum (L): 0.1-1.0

Special Instructions:

1. *Store in freezer and ship refrigerated.*
2. *Single analyte sample tube required.*

**Note: The analytical protocol for this contaminant requires the use of a modifier to the desorption solvent. Because of this requirement, use a separate sampling tube if other analyses are desired.*

3. *Sample stability unknown.*
-

**2-ETHOXYETHANOL (CELLOSOLVE, ETHYLENE GLYCOL MONOETHYLETHER, EGEE)
[CAS # 110-80-5]**

Test Code: 7134

Reference Method: NIOSH 1403, 4th Edition

Reporting Limit: 20 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.05

Air Collection Volume - Minimum-Maximum (L): 1-6

Special Instructions:

1. *Store in freezer and ship refrigerated.*
2. *Single analyte sample tube required.*

**Note: The analytical protocol for this contaminant requires the use of a modifier to the desorption solvent. Because of this requirement, use a separate sampling tube if other analyses are desired.*

3. *Sample stability unknown.*
-

2-ETHOXYETHYL ACETATE (CELLOSOLVE ACETATE) [CAS # 111-15-9]

Test Code: To be assigned.

Reference Method: NIOSH 1450, 4th Edition

Reporting Limit: 20 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

Air Collection Volume - Minimum-Maximum (L): 1-10

Special Instructions:

1. *Store and ship refrigerated.*
2. *Sample stability not determined.*

ETHRANE (ENFLURANE) - SEE "ANESTHETIC GASES"

ETHYL ALCOHOL - SEE ETHANOL

ETHYL ACETATE [CAS # 141-78-6]

Test Codes: 5058

Reference Method: NIOSH 1457, 4th Edition

Reporting Limit: 50 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

Air Collection Volume - Minimum-Maximum (L): 0.1-10

Special Instructions:

1. *Ship refrigerated.*
2. *Sample stable 6 days at 5 °C.*

ETHYL BENZENE - SEE "AROMATIC HYDROCARBONS"

ETHYL 2-CYANOACRYLATE (ECA) [CAS # 7085-85-0]

Test Code: 7114

Reference Method: OSHA 55

Reporting Limit: 0.8 µg/sample

Collection Media: Solid Sorbent Tube [Phosphoric Acid Treated XAD-7,
80 mg/40 mg]

Sample Flow Rate - (LPM): 0.1 (No Range Given in Reference Method)

Air Collection Volume - (L): 12 (No Range Given in Reference Method)

Special Instructions:

1. *Store samples in refrigerator.*
2. *Ship samples frozen on dry ice.*
3. *Stable 17 days at refrigerated temperature.*

ETHYL ETHER [CAS # 60-29-7]

Test Code: To be assigned.

Reference Method: NIOSH 1610, 4th Edition

Reporting Limit: 20 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

Air Collection Volume - Minimum-Maximum (L): 0.25-3

Special Instructions:

1. *Ship refrigerated.*
2. *Single analyte sample tube required.*

**Note: The analytical protocol for this contaminant requires the use of a modifier to the desorption solvent. Because of this requirement, use a separate sampling tube if other analyses are desired.*

3. *Sample stability unknown.*

ETHYLENE DICHLORIDE - SEE "HALOGENATED HYDROCARBONS" (1,2-DICHLOROETHANE)

ETHYLENE GLYCOL [CAS # 107-21-1]

Test Code: 7257.

Reference Method: NIOSH 5523, 4th Edition

Reporting Limit: 5 µg/sample

Collection Media: Filter and Sorbent [Glass Fiber Filter, 13-mm, and XAD-7 OVS tube, 200 mg/100 mg]

Sample Flow Rate (LPM): 0.5-2

Air Collection Volume - Minimum-Maximum (L): 5-60

Special Instructions:

1. *Store and ship refrigerated.*
2. *Samples stable at least 14 days at 5 °C.*

ETHYLENE GLYCOL DINITRATE (EGDN, ETHYLENE DINITRATE) [CAS # 628-96-6]

Test Code: To be assigned.

Reference Method: NIOSH 2507, 4th Edition

Reporting Limit: 0.3 µg/sample

Collection Media: Solid Sorbent Tube [Tenax-GC, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.2-1.0

ETHYLENE GLYCOL DINITRATE (EGDN, ETHYLENE DINITRATE) [CAS # 628-96-6]
(CONTINUED)

Air Collection Volume - Minimum-Maximum (L): 3-100

Special Instructions: *Stable at least 25 days at 25 °C.*

ETHYLENE GLYCOL MONOBUTYLEETHER - SEE 2-BUTOXYETHANOL

ETHYLENE GLYCOL MONOETHYLEETHER - SEE 2-ETHOXYETHANOL

ETHYLENE OXIDE (ETO) [CAS # 75-21-8]

Test Code: To be assigned.

Reference Method: NIOSH 1614, 4th Edition

Reporting Limit: 0.5 µg/sample

Collection Media: Solid Sorbent Tube [HBr-Coated Petroleum Charcoal, 100 mg/
50 mg] or 3M ETO Passive Monitor

Sample Flow Rate - Minimum-Maximum (LPM): 0.05-0.15

Air Collection Volume - Minimum-Maximum (L): 1-24

Special Instructions: *OSHA Method 49, utilizing a 3M (#3551) passive monitor for 8-hour exposures, is an alternative procedure.*

ETHYLENE TRICHLORIDE - SEE "HALOGENATED HYDROCARBONS" (TRICHLOROETHYLENE)

ETO [CAS # 75-21-8] - SEE ETHYLENE OXIDE

FIBERGLASS [CAS # 65997-17-3]

Test Code: To be assigned.

Reference Method: NIOSH 0500, 4th Edition

Reporting Limit: 100 µg/sample

Collection Media: Filter [Tared, 37-mm, 5 micron PVC membrane]

Sample Flow Rate - Minimum-Maximum (LPM): 1-2

Air Collection Volume - Minimum-Maximum (L): 7-133

Special Instructions:

1. *Each set of 10 samples should be accompanied by two field blanks.*
2. *Sample stable indefinitely.*
3. *Fibers are not identified in this procedure.*

FLUORIDES (AEROSOL AND GAS) [CAS # (HF) 7664-39-3]

Test Code: To be assigned.

Reference Method: NIOSH 7902/7906, 4th Edition

Reporting Limit: 10 µg/sample

FLUORIDES (AEROSOL AND GAS) [CAS # (HF) 7664-39-3] (CONTINUED)

Collection Media: Filter and Treated Pad [0.8 micron CE membrane and Sodium Carbonate-Treated Cellulose Pad]

Sample Flow Rate - Minimum-Maximum (LPM): 1-2

Air Collection Volume - Minimum-Maximum (L): 1-800

Special Instructions: *None*

FLUORIDES (PARTICULATE) [CAS # VARIOUS]

Test Code: To be assigned.

Reference Method: NIOSH 7902/7906, 4th Edition

Reporting Limit: 400 µg/sample

Collection Media: Filter and Treated Pad [0.8 micron CE membrane and Sodium Carbonate-Treated Cellulose Pad]

Sample Flow Rate - Minimum-Maximum (LPM): 1-2

Air Collection Volume - Minimum-Maximum (L): 1-800

Special Instructions: *None*

FORANE (ISOFLURANE) - SEE "ANESTHETIC GASES"

FORMALDEHYDE (HCHO) [CAS # 50-00-0]

Test Code: 7122

Reference Method: NIOSH 2016, 4th Edition

Reporting Limit: 0.5 µg/sample

Collection Media: Silica Gel, 300 mg/250 mg [coated with Dinitrophenylhydrazine HCl, SKC-226-119 or equivalent]

Sample Flow Rate (LPM): 0.03-0.15

Air Collection Volume (L): 1-15

Special Instructions: *Samples need to be shipped on ice; tubes have a 30-day holding time at 5 °C. Passive monitors not recommended when source of formaldehyde is formalin. Tube capacity: 70 µg formaldehyde.*

FUEL OIL #2 - SEE "NAPHTHAS"

GASOLINE - SEE "NAPHTHAS"

GLUTARIC DIALDEHYDE - SEE GLUTARALDEHYDE

GLUTARALDEHYDE (GLUTARIC DIALDEHYDE, 1,5-PENTANEDIAL) [CAS # 111-30-8]

Test Code: 7201

Reference Method: NIOSH 2532, 4th Edition

GLUTARALDEHYDE (GLUTARIC DIALDEHYDE, 1,5-PENTANEDIAL) [CAS # 111-30-8]
(CONTINUED)

Reporting Limit: 0.3 µg/sample

Collection Media: Solid Sorbent Tube [Silica Gel Coated with
2,4-Dinitrophenylhydrazine HCl, 300 mg/150 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.05-0.5

Air Collection Volume - Minimum-Maximum (L): 1-30

Special Instructions: *Stable at least 30 days at 25 °C.*

HALOGENATED HYDROCARBONS

Halogenated Hydrocarbon	CAS Number	Test Code	Reporting Limit (µg /sample)	Air Collection Volume (L)
Carbon Tetrachloride	56-23-5	5040	50	3-150
Chlorobenzene	108-90-7	5041	50	1.5-40
Chloroform	67-66-3	5034	40	1-50
1,1-Dichloroethane	75-34-3	5037	10	0.5-15
1,2-Dichloroethane	107-06-2	5043	20	1-50
Hexachloroethane	67-72-1	5042	50	3-70
Tetrachloroethylene	127-18-4	5117	20	1-40
Trichloroethylene	79-01-6	5115	20	0.2-30
1,1,1-Trichloroethane	71-55-6	5029	20	0.1-8
1,1,2-Trichloroethane	79-00-5	5036	10	2-60
1,2-Dichlorobenzene (o-)	95-50-1	5038	60	1-10
1,4-Dichlorobenzene (p-)	106-46-7	5039	60	1-8

Reference Method: NIOSH 1003, 4th Edition

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100mg/50mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

Special Instructions: *Sample stability not determined.*

HALOTHANE - SEE "ANESTHETIC GASES"

HDI - SEE "DIISOCYANATES"

n-HEPTANE - SEE "HYDROCARBONS"

Test Code: 7143

Reference Method: NIOSH 1500, 4th Edition

Reporting Limit: 10 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

n-HEPTANE - SEE "HYDROCARBONS" (CONTINUED)**Air Collection Volume (L):** 4 (No Range Given in Reference Method)**Special Instructions:** *Stable at least 2 weeks at 25 °C.*

HEXACHLOROETHANE - SEE "HALOGENATED HYDROCARBONS"

1,6-HEXAMETHYLENE DIISOCYANATE (HDI) – SEE "DIISOCYANATES"**HEXAVALENT CHROMIUM, (Cr⁺⁶) - SEE CHROMIUM HEXAVALENT**

HMX (OCTOGEN) [CAS # 2691-41-0]**Test Code:** 5203**Reference Method:** OSHA 44 for Sampling Requirements
D516 for Sample Analysis**Reporting Limit:** 0.5 µg/sample**Collection Media:** Solid Sorbent Tube [Filter + Tenax-GC, ORBO 79 tube, or equivalent].

HYDROCARBONS

Hydrocarbon	CAS Number	Test Code	Reporting Limit (µg /sample)	Air Collection Volume (L)
Cyclohexane	110-82-7	7139	5	2.5-5
Cyclohexene	110-83-8	7140	5	5-7
n-Decane	124-18-5	7146	5	4
n-Dodecane	112-40-3	7301	5	2
n-Heptane	142-82-5	7143	10	4
n-Hexane	110-54-3	7141	10	4
Methylcyclohexane	108-87-2	7142	5	4
n-Nonane	111-84-2	7147	5	4
n-Octane	111-65-9	7144	5	4
n-Pentane	109-66-0	7145	30	4
n-Undecane	1120-21-4	7148	10	2

Reference Method: NIOSH 1500, 4th Edition**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal Tube, 100 mg/50 mg]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.01-0.2**Special Instructions:** *Stable at least 2 weeks at 25 °C.*

HYDROCHLORIC ACID (HYDROGEN CHLORIDE) - SEE "ACID GASES"

HYDROFLUORIC ACID (HYDROGEN FLUORIDE) - SEE "ACID GASES"

HYDROGEN CYANIDE [CAS # 74-90-8]

Test Code: To be assigned.

Reference Method: NIOSH 7904, 4th Edition

Reporting Limit: 2 µg/sample

Collection Media: Filter and Bubbler [0.8 Micron PVC Membrane + 15 ml 0.1N KOH]

Sample Flow Rate (LPM): 0.5-1.0

Air Collection Volume (L): 10-180

Special Instructions:

1. Analyze within 5 days.
 2. Particulate on filter may liberate Hydrogen Cyanide gas.
-

HYDROGEN SULFIDE [CAS# 7783-06-04]

Test Code: To be assigned.

Reference Method: NIOSH 6013, 4th Edition

Reporting Limit: 11 µg/sample

Collection Media: Filter + Solid Sorbent Tube [Zefluor, 0.5µm; Coconut Shell Charcoal, 400/200 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.1-1.5 (0.2 Recommended)

Air Collection Volume - Minimum-Maximum (L): 1.2-40

Special Instructions: *None*

HYDROQUINOL - SEE HYDROQUINONE

HYDROQUINONE (HYDROQUINOL, 1,4-BENZENEDIOL) [CAS # 123-31-9]

Test Code: To be assigned.

Reference Method: NIOSH 5004, 4th Edition

Reporting Limit: 3 µg/sample

Collection Media: Filter [0.8 micron CE membrane]

Sample Flow Rate - Minimum-Maximum (LPM): 1-4

Air Collection Volume - Minimum-Maximum (L): 30-180

Special Instructions:

1. After sampling, filters must be preserved in 10 mL of 1 percent acetic acid solution. The blanks must be treated in the same manner.
-

HYDROQUINONE (HYDROQUINOL, 1,4-BENZENEDIOL) [CAS # 123-31-9] (CONTINUED)

**Note: Do not ship hydroquinone samples in the same container with samples collected for acetic acid (ORBO 70 tubes). The 1 percent acetic acid solution from the hydroquinone samples will contaminate the acetic acid ORBO 70 tubes.*

2. *Stable at least 7 days at 25 °C.*

IRON - SEE "METALS"

ISOAMYL ACETATE (PENTYL ACETATE ISOMER) [CAS # 123-92-2]

Test Code: To be assigned.

Reference Method: NIOSH 1450, 4th Edition

Reporting Limit: 20 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

Air Collection Volume - Minimum-Maximum (L): 1-10

Special Instructions:

1. *Ship refrigerated.*
 2. *Sample stability not determined.*
-

ISOBUTYL ACETATE [CAS # 110-19-0]

Test Code: 7243

Reference Method: NIOSH 1450, 4th Edition

Reporting Limit: 20 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

Air Collection Volume - Minimum-Maximum (L): 1-10

Special Instructions:

1. *Store and ship refrigerated.*
 2. *Sample stability not determined.*
-

ISOPHORONE [CAS # 78-59-1]

Test Code: To be assigned.

Reference Method: NIOSH 2508, 4th Edition

Reporting Limit: 50 µg/sample

Collection Media: Solid Sorbent Tube [Petroleum-based Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-1

ISOPHORONE [CAS # 78-59-1] (CONTINUED)

Air Collection Volume - Minimum-Maximum (L): 2-25

Special Instructions: *Stable at least 7 days at 25 °C.*

ISOFLURANE (FORANE) - SEE "ANESTHETIC GASES"

JP4 - SEE "NAPHTHAS"

JP8 - SEE "NAPHTHAS"

KEROSENE - SEE "NAPHTHAS"

LEAD - SEE "METALS"

LEAD [CAS # 7439-92-1]

Test Code: 3191

Reference Method: ASTM 1645/1613

Reporting Limit: 50 µg/g

Collection Media: Paint Chips

Sample Flow Rate - Minimum-Maximum (LPM): NA

Air Collection Volume - Minimum-Maximum (L): NA

Special Instructions: *Place 500-mg sample in plastic bag or glass vial.*

LEAD [CAS # 7439-92-1]

Test Code: 3193

Reference Method: ASTM 1644/1613

Reporting Limit: 0.5 µg/sample

Collection Media: Dust Wipes (LW)

Sample Flow Rate - Minimum-Maximum (LPM): NA

Air Collection Volume - Minimum-Maximum (L): NA

Special Instructions:

1. *Use Ghost Wipes to collect the sample.*
2. *Send blank wipes at a 20 percent frequency.*
3. *Place each wipe in a 50-mL plastic centrifuge tube (preferred), plastic tube or bag prior to shipment.*

MAGNESIUM - SEE "METALS"

MALATHION - SEE "ORGANOPHOSPHORUS PESTICIDES"

MANGANESE - SEE "METALS"

MDI - METHYLENE BISPHENYL ISOCYANATE- SEE "DIISOCYANATES"

MEK - SEE METHYL ETHYL KETONE

MEK PEROXIDE - PLEASE CALL THE LS TECHNICAL CONSULTANT FOR INFORMATION

MERCURY - PLEASE CALL THE LS TECHNICAL CONSULTANT FOR INFORMATION

METALS

Metal	CAS Number	Test Code	Reporting Limit (µg /sample)	Air Collection Volume (L)
Aluminum	7429-90-5	5119	2.5	5-100
Metal	CAS Number	Test Code	Reporting Limit (µg /sample)	Air Collection Volume (L)
Antimony	7440-36-0	5120	0.5	50-2000
Arsenic	7440-38-2	5121	0.5	5-2000
Barium	7440-39-3	5122	0.5	50-2000
Beryllium	7440-41-7	5123	0.25	1250-2000
Cadmium	7440-43-9	5124	0.25	13-2000
Chromium	7440-47-3	5125	1	5-1000
Cobalt	7440-48-4	5126	0.5	25-2000
Copper	7440-50-8	5127	0.5	5-1000
Iron	7439-89-6	5128	2.5	5-100
Lead	7439-92-1	5129	0.5	50-2000
Magnesium	7439-95-4	5130	2.5	5-67
Manganese	7439-96-5	5131	0.5	5-200
Molybdenum	7439-98-7	5132	0.5	5-67
Nickel	7440-02-0	5133	0.5	5-1000
Selenium	7782-49-2	5134	1	13-2000
Silver	7440-22-4	See Silver	0.5	Sampled separately
Thallium	7440-28-0	5137	0.5	25-2000
Tin	7440-31-5	See Tin	3	Sampled separately
Titanium	7440-32-6	5173	0.15	5-100
Vanadium	7440-62-2	5138	0.5	5-2000
Zinc	7440-66-6	5139	2.5	5-200

Reference Method: Modified NIOSH 7300, 4th Edition

Reporting Limit: See Table for each metal

Collection Media: Filter [0.8 micron cellulose ester (CE) membrane]

Sample Flow Rate Minimum - Maximum (LPM): 1-4

Air Collection Volume - Minimum-Maximum (L): See Table for each metal

Special Instructions: *Provide 1 field blank and 1 media blank for each batch of 10 samples.*

METHANOL (METHYL ALCOHOL, CARBINOL, WOOD ALCOHOL) [CAS # 67-56-1]**Test Code:** 5131**Reference Method:** NIOSH 2000, 4th Edition**Reporting Limit:** 30 µg/sample**Collection Media:** Solid Sorbent Tube [Silica Gel, 100 mg/50 mg]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.02-0.2**Air Collection Volume - Minimum-Maximum (L):** 1-5**Special Instructions:** *Samples stable 6 weeks.*

METHYL ACETATE [CAS # 79-20-9]**Test Code:** 7110**Reference Method:** Modified NIOSH 1450, 4th Edition**Reporting Limit:** 20 µg/sample**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.01-0.2**Air Collection Volume - Minimum-Maximum (L):** 1-10**Special Instructions:**

1. *Store and ship refrigerated.*
 2. *Sample stability not determined.*
-

METHYL ALCOHOL - SEE METHANOL

METHYL-2-CYANOACRYLATE (MCA) [CAS# 137-05-3]**Test Code:** To be assigned.**Reference Method:** OSHA 55**Reporting Limit:** 2 µg/sample**Collection Media:** Solid Sorbent Tube [Phosphoric Acid Treated XAD-7]**Sample Flow Rate - (LPM):** 0.1 (No Range Given in Reference Method)**Air Collection Volume - (L):** 12 (No Range Given in Reference Method)**Special Instructions:**

1. *Store samples in refrigerator.*
 2. *Ship samples frozen on dry ice.*
 3. *Stable 17 days at refrigerated temperature.*
-

METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE) - SEE "HALOGENATED HYDROCARBONS"**METHYLENE BISPHENYL ISOCYANATE (MDI) - SEE "DIISOCYANATES"****METHYLENE DICHLORIDE - SEE DICHLOROMETHANE**

METHYL ETHYL KETONE (2-BUTANONE, MEK) [CAS # 78-93-3]**Test Codes:** 7115**Reference Method:** NIOSH 2500**Reporting Limit:** 4 µg/sample**Collection Media:** Solid Sorbent Tube [SKC 226-121 or equivalent]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.01-0.2**Air Collection Volume - Minimum-Maximum (L):** 0.25-12**Special Instructions:**

1. Ship samples cold via express delivery.
2. Store samples in a freezer.
3. MEK is stable at least 90 days at -0.5 °C.

METHYL ETHYL KETONE PEROXIDE - PLEASE CALL THE LS TECHNICAL CONSULTANT FOR INFORMATION

METHYL n-BUTYL KETONE (2-HEXANONE) [CAS # 591-78-6]**Test Code:** 5050**Reference Method:** NIOSH 1300, 4th Edition**Reporting Limit:** 20 µg/sample**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.01 – 0.2**Air Collection Volume - Minimum-Maximum (L):** 1 - 10**Special Instructions:** *Sample stability unknown.*

METHYL ISOAMYL KETONE (MIAK, 5-METHYL-2HEXANONE) [CAS # 110-12-3]**Test Code:** 5151**Reference Method:** Modified NIOSH 1300, 4th Edition**Reporting Limit:** 20 µg/sample**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.01-0.2**Air Collection Volume - Minimum-Maximum (L):** 1-10**Special Instructions:** *None*

METHYL ISOBUTYL KETONE (MIBK) [CAS # 108-10-1]**Test Codes:** 5051**Reference Method:** NIOSH 1300, 4th Edition

METHYL ISOBUTYL KETONE (MIBK) [CAS # 108-10-1] (CONTINUED)

Reporting Limit: 20 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

Air Collection Volume - Minimum-Maximum (L): 1-10

Special Instructions: *None*

METHYL METHACRYLATE [CAS # 80-62-6]

Test Codes: 7198

Reference Method: NIOSH 2537, 4th Edition

Reporting Limit: 20 µg/sample

Collection Media: Solid Sorbent Tube [XAD-2, 400 mg/200 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.05

Air Collection Volume - Minimum-Maximum (L): 1-8

Special Instructions:

1. *Store frozen.*
 2. *Ship sample frozen in dry ice or at 4 °C or lower.*
 3. *Samples stable greater than seven days at 25 °C; greater than 32 days at 4 °C.*
-

2-METHYL-2-PROPANOL - SEE TERT-BUTYL ALCOHOL

MIAK - SEE METHYL ISOAMYL KETONE, (5-METHYL-2-HEXANONE)

MIBK - SEE METHYL ISOBUTYL KETONE

MINERAL OIL (SPIRITS) – SEE “NAPHTHAS”

MOLYBDENUM - SEE “METALS”

NAPHTHALENE [CAS # 91-20-3]

Test Code: 5156

Reference Method: NIOSH 1501, 4th Edition

Reporting Limit: 20 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): Equal to or Less Than 1.0

Air Collection Volume - Minimum-Maximum (L): 100-200

Special Instructions: *None*

NAPHTHAS

Naphtha	CAS Number	Test Codes
Fuel Oil #2	68476-30-2	7151
Gasoline	8006-61-9	5172/7213
JP-4	94742-47-9	To be assigned
JP-8	See Kerosene	5054
Kerosene	8008-20-6	5054
Mineral Oil	8052-41-3	To be assigned
Petroleum Distillates		5167
Petroleum Naphtha	8002-05-9	7152
Stoddard Solvent	8052-41-3	7150
VM&P Naphtha	8032-32-4	7203

Test Codes: See Table above

Reference Method: NIOSH 1550, 4th Edition

Reporting Limit: 100 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

Air Collection Volume - Minimum-Maximum (L): 1.3-20

Special Instructions:

1. A small bulk sample (5 to 10 mL) is required. The bulk sample must be shipped in a separate container to avoid contamination of sample tubes.
2. Stable at least 1 week at 25 °C.

NICKEL - SEE "METALS"

NITRIC ACID (HNO₃) -- SEE "ACID GASES"

NITROUS OXIDE - PLEASE CALL THE LS TECHNICAL CONSULTANT FOR INFORMATION

NITROGLYCERIN (NG) [CAS # 55-63-00]

Test Code: 5020

Reference Method: NIOSH 2507, 4th Edition

Reporting Limit: 0.1 µg/sample

Collection Media: Solid Sorbent Tube [Tenax-GC, 100/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.2-1.0

Air Collection Volume - Minimum-Maximum (L): 3-100

Special Instructions: Stable at least 25 days at 25 °C.

OCTACHLOR - SEE CHLORDANE

OIL MIST**TEST CODE:** 7106**Reference Method:** Modified NIOSH 0500, 4th Edition

(Note: This analysis is performed gravimetrically.)

Reporting Limit: 100 µg/sample**Collection Media:** Filter [Teflon tared membrane, 5 micron, closed-face]**Sample Flow Rate - Minimum-Maximum (LPM):** 1 - 2**Air Collection Volume - Minimum-Maximum (L):** 7 - 133**Special Instructions:** *None***ORGANOPHOSPHORUS PESTICIDES (OP)****INCLUDES: CHLORPYRIFOS (DURSBAN), DIAZINON, DICHLORVOS (DDVP), MALATHION, AND PARATHION**

Pesticide	CAS Number	Test Code	Reporting Limit (µg /sample)	Air Collection Volume (L)
Chlorpyrifos	2921-88-2	To be assigned	1.6	480
Diazinon	333-41-5	To be assigned	1.5	480
Dichlorvos	62-73-7	To be assigned	0.9	480
Malathion	121-75-5	To be assigned	1.8	60
Parathion	56-38-2	To be assigned	1.5	480

Reference Method: OSHA 62**Collection Media:** Filter AND Solid Sorbent Tube [13 mm, Glass fiber filter and XAD-2, 270/140 mg]**Sample Flow Rate (LPM):** 1.0 for All Parameters

(No Range Given in Reference Method)

(No Range Given in Reference Method)

Special Instructions: *None***OZONE [CAS # 10028-15-6]****Test Code:** 7209**Reference Method:** OSHA ID-214**Reporting Limit:** 5 µg/sample**Collection Media:** TWO Treated Filters, SKC-225-9014 or equivalent. Limited shelf-life (within 4 weeks of preparation)**Sample Flow Rate (LPM):** 0.25 - 0.5

OZONE [CAS # 10028-15-6] (CONTINUED)

Air Collection Volume (L): 90 (No Range Given in Reference Method)
Special Instructions: *None*

PAHs - SEE POLYNUCLEAR AROMATIC HYDROCARBONS

PARATHION - SEE "ORGANOPHOSPHORUS PESTICIDES"

PARTICULATES NOT OTHERWISE REGULATED (NOR), RESPIRABLE

Test Code: 7196
Reference Method: Modified NIOSH 0600, 4th Edition
Reporting Limit: 100 µg/sample
Collection Media: Cyclone and Filter [10-mm Aluminum Cyclone and Tared 5-micron PVC membrane]
Sample Flow Rate - Minimum-Maximum (LPM):
For Al Cyclone: 2.5 (No Range Given in Reference Method)
Air Collection Volume - Minimum-Maximum (L): 20-400
Special Instructions: *Sample stable indefinitely.*

PARTICULATES NOT OTHERWISE REGULATED (NOR), TOTAL

Test Code: 7197
Reference Method: Modified NIOSH 0500, 4th Edition
Reporting Limit: 100 µg/sample
Collection Media: Filter [Tared, 37-mm, 5 micron PVC membrane]
Sample Flow Rate - Minimum-Maximum (LPM): 1-2
Air Collection Volume - Minimum-Maximum (L): 7-133
Special Instructions:

1. *Each set of 10 samples should be accompanied by two field blanks.*
2. *Sample stable indefinitely.*

PCP - SEE PENTACHLOROPHENOL

PENTACHLOROPHENOL (PCP) [CAS # 87-86-5]

TEST CODE: To be assigned
Reference Method: OSHA 39
Reporting Limit: 2 µg/sample
Collection Media: Solid Sorbent Tubes [TWO XAD-7 Tubes in Series, each 175 mg AND one extra XAD-7 Tube, 175 mg; [SKC Catalog # 226-97]
Sample Flow Rate (LPM): 0.2 (No Range Given in Reference Method)

PENTACHLOROPHENOL (PCP) [CAS # 87-86-5] (CONTINUED)

Air Collection Volume (L): 48 (No Range Given in Reference Method)

Special Instructions: *Two tubes in series are used for sampling. After sampling, a third XAD-7 tube (which was not used in the sampling train) must be placed in front of the first sampling tube in the series. This third tube captures any PCP, which might volatilize from the front tube after sampling. Please contact the AIPH-LS IH Technical Consultant for additional guidance.*

N-PENTANE – SEE “HYDROCARBONS”

1,5-PENTANEDIAL - SEE GLUTARALDEHYDE

PETROLEUM DISTILLATES – SEE “NAPHTHAS”

PETROLEUM NAPHTHA – SEE “NAPHTHAS”

PHENOL [CAS # 108-95-2]

Test Code: 7225

Reference Method: Modified OSHA 32

Reporting Limit: 10 µg/sample

Collection Media: Solid Sorbent Tube [XAD-7 tube, 100/50 mg]

Sample Flow Rate (LPM): 0.1 (No Range Given in Reference Method)

Air Collection Volume (L): 24 (No Range Given in Reference Method)

Special Instructions: *None*

PHOSPHORIC ACID (H₃PO₄) - SEE “ACID GASES”

PHOSPHORUS, WHITE OR YELLOW [CAS # 7723-14-0]

Test Code: 5183

Reference Method: NIOSH 7905, 4th Edition

Reporting Limit: 0.05 µg/sample

Collection Media: Solid Sorbent Tube [Tenax-GC, 100/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

Air Collection Volume - Minimum-Maximum (L): 5-100

Special Instructions: *Stable at least 7 days at 25 °C.*

PNAS - SEE POLYNUCLEAR AROMATIC HYDROCARBONS

POLYNUCLEAR AROMATIC HYDROCARBONS [CAS #: VARIOUS]

Test Codes: 7371.

Reference Method: NIOSH 5506, 4th Edition

Reporting Limit: As low as possible

POLYNUCLEAR AROMATIC HYDROCARBONS [CAS #: VARIOUS] (CONTINUED)

Collection Media: Filter and Solid Sorbent Tube [37 mm PTFE, 2 micron AND XAD-2, 100 mg/50 mg]

Sample Flow Rate (LPM): 2 (No Range Given in Reference Method)

Air Collection Volume - Minimum-Maximum (L): 200-1000

Special Instructions:

1. *PTFE filter must be transferred to a glass vial after sampling.*
2. *Both the filter and tube should be wrapped in foil.*
3. *Store and ship samples frozen at 0 °C.*
4. *Each set of samples should be accompanied by 6 to 10 media blanks.*
5. *Sample stability unknown; protect from heat and ultraviolet light.*

POTASSIUM (HYDROXIDE) - SEE "ALKALINE DUSTS"

N-PROPANOL (N-PROPYL ALCOHOL) [CAS # 71-23-8]

Test Code: To be assigned.

Reference Method: NIOSH 1401, 4th Edition

Reporting Limit: 30 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

Air Collection Volume - Minimum -Maximum (L): 1-10

Special Instructions:

1. *Store in freezer and ship refrigerated.*
2. *Single analyte sample tube required.*

**Note: The analytical protocol for this contaminant requires the use of a modifier to the desorption solvent. Because of this requirement, use a separate sampling tube if other analyses are desired.*

3. *Sample stability unknown.*

2-PROPANOL (ISOPROPYL ALCOHOL, ISOPROPANOL) [CAS # 67-63-0]

Test Codes: 5163

Reference Method: NIOSH 1400, 4th Edition

Reporting Limit: 30 µg/sample

Collection Media: Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

Sample Flow Rate - Minimum-Maximum (LPM): 0.01-0.2

Air Collection Volume - Minimum -Maximum (L): 0.3-3

2-PROPANOL (ISOPROPYL ALCOHOL, ISOPROpanol) [CAS # 67-63-0] (CONTINUED)**Special Instructions:**

1. *Store in freezer and ship refrigerated.*
 2. *Sample stability unknown.*
-

RDX (CYCLONITE) [CAS # 121-82-4]**Test Code:** 5142**Reference Method:** OSHA 44 for Sampling Requirements
D516 for Sample Analysis**Reporting Limit:** 0.25 µg/sample**Collection Media:** Solid Sorbent Tube [Filter + Tenax-GC, ORBO 79 tube, or equivalent]**Sample Flow Rate (LPM):** 1.0 (No Range Given in Reference Method)**Air Collection Volume:** 60 (No Range Given in Reference Method)**Special Instructions:**

1. *The air sampling pump must be certified by NIOSH or MSHA as intrinsically safe for use in coal mines.*
 2. *Sample stable at least 19 days at ambient temperature.*
-

RESPIRABLE DUST, NUISANCE - SEE PARTICULATES NOR, RESPIRABLE**SELENIUM - SEE "METALS"****SEVOFLURANE - SEE "ANESTHETIC GASES"**

SILICA-CRYSTALLINE, RESPIRABLE [CAS # 7631-86-9]**Test Code:** 7218**Reference Method:** NIOSH 7500, 4th Edition**Reporting Limit:** 10 µg/sample**Collection Media and Flowrate:** Cyclone and Filter [Tared 5 micron PVC membrane]

Cyclones (see notes in Appendix E-6):

Dorr-Oliver 10-mm nylon cyclone @ 1.7 lpm

Higgins-Dewell (HD) cyclone @ 2.2 lpm

SKC Aluminum cyclone @ 2.5 lpm

BGI GK 2.69 cyclone @ 4.2 lpm

Air Collection Volume - Minimum-Maximum (L): 400-1000**Special Instructions:** *Blanks should accompany samples at a 10 percent frequency rate.*

SILICA-CRYSTALLINE, TOTAL [CAS # 7631-86-9]**Test Code:** 7217**Reference Method:** NIOSH 7500, 4th Edition**Reporting Limit:** 10 µg/sample**Collection Media and Flowrate:** Filter [Tared 5 micron PVC membrane]**Air Collection Volume - Minimum-Maximum (L):** 400-1000**Special Instructions:** *Blanks should accompany samples at a 10 percent frequency rate.*

SILVER [CAS # 7440-22-4]**Test Code:** To be assigned.**Reference Method:** OSHA ID-121**Reporting Limit:** 0.5 µg/sample**Collection Media:** Filter [0.8 micron CE membrane]**Sample Flow Rate - Minimum-Maximum (LPM):** 1.0-4.0**Air Collection Volume - Minimum-Maximum (L):** 250-2000**Special Instructions:** *This metal must be sampled separately. Provide one field blank and one media blank for each batch of 10 samples.*

SODIUM (HYDROXIDE) - SEE "ALKALINE DUSTS"

STODDARD SOLVENT - SEE "NAPHTHAS"

STYRENE - SEE "AROMATIC HYDROCARBONS"

SULFURIC ACID (H₂SO₄) - SEE "ACID GASES"

SUPRANE (DESFLURANE) - SEE "ANESTHETIC GASES"

TCE - SEE "HALOGENATED HYDROCARBONS" (TRICHLOROETHYLENE)

TDI - SEE "DIISOCYANATES"

1,1,2-TETRACHLOROETHANE - SEE "HALOGENATED HYDROCARBONS"

TETRACHLOROETHYLENE (PERCHLOROETHYLENE) - SEE "HALOGENATED HYDROCARBONS"

TETRAHYDROFURAN [CAS # 109-99-9]**Test Code:** To be assigned.**Reference Method:** NIOSH 1609, 4th Edition**Reporting Limit:** 100 µg/sample**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.01-0.2**Air Collection Volume - Minimum-Maximum (L):** 1-9**Special Instructions:** *Sample stability unknown.*

THALLIUM - SEE "METALS"

TIN [CAS# 7440-31-5]**Test Code:** To be assigned.**Reference Method:** OSHA ID-121**Reporting Limit:** 3 µg/sample**Collection Media:** Filter [0.8 micron CE membrane]**Sample Flow Rate - Minimum-Maximum (LPM):** 1.0-4.0**Air Collection Volume - Minimum-Maximum (L):** 5-1000**Special Instructions:** *This metal must be sampled separately. Provide one field blank and one media blank for each batch of 10 samples.*

TITANIUM - SEE "METALS"

TNT - SEE 2,4,6-TRINITROTOLUENE

TOLUENE - SEE "AROMATIC HYDROCARBONS"

TOLUENE DIISOCYANATES (TDI) - SEE "DIISOCYANATES"

TOTAL DUST, NUISANCE - SEE PARTICULATES NOR, TOTAL

TOXICHLOR - SEE CHLORDANE

1,1,1-TRICHLOROETHANE - SEE "HALOGENATED HYDROCARBONS"

1,1,2-TRICHLOROETHANE - SEE "HALOGENATED HYDROCARBONS"

TRICHLOROETHENE (TRICHLOROETHYLENE) - SEE "HALOGENATED HYDROCARBONS"

TRICHLOROETHYLENE (TCE, TRICHLOROETHENE, ETHYLENE TRICHLORIDE) - SEE "HALOGENATED HYDROCARBONS"

2,4,6-TRINITROTOLUENE (TNT) [CAS # 118-96-7]**Test Code:** 5019**Reference Method:** OSHA 44 for Sampling Requirements,
D516 for Sample Analysis**Reporting Limit:** 0.05 µg/sample**Collection Media:** Solid Sorbent Tube [Filter + Tenax-GC, ORBO 79 tube, or equivalent]**Sample Flow Rate (LPM):** 1 (No Range Given in Reference Method)**Air Collection Volume (L):** 60 (No Range Given in Reference Method)**Special Instructions:**

1. *The air sampling pump must be certified by NIOSH or MSHA as intrinsically safe for use in coal mines.*
2. *Samples stable at least 19 days at ambient temperature.*

UNKNOWN, INDUSTRIAL HYGIENE ORGANICS: CONTACT THE IH TECHNICAL CONSULTANT FOR INFORMATION

VANADIUM - SEE "METALS"

VM&P NAPHTHA – SEE "NAPHTHAS"

WELDING FUMES, PROFILE

Metals: Aluminum, Cadmium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, Nickel, Zinc

Test Codes: Various (See individual metal)

Reference Method: Modified NIOSH 7300, 4th Edition

Reporting Limit: Varies by metal

Collection Media: Filter [0.8 micron CE membrane]

Sample Flow Rate - Minimum-Maximum (LPM): 1.0-4.0

Air Collection Volume - Minimum-Maximum (L): 5-2000

Special Instructions: *Provide one field blank and one media blank for each batch of 10 samples.*

WOOD ALCOHOL - SEE METHANOL

XYLENES - SEE "AROMATIC HYDROCARBONS"

ZINC - SEE "METALS"

APPENDIX C

OUTSIDE THE CONTINENTAL UNITED STATES SUPPORT SERVICES

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C-1. CUSTOMER SUPPORT SERVICES

Good lines of communication with customers offer the USAPHC laboratories the ability to respond to customer needs. Communication and interaction with the USAPHC laboratories should begin in the earliest stages of project planning and continue throughout the entire life of the project.

C-2. PROJECT COORDINATION INFORMATION

- A. THE PHCR-EUROPE.** The IH customers in Europe, Africa, and the Middle East should coordinate their sampling activities with the PHCR-EUROPE laboratory at the following addresses:

- (1) APO address—

CDR, PHCR-EUROPE
Department of Laboratory Sciences
ATTN: MCHB-AE-LS
CMR 402
APO AE 09180-3619

- (2) Commercial or civilian address—

PHCR-EUROPE
Department of Laboratory Sciences
ATTN: MCHB-AE-LS
Kirchberg Kaserne
Gebäude 3809, Raum 110
66849 Landstuhl
Germany

- (3) POC: Customer Support Division or CSD—

Telephone: DSN: 8-314-486-7052 or 486-8381 (alternate)
(Commercial or Civilian) 06371-86-7052/8381
(From CONUS) 011-49-6371-86-7052/8381

Fax: DSN: 8-314-486-7054 or 314-486-8788 (alternate)

E-mail: usachppmeur.dlshotline@amedd.army.mil

B. The PHCR–PACIFIC. The IH customers in Asia, Alaska, and Hawaii should coordinate their sampling activities with the PHCR–PACIFIC laboratory at the following addresses:

(1) APO address—

CDR PHCR–PACIFIC
Unit 45006 (MCHB-AJ-TL)
APO, AP 96343-5006

(2) Commercial or civilian address—

PHCR–PACIFIC
Bldg 715, Camp Zama
Zama-shi, Kanagawa-ken
T228-8920, Japan

(3) POC: Sample Coordination Office

Telephone: DSN: 8-315-263-8418
Commercial within Japan: 046-407-8418
Commercial from outside Japan: 011-81-46-407-8418

Fax: DSN: 8-315-263-8597
Commercial within Japan: 046-407-8597
Commercial from outside Japan: 011-81-46-407-8597

E-mail: PHCR-Pacific-EL-Customer-Support@AMEDD.ARMY.MIL

APPENDIX D

INFORMATION ABOUT INDUSTRIAL HYGIENE MONITORING SUPPLIES

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D-1. SUGGESTED SOURCES FOR INDUSTRIAL HYGIENE MONITORING SUPPLIES

The following list of suggested sources for IH monitoring supplies does not imply endorsement by the U.S. Army for these vendors or manufacturers but is intended only to offer assistance in finding appropriate sampling supplies.

ACE GLASS, INC.

P.O. Box 688
1430 Northwest Blvd.
Vineland, NJ 08361
(800) 223-4524
<http://www.aceglass.com>

FISHER SCIENTIFIC

Telephone: (800)-766-7000
<http://www.fishersci.com>

Fisher Scientific has multiple regional offices. Call the telephone number above to determine which regional office is best for you.

INDUSTRIAL HYGIENE NEWS BUYER'S GUIDE

Circulation Department
86502 Babcock Blvd.
Pittsburgh, PA 15237
(800)-245-3182
(412)-364-5366
<http://www.rimbach.com>

MILLIPORE CORPORATION

290 Concord Road
Billerica, MA 01821
(800) 225-1380
<http://www.millipore.com>

MINNESOTA MINING & MANUFACTURING COMPANY (3M)

Occupational Health & Safety Products
Division
3M Center, 235-2E-80
St. Paul, MN 55144
(800) 328-1667
<http://www.3m.com>

PALL LIFE SCIENCES (FORMERLY GELMAN)

600 South Wagner Road
Ann Arbor, MI 48103
(800) 645-5476
<http://www.pall.com>

SIGMA ALDRICH/SUPELCO, INC.

595 North Harrison Road
Bellefonte, PA 16823-0048
(800) 247-6628
<http://www.sigmaaldrich.com/supelco>

SKC, INC.

863 Valley View Road
Eighty Four, PA 15330-9614
(800) 752-8472
<http://www.skcinc.com>

VWR INTERNATIONAL

(800) 932-5000
1310 Goshen Way
West Chester, PA 19380
<http://www.vwr.com>

D-2. EXAMPLES OF ACCEPTABLE INDUSTRIAL HYGIENE MONITORING SUPPLIES

The following tables give examples of different types of monitoring supplies which are acceptable for use with the test methods used at USAPHC laboratories. The information in the tables, which gives product information and suggested sources, does not imply endorsements by the U.S. Army for these products but is intended only to offer assistance in finding appropriate sampling supplies.

TABLE D-1. FILTERS

SAMPLER TYPE	SIZE (mm)	POROSITY (microns)	SUGGESTED SOURCE	CATALOG NUMBER
Cellulose Ester (CE) (*Note: For Asbestos, use a 25-mm monitor with 50-mm conductive extension cowl.)	25	0.8	Pall/Gelman®	64677 (GN-4)
	25	0.8	Millipore®	AWWP-025-0000
	37	0.8	Pall/Gelman	64678 (GN-4)
	37	0.8	Millipore	AAWP-037-00
Glass Fiber (Type A/E) (For PCBs)	13	1	SKC	225-16
	37	1	Pall/Gelman	61652
Polymer of Tetrafluorethylene (PTFE) [Zeflour]- for PAH	37	2	Pall/Gelman	P5PJO37
PVC	37	5	Pall/Gelman	66467
Swinnex Cassette (for PCBs)	13	-	Millipore	SX00-013-00

Notes:

Gelman® is a registered trademark of Pall Corp.

Millipore® is a registered trademark of Millipore Filter Corp.

TABLE D-2. PASSIVE MONITORS

SAMPLER TYPE	SUGGESTED SOURCE	CATALOG NUMBER
Ethylene Oxide	3M Advanced Sensors	3551 (Monitor Only)
Organic Vapor Monitor (for Selected Solvents)	3M 3M	3500 3520 (with Backup Section)

TABLE D-3. SOLID SORBENT TUBES

SAMPLER TYPE	SIZE (mm)	SUGGESTED SOURCE	CATALOG NUMBER
Alumina	400/200	SKC	226-18
Carbon Bead, H ₂ SO ₄ -Treated (for Ammonia)	500/250	Sigma Aldrich	ORBO-77
Anasorb CSC, Coconut Charcoal (for Solvents)	100/50	SKC	226-01
Activated coconut charcoal	100/50	Sigma Aldrich	ORBO-32 small
Chromosorb 102 (for Pesticides)	66/33	SKC	226-49-102
Supelpak 20E	100/50	Sigma Aldrich	ORBO-42 large
Supelpak 20E	66/33	Sigma Aldrich	ORBO-42 small
Chromosorb-P, Coated with 5% Na ₂ CO ₃ (for Acids)	335-185	Sigma Aldrich	ORBO-70
Carboxen-564 (for Ethylene Oxide)	400/200	Sigma Aldrich	ORBO-78
Florisil	100/50	SKC	226-39
Silica Gel -2, 4-Dinitrophenyl hydrazine Treated – (for Formaldehyde)	300/150	SKC	226-119
Activated Silica Gel (for Inorganic Acids)	400/200	Sigma Aldrich	ORBO-53
High-Purity Silica Gel	400/200	SKC	226-10-03
Molecular Sieve –Triethanolamine Treated (for Nitrogen Dioxide)	400/200	SKC	226-40-02 (SP)
Supelpak 20U (for Polyaromatic Hydrocarbons)	100/50	Sigma Aldrich	ORBO-43
Silica Gel	520/260	SKC	226-15
Silica Gel, H ₂ SO ₄ Treated	200/100	SKC	226-10-06
Anasorb 747, KOH Treated - (for Sulfur Dioxide)	100/50	SKC	226-80
Tenax	100/50	SKC	226-35-03
Tenax with Built-in Filter	140/70	SKC	226-56
XAD-2	400/200	SKC	226-30-06

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APPENDIX E

PARTICLE SIZE-SELECTIVE SAMPLING FOR AIRBORNE PARTICULATE MATTER

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E-1. BACKGROUND

- A. Historically, particulates have been measured and expressed as "total particulates" or "total dust." Total particulates cover a wide range of particle sizes capable of being deposited in the various regions of the human respiratory tract from the nasal passages (the nasopharyngeal region) to the gas exchange area of the lung (the alveoli). Total particulates generally include particle sizes in the range of 1 μm to 50 μm aerodynamic equivalent diameter (AED), but particulates up to 100 μm in size typically collect in the nasal region. Particles of a size less than 1 μm tend not to be deposited in the lung as their small size keeps them airborne; they move in and out with the air.
- B. Particle size determines the deposition site within the respiratory tract and the subsequent health effect. In 1993, the ACGIH first recommended that particle-size selective TLVs be developed for inhalation hazards in the workplace. For those substances that have not been reviewed, the original label for particles/particulates (formerly considered "total dust") has been retained (for example, aluminum oxide, calcium sulfate, portland cement, and silicon). For substances that have been reviewed, the ACGIH now recommends that particle-size selective TLVs be expressed in three forms: inhalable, thoracic, and respirable. The criteria for particle size TLV classifications are shown in Table E-1.

TABLE E-1. THE ACGIH PARTICLE-SIZE CRITERIA FOR AIRBORNE PARTICULATE MATTER

PARTICULATE MASS	AED	HAZARDOUS DEPOSITION AREA	50% AED CUT POINT
Total	1 μm - 100 μm	Respiratory tract from nasal passages to the gas exchange region	100 μm
Inhalable	1 μm - 100 μm	Respiratory tract from nasal passages to the gas exchange region	100 μm
Thoracic	1 μm - 25 μm	Lung airways and gas exchange region	10 μm
Respirable	1 μm - 10 μm	Gas exchange region of lung	4 μm
	<1 μm	Tend not to be deposited in the lung	<1 μm

- C. It should be noted that the hazard potential of airborne particulate mass, solid particles or droplets is dependent on the mass concentration as well as the particle size.

E-2. INHALABLE PARTICULATE MASS

- A. Substances that have been reviewed by the ACGIH are now reported as "inhalable" where appropriate. Inhalable particulate mass are materials that are hazardous when deposited anywhere in the respiratory tract.

- B. These are particles having a 50 percent cut-point of 100 μm . Inhalable particulate mass standards (2011) are listed in Table E-2. The list includes numerous pesticides such as diazinon and malathion, materials such as mineral oil and carbon black, and some metal compounds of manganese, molybdenum and nickel.

TABLE E-2. INHALABLE PARTICULATE MASS STANDARDS (2011)

Item	Substance	CAS No.	TWA	STEL
I-1	Acrylamide	79-06-1	0.03 mg/m ³ (IFV)	
I-2	Alachlor	15792-60-8	1 mg/m ³ (IFV)	
I-3	Aldrin	309-00-2	0.05 mg/m ³ (IFV)	
I-4	Asphalt fume, as benzene soluble aerosol	8052-42-4	0.5 mg/m ³ (I)	
I-5	Azinphos-methyl	86-50-0	0.2 mg/m ³ (IFV)	
I-6	Benomyl	17804-35-2	1 mg/m ³	
I-7	Beryllium and compounds	7440-41-7	0.00005 mg/m ³ (I)	
I-9	Borate compounds, inorganic	Several	2 mg/m ³ (I)	6 mg/m ³ (I)
I-10	Butylated hydroxytoluene (BHT)	128-37-0	2 mg/m ³ (IFV)	
I-11	Calcium silicate, synthetic nonfibrous	1344-95-2	10 mg/m ³ (E)	
I-12	Calcium sulfate	Several	10 mg/m ³ (I)	
I-13	Caprolactam	105-60-2	5 mg/m ³ (IFV)	
I-14	Captan	133-06-2	5 mg/m ³ (I)	
I-15	Carbaryl	63-25-2	0.5 mg/m ³ (IFV)	
I-16	Carbofuran	1563-66-2	0.1 mg/m ³ (IFV)	
I-17	Carbon black	1333-86-4	3 mg/m ³ (I)	
I-18	Chlorpyrifos	2921-88-2	0.1 mg/m ³ (IFV)	
I-19	Citral	5392-40-5	5 ppm ^(IFV)	
I-20	Coumaphos	56-72-4	0.05 mg/m ³ (IFV)	
I-21	Cresol, all isomers	Several	20 mg/m ³ (IFV)	
I-22	Demeton	8065-48-3	0.05 mg/m ³ (IFV)	
I-23	Demeton-S-methyl	919-86-8	0.05 mg/m ³ (IFV)	
I-24	Diazinon	333-41-5	0.01 mg/m ³ (IFV)	
I-25	Dibutyl phosphate	107-66-4	5 mg/m ³ (IFV)	
I-26	2,2-Dichloropropionic acid	75-99-0	5 mg/m ³ (I)	
I-27	Dichlorvos (DDVP)	62-73-7	0.1 mg/m ³ (IFV)	
I-28	Dicrotophos	141-66-2	0.05 mg/m ³ (IFV)	
I-29	Dieldrin	60-57-1	0.1 mg/m ³ (IFV)	
I-30	Diesel fuel, as total hydrocarbons	Several	100 mg/m ³ (IFV)	
I-31	Diethanolamine	111-42-2	1 mg/m ³ (IFV)	
	Diethylene glycol monobutyl ether *	112-34-5	7 ppm ^(IFV)	

TABLE E-2. INHALABLE PARTICULATE MASS STANDARDS (2011) (CONTINUED)

Item	Substance	CAS No.	TWA	STEL
I-32	Dioxathion	78-34-2	0.1 mg/m ³ (IFV)	
I-33	Diquat (Inhalable)	Several	0.5 mg/m ³ (I)	
I-34	Disulfoton	298-04-4	0.05 mg/m ³ (IFV)	
I-35	Endosulfan	115-29-7	0.1 mg/m ³ (IFV)	
I-36	EPN	2104-64-5	0.1 mg/m ³ (I)	
I-37	Ethion	563-12-2	0.05 mg/m ³ (IFV)	
I-38	Ethylene glycol	107-21-1		C 100 mg/m ³ (H)
I-39	2-Ethylhexanoic acid	149-57-5	5 mg/m ³ (IFV)	
I-40	Fenamiphos	22224-92-6	0.05 mg/m ³ (IFV)	
I-41	Fensulfothion	115-90-2	0.01 mg/m ³ (IFV)	
I-42	Fenthion	55-38-9	0.05 mg/m ³ (IFV)	
I-43	Ferbam	14484-64-1	5 mg/m ³ (I)	
I-44	Flour dust	NA	0.5 mg/m ³ (I)	
I-45	Fonofos	944-22-9	0.01 mg/m ³ (IFV)	
I-46	Glyoxal	107-22-2	0.1 mg/m ³ (IFV)	
I-47	Hexahydrophthalic anhydride, All isomers	Several		C 0.005 mg/m ³ (IFV)
I-48	Iodine (and Iodides)	7553-56-2	0.01 ppm (IFV)	0.1 ppm (V) (Iodine)
I-49	Isobutyl nitrite	542-56-3		C 1 ppm (IFV)
I-50	Magnesium oxide	1309-48-4	10 mg/m ³ (I)	
I-51	Malathion	121-75-5	1 mg/m ³ (IFV)	
I-52	Maleic anhydride	108-31-6	0.01 mg/m ³ (IFV)	
I-53	Manganese, elemental and inorganic compounds, as Mn *	7439-96-5	0.2 mg/m ³ (I)	
I-54	Methyl demeton	8022-00-2	0.05 mg/m ³ (IFV)	
I-55	Methyl parathion	298-00-0	0.02 mg/m ³ (IFV)	
I-56	Mevinphos	7786-34-7	0.01 mg/m ³ (IFV)	
I-57	Mineral oil (used in metal working)	8012-95-1	0.2 mg/m ³ (I)	
I-58	Mineral oil (pure, highly refined)	8012-95-1	5 mg/m ³ (I)	
I-59	Molybdenum, metal and insoluble compounds	7439-98-7	10 mg/m ³ (I)	
I-60	Monochloroacetic acid	79-11-8	0.5 ppm (IFV)	
I-61	Monocrotophos	6923-22-4	0.05 mg/m ³ (IFV)	
I-62	Naled	300-76-5	0.1 mg/m ³ (IFV)	
I-63	Natural rubber latex, as inhalable allergenic proteins	9006-04-6	0.0001 mg/m ³ (I)	
I-64	Nickel, elemental	7440-02-0	1.5 mg/m ³ (I)	
I-65	Nickel, soluble inorganic compounds (NOS)	Several	0.1 mg/m ³ (I)	
I-66	Nickel, insoluble inorganic compounds (NOS)	Several	0.2 mg/m ³ (I)	
I-67	Nickel subsulfide, as Ni	12035-72-2	0.1 mg/m ³ (I)	
I-68	5-Nitro-o-toluidine	99-55-8	1 mg/m ³ (I)	
I-69	p,p'-Oxybis(benzenesulfonyl hydrazide)	80-51-3	0.1 mg/m ³ (I)	
I-70	Parathion	56-38-2	0.05 mg/m ³ (IFV)	

TABLE E-2. INHALABLE PARTICULATE MASS STANDARDS (2011) (CONTINUED)

Item	Substance	CAS No.	TWA	STEL
I-71	m-Phthalodinitrile	626-17-5	5 mg/m ³ (IFV)	
I-72	o-Phthalodinitrile *	91-15-6	1 mg/m ³ (IFV)	
I-73	Phorate	298-02-2	0.05 mg/m ³ (IFV)	
I-74	Piperazine and salts *	110-85-0	0.03 ppm ^(IFV)	
I-75	Ronnel	299-84-3	5 mg/m ³ (IFV)	
I-76	Silicon carbide, nonfibrous (inhalable)	409-21-2	10 mg/m ³ (I,E)	
I-77	Sulfotepp	3689-24-5	0.1 mg/m ³ (IFV)	
I-78	Sulprofos	35400-43-2	0.1 mg/m ³ (IFV)	
I-79	Synthetic vitreous fibers- continuous filament glass fibers	NA	5 mg/m ³ (I)	
I-80	Temephos	3383-96-8	1 mg/m ³ (IFV)	
I-81	Terbufos	13071-79-9	0.01 mg/m ³ (IFV)	
I-82	1,1,2,2-Tetrabromoethane	79-27-6	0.1 ppm ^(IFV)	
I-83	Tetraethyl pyrophosphate	107-49-3	0.01 mg/m ³ (IFV)	
I-84	Thallium and compounds	7440-28-0	0.02 mg/m ³ (IFV)	
I-85	4,4'-Thiobis(6-tert butyl-m-cresol)	96-69-5	0.02 mg/m ³ (IFV)	
I-86	Thiram	137-26-8	0.05 mg/m ³ (IFV)	
I-87	Toluene-2,4 or 2,6-diisocyanate *	Several	0.001 ppm ^(IFV)	0.003 ppm ^(IFV)
I-88	Trichlorphon	52-68-6	1 mg/m ³ (I)	
I-89	Trimellitic anhydride	552-30-7	0.0005 mg/m ³ (IFV)	0.002 mg/m ³ (IFV)
I-90	Vanadium pentoxide (as V)	1314-62-1	0.05 mg/m ³ (I)	
I-91	Wood dusts (Western red cedar)	NA	0.5 mg/m ³ (I)	
I-92	Wood dusts (all other species)	NA	1 mg/m ³ (I)	
I-93	Xylidine, mixed isomers	1330-73-8	0.5 ppm ^(IFV)	

Notes:

I - Inhalable Fraction

V - Vapor and Aerosol

IFV - Inhalable Fraction and Vapor

H - Aerosol only

C - Ceiling Limit

E - Particulate matter containing no asbestos and <1% crystalline silica

NA - Not Applicable

* - 2011 NIC Proposed Changes

E-3. THORACIC PARTICULATE MASS

Thoracic particulate mass are materials deposited anywhere within the lung airways and the gas-exchange region. These particles have a 50 percent cut-point of 10 μm . There are two thoracic particulate mass standards (2011)—cotton dust and sulfuric acid—listed below in Table E-3.

TABLE E-3. THORACIC PARTICULATE MASS STANDARDS (2011)

Item	Substance	CAS No.	TWA
1	Cotton dust, raw, untreated	Unspecified	0.1 mg/m ³
2	Sulfuric acid	7664-93-9	0.2 mg/m ³

E-4. RESPIRABLE PARTICULATE MASS

Respirable particulate mass are materials that are hazardous when deposited anywhere in the gas-exchange region of the lung. These particles have a 50 percent cut-point of 4 µm. Respirable particulate mass standards (2011) are listed in Table E-4.

TABLE E-4. RESPIRABLE PARTICULATE MASS STANDARDS (2011)

Item	Substance	CAS No.	TWA	STEL
R-1	Aluminum metal (and insoluble compounds)	7429-90-5	1 mg/m ³	
R-2	Cadmium and compounds, as Cd	7440-43-9	0.002 mg/m ³	
R-3	Coal dust-Anthracite	NA	0.4 mg/m ³	
R-4	Coal dust-Bituminous	NA	0.9 mg/m ³	
R-5	Diquat (Respirable)	Several	0.1 mg/m ³	
R-6	Gallium arsenide	1303-00-0	0.0003 mg/m ³	
R-7	Graphite (all forms except graphite fibers)	7782-42-5	2 mg/m ³	
R-8	Iron oxide	1309-37-1	5 mg/m ³	
R-9	Kaolin	1332-58-7	2 mg/m ³ (E)	
R-10	Manganese, elemental and inorganic compounds*	7439-96-5	0.02 mg/m ³	
R-11	Mica	12001-26-2	3 mg/m ³	
R-12	Molybdenum, soluble compounds	7439-98-7	0.5 mg/m ³	
R-13	Molybdenum, metal and insoluble compounds	7439-98-7	3 mg/m ³	
R-14	Paraquat, as the cation	4685-14-7	0.1 mg/m ³	
R-15	Portland cement	65997-15-1	1 mg/m ³ (E)	
R-16	Polyvinyl chloride (PVC)	9002-86-2	1 mg/m ³	
R-17	Silica, crystalline - Cristobalite	14464-46-1	0.025 mg/m ³	
R-18	Silica, crystalline - alpha Quartz	Several	0.025 mg/m ³	
R-19	Silicon carbide, nonfibrous (respirable)	409-21-2	3 mg/m ³ (E)	
R-20	Talc - containing no asbestos fibers **	14807-96-6	2 mg/m ³ (E)	
R-21	Vanadium pentoxide, dust and fume, as V ₂ O ₅	1314-62-1	0.05 mg/m ³	
R-22	Zinc oxide	1314-13-2	2 mg/m ³	10 mg/m ³

Notes:

^E - Particulate matter containing no asbestos and <1% crystalline silica

NA - Not Applicable

* - 2011 NIC Proposed Changes

E-5. SAMPLING PARTICULATE MASS WITH THE INSTITUTE OF OCCUPATIONAL MEDICINE SAMPLER

- A. A total particulate mass sample is usually collected on standard 37-mm PVC filters in a 3-stage cassette, using airflow in the range of 2 liters per minute (L/min). A respirable particulate mass sample is normally collected on a 37-mm PVC filter after the dust-laden air passes through a cyclone assembly (such as the Dorr-Oliver cyclone), which effectively removes particles exceeding 10 μm AED. The airflow used for collecting a respirable particulate mass sample with a Dorr-Oliver cyclone is 1.7 L/min.
- B. The patented (Patent No. 4,675,034) IOM Sampler (SKC #225-70A or equivalent), developed by J. H. Vincent and D. Mark at the Institute of Occupational Medicine (IOM) in Scotland, meets the ACGIH sampling criteria for inhalable particulate mass. The IOM Personal Inhalable Sampler is a conductive plastic sampling head that houses a reusable 25-mm filter cassette with specified filter for the collection of inhalable airborne particles. When attached to a personal sampling pump operating at 2 L/min and clipped near a worker's breathing zone, the IOM effectively traps particles up to 100 μm in aerodynamic diameter and closely simulates the manner in which airborne workplace particles are inhaled through the nose and mouth. Because both the cassette and the filter are pre- and post-weighed as a single unit, all particles collected (even larger ones) are included in the analysis. The cassette can be cleaned, reloaded with a new filter, and reused.

Using the IOM Inhalable Particle Sampler with a MultiDust™ foam disc and filter converts the IOM into a multipurpose personal particulate mass sampler, able to sample inhalable and respirable fractions individually or simultaneously. By inserting a MultiDust polyurethane foam disc of specific porosity into the inlet of the IOM cassette, respirable particles can be collected on the filter at the back of the cassette. The sample collected on the foam can be weighed with the filter for determination of the inhalable fraction. Analysis is gravimetric. The redesigned IOM Sampler provides optimum sampling with the MultiDust foam disc. *Only IOMs manufactured after June 2000 are suitable for MultiDust sampling.* (MultiDust™ is a trademark of SKC, Inc.)

***Note:** The MultiDust foam disc must be washed and sterilized with ultraviolet light, and the polycarbonate filter autoclaved before sampling. For optimum results, handle all components of the sampler and media with sterile gloves before and after sampling.

APPENDIX F

PASSIVE MONITOR METHODS

Table F-1 provides a listing of passive sampler methods currently in place in AIPH-LS. New methods are being added to the list on a continuing basis. These procedures are easily developed once the sampling need is identified. Coordinate specific requirements with the AIPH-LS Industrial Hygiene Laboratory Consultant.

TABLE F-1. PASSIVE MONITOR METHODS (2011)

ANALYTE	MEDIA	METHOD	TEST CODE
1,1,1-Trichloroethane	OVM-PS	NIOSH 1003	5100
1,4-Dichlorobenzene	OVM-PS	NIOSH 1003	5101
1-Butanol {n-Butylalcohol}	SKC PS 2	NIOSH 1401	5191
1-Butanol {n-Butylalcohol}	OVM-PS	NIOSH 1401	5204
1-Methoxy-2-propanol	OVM-PS	OSHA 99	7207
2-Butanone {MEK}	OVM-PS	NIOSH 1300	7205
2-Butanone {MEK}	OVM-PS	OSHA 1004	5169
2-Butanone {MEK}	SKC PS 2	OSHA 1004	5188
2-Heptanone	OVM-PS	NIOSH 1301	7208
2-Pentanone	OVM-PS	NIOSH 1300	5196
2-Pentanone	SKC PS 2	NIOSH 1300	5185
4-Methyl-2-pentanone {MIBK}	OVM-PS	NIOSH 1300	5145
4-Methyl-2-pentanone {MIBK}	SKC PS 2	NIOSH 1300	5187
Acetone	OVM-PS	NIOSH 1300	5146
Benzene	OVM-PS	NIOSH 1501	5106
Benzene	3M-3520	NIOSH 1501	5178
Bundle, Anesthetic Gases	3M-3500 Single Stage	OSHA 103	5149
Bundle, BTEX (3M-3520)	3M-3520	NIOSH 1501	5182
Bundle, BTEX (OVM)	OVM-PS	NIOSH 1501	5152
Bundle, OVM VOCs	OVM-PS	Several NIOSH	5112
Carbon tetrachloride	OVM-PS	NIOSH 1003	5102
Chlorobenzene	OVM-PS	NIOSH 1003	7224
Chloroform	OVM-PS	NIOSH 1003	5111
Decane	OVM-PS	NIOSH 1500	7226
Desflurane {Suprane}	3M-3500 Single Stage	OSHA 29/103	5069
Diacetone alcohol	OVM-PS	NIOSH 1402	7222
Ethyl acetate	OVM-PS	NIOSH 1457	5143
Ethylbenzene	OVM-PS	NIOSH 1501	5108
Ethylbenzene	3M-3520	NIOSH 1501	5179
Ethylbenzene	SKC PS 1	NIOSH 1501	5190

TABLE F-1. PASSIVE MONITOR METHODS (2011) (CONTINUED)

ANALYTE	MEDIA	METHOD	TEST CODE
Forane {Isoflurane}	OVM-PS	OSHA 103 Modified	7238
Forane {Isoflurane}	SKC OVM	OSHA 29/103	5168
Forane {Isoflurane}	3M-3500 Single Stage	OSHA 29/103	5068
Forane {Isoflurane}	3M-3520	OSHA 29/103	5176
Formaldehyde	AT571 Badge	NIOSH 2016	7228
Formaldehyde	SKC PPFS	NIOSH 3500	7245
Glutaraldehyde	SKC UME1	NIOSH 2016	7253
Glutaraldehyde	AT580	OSHA 64 Modified	7201
Hexane	OVM-PS	NIOSH 1500	5105
Isobutyl acetate	OVM-PS	NIOSH 1450	7243
Isopropyl alcohol	OVM-PS	NIOSH 1400	7223
Methyl acetate	OVM-PS	NIOSH 1458	7239
Methyl isoamyl ketone	OVM-PS	NIOSH 1300	5151
Methyl methacrylate	OVM-PS	NIOSH 2537	5184
Methylene chloride	SKC OVM	NIOSH 1005	5171
Naphtha VM&P	OVM-PS	NIOSH 1550	7203
Naphthalene	OVM-PS	NIOSH 1501	5194
n-Butyl acetate	OVM-PS	NIOSH 1450	5144
n-Butyl acetate	SKC PS 2	NIOSH 1450	5186
n-Butyl alcohol	OVM-PS	NIOSH 1401	7204
Nonane	OVM-PS	NIOSH 1500	7227
Octane	OVM-PS	NIOSH 1500	7256
o-Xylene	OVM-PS	NIOSH 1501	5175
Petroleum distillates	3M-3520	NIOSH 1550	5201
Petroleum distillates	OVM-PS	NIOSH 1550	5174
Sevoflurane	3M-3500 Single Stage	OSHA 29/103	5067
Stoddard solvent	OVM-PS	NIOSH 1550	5199
Styrene	OVM-PS	NIOSH 1501	5110
tert-Butyl acetate	OVM-PS	NIOSH 1450	7202
Tetrachloroethene {PCE}	OVM-PS	NIOSH 1003	5103
Toluene	OVM-PS	NIOSH 1501	5107
Toluene	3M-3520	NIOSH 1501	5179
Toluene	SKC PS 1	NIOSH 1501	5189
Total hydrocarbons	OVM-PS	NIOSH 1500	5177
Total hydrocarbons	3M-3520	NIOSH 1500	5154
Trichloroethene {TCE}	OVM-PS	NIOSH 1022	5104
Xylenes, total	OVM-PS	NIOSH 1501	5109
Xylenes, total	3M-3520	NIOSH 1501	5181

APPENDIX G

SAMPLE AIPH-LS DOCUMENTS

FIGURE G-1. LIDS 9, INDUSTRIAL HYGIENE SAMPLE SUBMISSION FORM

FIGURE G-2. LIDS 235, CHAIN-OF-CUSTODY RECORD

FIGURE G-3. LIDS 330, REQUEST FOR LABORATORY SERVICES

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<h2 style="margin: 0;">INDUSTRIAL HYGIENE SAMPLE SUBMISSION FORM</h2> <p style="margin: 0;"><i>(For use of this form, see USAPHC TG 141; the proponent is MCHB-IP-LC)</i></p>	<p style="margin: 0; font-size: small;">FOR LS USE ONLY</p> <p style="margin: 0;">Date Received: _____</p> <p style="margin: 0;">Date Accepted: _____</p> <p style="margin: 0;">Processor's Initials/Date: _____</p>
<p>SECTION A: GENERAL INFORMATION</p>	
<p>1. Is an MSDS Enclosed for Safety Information for Laboratory Personnel? Y (Yes) or N (No) (1 Character): <input type="checkbox"/></p> <p>2. Program Number, PHC ONLY (2 Characters): <input type="text"/> 3. Subjono (4 Characters): <input type="text"/></p>	
<p>POC Information:</p> <p>4. POC Name: <input type="text"/> <input type="text"/> <small>First Name Last Name</small></p> <p>5. Voice Phone Number (30 Characters Maximum): <input type="text"/></p> <p>6. Voice DSN (30 Characters Maximum): <input type="text"/></p> <p>7. Fax Number: (30 Characters Maximum): <input type="text"/></p> <p>8. E-mail Address (80 Characters Maximum): <input type="text"/></p> <p>9. Street (30 Characters Maximum): <input type="text"/></p> <p>10. City (20 Characters Maximum): <input type="text"/></p> <p>11. State (2 Characters Maximum): <input type="text"/></p> <p>12. Zip Code + 4 (9 Characters Maximum): <input type="text"/></p> <p>13. Country (30 Characters Maximum): <input type="text"/></p>	
<p>14. Name of Sampled Installation (50 Characters Maximum): <input type="text"/></p> <p>15. Associated Complaints/Investigative DOEHS & Comments to the Lab (Be Specific/State "NONE" if applicable) (255 Characters Max.):</p> <div style="border: 1px solid black; height: 40px; width: 100%;"></div>	
<p>16. Priority Requested: <input type="radio"/> Standard, <input type="radio"/> High, <input type="radio"/> Top (Standard: 14 calendar days, High: 7 calendar days, prior approval required; Top: 3 calendar days, prior approval required)</p> <p>17. Requested Due Date: <input type="text"/></p> <p>18. Was Project Coordinated w/LS? Y (Yes) or N (No) (1 Character): <input type="checkbox"/></p> <p>19. LS Technical Consultant Name (20 Characters Maximum): <input type="text"/> <input type="text"/> <small>First Name Last Name</small></p> <p>20. Sample Collector Name (20 Characters Maximum): <input type="text"/> <input type="text"/> <small>First Name Last Name</small></p> <p>21. Are there Bulk Samples?: Y (Yes) or N (No) (1 Character): <input type="checkbox"/></p> <p>22. Field ID of first Bulk Sample, if applicable (30 Characters Maximum): <input type="text"/></p> <p style="font-size: x-small;">Note: Bulk Samples Must Be Shipped in a Separate Container from Air Samples.</p> <p>23. Collection Method/Media/Lot Number (40 Characters Maximum): <input type="text"/></p> <p>24. Date Shipped (mm/dd/yyyy) (10 Characters): <input type="text"/></p>	
<p style="font-size: x-small;">LIDS 9 REV 2 NOV 11 Authorized: Chief, Client Services Division Page 1 of 3</p>	

FIGURE G-1. SAMPLE LIDS 9, INDUSTRIAL HYGIENE SAMPLE SUBMISSION FORM

SECTION D: CALIBRATION INFORMATION						
27. Calibrator's Name : <input style="width: 150px;" type="text"/> <input style="width: 150px;" type="text"/>						
<small>First Name</small> <small>Last Name</small>						
29. <small>Note: See TG 141, Chapter 2, Section 2-7f for Information on Sampling, Pump Flow Rate Calibrations and Reporting</small>						
a. Pump Serial #	b. Pre-Cal Result	c. Pre-Cal Date	d. Post-Use Result	e. Post-Use Date	f. Flow Rate (LPM)	g. Calibration Method
SECTION E: LOCATION AND OPERATION INFORMATION						
30. Building/Area (20 Characters Maximum): <input style="width: 150px;" type="text"/>						
31. Location Name (50 Characters Maximum): <input style="width: 350px;" type="text"/>						
32. Operation Name (50 Characters Maximum): <input style="width: 350px;" type="text"/>						
33. Operation Employee(s) Perform (255 Characters Maximum):						
34. Number of Persons Exposed (3 Characters Maximum): <input style="width: 50px;" type="text"/>						
35. Exposure Duration and Frequency:						
a. Minutes (4 Char.): <input style="width: 50px;" type="text"/>						
b. Time(s) per Day (4 Char.): <input style="width: 50px;" type="text"/>						
c. Total Minutes/Day (4 Char.): <input style="width: 50px;" type="text"/>						
d. Days/Week (1 Char.): <input style="width: 50px;" type="text"/>						
e. Days/Month (2 Char.): <input style="width: 50px;" type="text"/>						
f. Months/Year (2 Char.): <input style="width: 50px;" type="text"/>						
36. Source of Contaminant (255 Characters Maximum):						
SECTION F: FIELD NOTES/ADDITIONAL COMMENTS						
37. DOEHS Submitted?: Y (Yes) or N (No): <input style="width: 50px;" type="text"/>						
38. Field Notes/Comments:						
LIDS 9 REV 2 NOV 11 Authorized: Chief, Client Services Division Page 3 of 3						

FIGURE G-1. SAMPLE LIDS 9, INDUSTRIAL HYGIENE SAMPLE SUBMISSION FORM (CONTINUED)

Directions for the LIDS 9

[Back to LIDS 9](#)

Section A:

The new LIDS 9 version in section A works just like the previous version except for the dates entries. For items 17 and 24, click on the text of the item to pop up the calendar. Use the calendar to find the date you wish to set, once the date is chosen click on it and the calendar will go away and you will see the date selected in the textbox for that item. Item 23 is required, the form will not process unless you provide a value for "Collection Method".

Please pay attention to the items that have the * next to them. These are required fields and the form cannot be processed without them being filled out and some cases they require a proper format to be followed also beware of the field sizes. In order to prevent information from being truncated, make sure that the field size next to the item is followed.

Section B:

In Section B, please enter the appropriate data for columns of the table and then click the ADD button on the row to add the data to the table. If you need to edit the data, click edit for the row you wish to edit. An Update button along with a Cancel button appears, make the appropriate changes to fields you wish to edit and then when you are finish click the Update button and the data will be altered. You can add as many items to this table as needed.

Section C:

In Section C, please enter the appropriate data for columns of the table and then click the ADD button on the row to add the data to the table. Pay close attention to the date column. It follows a set format "dd/mm/yyyy" and it is required along with the field called "Field Sample". If you need to edit the data, click edit for the row you wish to edit. An Update button along with a Cancel button appears, make the appropriate changes to fields you wish to edit and then when you are finish click the Update button and the data will be altered. You can add as many items to this table as needed.

Section D:

In Section D, please pay attention to the size restrictions listed on all fields. Pay close attention to the date columns. They follow a set format "dd/mm/yyyy". If you need to edit the data, click edit for the row you wish to edit. An Update button along with a Cancel button appears, make the appropriate changes to fields you wish to edit and then when you are finish click the Update button and the data will be altered. You can add as many items to this table as needed.

Directions for the LIDS 9 (CONT)**Section E:**

In Section E, please enter the appropriate data while keeping the item's size restriction in mind. There are no required fields in this section.

Section F:

In Section F, there are only two data items to be concerned about. Please keep in mind the size restrictions of the "Field Notes" item. In order to submit the data, click the Submit button and if the fields of the form are properly filled out the form will be submitted for process. Someone from PHC will be back to you shortly with the status of your submission. You can "Print" your form if you wish by clicking on the print button.

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Guidance and Instructions for Filling out LIDS 235

Field Personnel: The sample collector is responsible for assuring that proper COC requirements are met during collection of environmental and occupational health sample(s). Field personnel have the responsibility to notify the laboratory prior to shipment that incoming samples are being submitted under COC. All actions associated with COC will be documented on COC documents in the field; information which is assigned to each field sample must include the following:

- Source/installation where sample was collected.
- Date and time of collection of field sample.
- Field assigned sample I.D. number.
- Analyses desired for sample.
- Sample collector's name.
- USAPHC Project Number (if applicable).
- Total number of containers per sample.
- Date of shipment of sample to laboratory.
- Method of shipment (e.g. UPS, Federal Express, hand delivered).
- Preservative used, if applicable.

When transferring the "possession" of the container to the next party, i.e. laboratory personnel, the transferring official will sign and record the date/time of transfer on the COC document(s) included with each group of sample(s) for each transportation container. The original COC document(s) must be placed in a sealed plastic bag to prevent wetting and placed inside the respective sample's shipping container. They must also write the name of the carrier (FedEx, UPS, etc) in the "Relinquished to" box of the COC. Transportation containers will then be sealed with tamper proof shipping tape and forwarded to the laboratory for subsequent analyses. This USAPHC COC document (LIDS 235) can also be viewed and obtained at the USAPHC public website @ <http://phc.amedd.army.mil/topics/labsciences/lsm/Pages/LIDS.aspx>

Lab Personnel: Unless hand carried, transportation containers must be shipped to the laboratory via common carrier (UPS, Federal Express, etc.). Common carriers should abide by Department of Transportation regulations governing shipment of COC sample(s). Upon receipt of containers from a common carrier or from the customer, COC shall be relinquished to the laboratory sample receiving area. Any evidence of tampering (e.g. breakage of seal) during shipment by common carrier must be documented upon receipt and inspection of transportation containers by sample receiving personnel during duty hours or by those individuals assigned such responsibility during non-duty hours. Responsible off-duty personnel shall follow guidelines of the non-duty sample receipt policy. As soon as sample(s) is/are transferred to analytical laboratory personnel, custody must be formally relinquished to them. If, for any reason, the chain is broken between transfer of sample(s) from field to sample receiving/responsible off-duty personnel, or from transfer of sample(s) from sample receiving/responsible off-duty personnel to the laboratory, a contingency plan will be implemented to determine cause of breakage of chain and to perform corrective action to reconstruct chain, if possible.

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FIGURE G-2. SAMPLE LIDS 235, CHAIN-OF-CUSTODY RECORD (CONTINUED)

<h2 style="margin: 0;">Request For Laboratory Services</h2> <p style="margin: 0;"><i>(For use of this form, see USAPHC TG 214; the proponent is MCHB-IP-LOD)</i></p>	
SECTION A: PROJECT INFORMATION	
1. Request submitted by (name):	<input style="width: 95%;" type="text"/>
2. Program number, PHC ONLY:	<input style="width: 30%;" type="text"/>
3. JONO:	<input style="width: 30%;" type="text"/>
4. SUBJONO:	<input style="width: 30%;" type="text"/>
5. Other fund source (if applicable):	<input style="width: 95%;" type="text"/>
Customer information:	
6. Project officer name:	<input style="width: 95%;" type="text"/>
7. Address:	<input style="width: 95%;" type="text"/>
8. Voice phone number:	<input style="width: 60%;" type="text"/>
9. Cell phone:	<input style="width: 60%;" type="text"/>
10. E-mail address:	<input style="width: 95%;" type="text"/>
11. Was project coordinated w/LS? Y (Yes) or N (No):	<input style="width: 20px;" type="checkbox"/>
12. LS Technical Consultant:	<input style="width: 95%;" type="text"/>
13. Date range that samples are expected to arrive at LS (dd/mm/yyyy):	<input style="width: 150px;" type="text"/> To <input style="width: 100px;" type="text"/>
14. Project name:	<input style="width: 95%;" type="text"/>
15. Project installation:	<input style="width: 95%;" type="text"/>
16. Installation State:	<input style="width: 30%;" type="text"/>
17. Installation country:	<input style="width: 60%;" type="text"/>
18. Special project criteria that need to be met:	
<input type="checkbox"/> a. Regulatory <input type="checkbox"/> b. Is there a project QAPP (please provide to Client Services Division POC)	
<input type="checkbox"/> c. Other special conditions:	
<input style="width: 95%; height: 30px;" type="text"/>	
19. Project description / objective:	<input style="width: 95%; height: 60px;" type="text"/>
20. Sample or site history (High concentrations, etc.):	<input style="width: 95%; height: 30px;" type="text"/>
<small>LIDS 330 REV 2 Dec 11 Authorized: Chief, Client Services Division Page 1 of 4</small>	

FIGURE G-3. SAMPLE LIDS 330, REQUEST FOR LABORATORY SERVICES

SECTION B: PROJECT COORDINATION INFORMATION	
21. Are sampling kits/ supplies needed? <input type="radio"/> No <input type="radio"/> Yes	22. Date the kit/supplies are requested by (dd/mmm/yyyy): <input style="width: 100%;" type="text"/>
23. Kit handling preference: <input type="radio"/> Pick-Up <input type="radio"/> Ship	
Kit shipping address Information:	
24. Name: <input style="width: 90%;" type="text"/>	
25. Address: <input style="width: 90%;" type="text"/>	
<input style="width: 90%;" type="text"/>	
<input style="width: 90%;" type="text"/>	
26. Voice phone number: <input style="width: 50%;" type="text"/>	
27. Number of coolers requested: <input style="width: 50%;" type="text"/>	
28. Expected number of shipments: <input style="width: 50%;" type="text"/>	
Special Project Requirements:	
29. <input type="checkbox"/> Chain-Of-Custody	
30. <input type="checkbox"/> Safety considerations	Specify: <input style="width: 90%;" type="text"/>
31. <input type="checkbox"/> Analyses with short holding times	
List specific analyses: <input style="width: 90%;" type="text"/>	
32. Will samples contain residual chlorine? <input type="checkbox"/> All <input type="checkbox"/> None	
<input type="checkbox"/> Some Explain: <input style="width: 90%;" type="text"/>	
33. Number of VOC trip blanks required: <input style="width: 50%;" type="text"/>	
34. Other special handling requirements: <input style="width: 90%;" type="text"/>	
SECTION C: REPORT DELIVERY	
35. All results will be delivered by e-mail. The e-mail will contain the final report and associated electronic data deliverables (EDDs).	
36. Additional e-mail addresses (if different than e-mail address in item 10):	
Note: The report will be addressed to the project officer. If any others are to receive the report via e-mail, please list their contact information here (at least e-mail, name and address).	
<input style="width: 90%; height: 40px;" type="text"/>	
LIDS 330 REV 2 DEC 11 Authorized: Chief, Client Services Division Page 2 of 4	

FIGURE G-3. SAMPLE LIDS 330, REQUEST FOR LABORATORY SERVICES (CONTINUED)

**SECTION F: INSTRUCTIONS FOR COMPLETING A REQUEST FOR LABORATORY SERVICES
(IF CLARIFICATION NEEDED)**

Section 2. Program number: Internal PHC-AIPH customers should list the program number with which the project is associated. External PHC-AIPH customers list program number as 00.

Section 3. JONO: An internal PHC-AIPH Accounting Number. For internal PHC-AIPH customers, indicate the SUBJONO assigned to your project. PHC-AIPH external customers use X7G003.

Section 4. SUBJONO: An internal PHC-AIPH Project Job Number. For internal PHC-AIPH customers, indicate the SubJono assigned to your project for laboratory analysis. PHC-AIPH external customers use 1236.

Section 5. Other fund source: (If not identified in JONO, SUBJONO).

Section 13. Date range that samples are expected to arrive At LS: List the date (dd/mmm/yyyy - 12 Dec 2000) you expect LS to receive your samples. Note: Prior arrangements must be made with LS-SML for sample delivery outside of the routine (M-F, 0730-1600hrs) duty hours. This requirement includes weekend and holiday deliveries.

Section 14. Project name: List the name of project as referred to in your project plan.

Section 15. Project installation: The installation or site where sampling is occurring.

Section 19. Project description/objective: Write a brief description of the primary project objective. Indicate whether the samples are being analyzed for screening, monitoring, regulatory compliance, or health concern purposes.

Section 20. Sample or site history: Write a brief statement indicating any pertinent sample or site histories that LS staff members should be aware of when analyzing the samples.

Section 23. Kit handling preference: Indicate whether the sample containers will be picked-up or request that LS ship sample containers to a specific location. If selecting the shipping option provide address (no P.O. Boxes) and a telephone number at the shipping destination.

Section 27. Number of coolers requested: Indicate the number of cooler(s) that need to be shipped by LS to the project site.

Section 28. Expected number of shipments: Indicate the number of sample shipments planned to the laboratory (include direct shipment to LS contract labs).

Section 29. Chain-of-Custody (COC): Check here if project requires COC. COC is legal documentation of the possession and handling of a sample from the time of collection until final disposition.

Section 30. Safety considerations: Briefly list the known associated hazardous and safety requirements for the samples. If available, provide LS with an MSDS on the samples (e.g., see MSDS, use Personal Protective Equipment (PPE) when handling samples, etc.).

Section 31. Analyses with short holding times: List the analysis(es) that have less than 7 days holding times (e.g., BOD, Conductivity, pH; Encore Samples, Coliform, etc.). Holding time is the elapsed time from the date of sample collection until the initiation of the analytical procedure.

Section 32. Will samples contain residual chlorine? Drinking water samples, for example, usually contain residual chlorine. Please specify.

Section 33. Note: Volatile organic compound analyses require that trip blanks be included in the sample kit. If applicable, list the number required.

Section 34. Other special handling requirements: In addition to those described above.

Section 36. Additional e-mail addresses: (If different than, or in addition to e-mail address in item 10). Note that the report will be sent to the project officer. If any others are to receive the report via e-mail, please list their e-mail information here.

Section 37. Priority requested: Select the priority you would like for your project. Note: Turn-around-time is calculated using calendar days from date of sample receipt at the laboratory. Samples are routinely processed as Standard Priority. High-Priority and Top Priority requests require coordination with LS and are subject to surcharges. Requesting a nonstandard due date requires pre-approval, and a surcharge may be applied.

Section 38. Analytical request table: List in the table the analysis(es) requested for the project. If more than 25 analyses will be requested, reuse page 3.

- a. LS Acode (optional) - LS analytical procedure code (if known).
- b. Analyte/Parameter - Analysis name or abbreviation (e.g., Turbidity, VOCs, Lead, etc.).
- c. Method - List the standard method number (e.g., NIOSH 1501, EPA 200.7, ASTM 1613, etc.).
- d. Matrix - The predominant material of which the sample to be analyzed (e.g., Drinking Water (D), Water (W), Waste Water (WW), Soil/Sediment/Sludge (S), Air (A), Bulk (B), Wipe (WI), Biological Liquid (BL), Biological Solid (BS), Paint Chip (P), Oil (O), Metal Fragment (F), etc.).
- e. Quantity - The number of samples to be analyzed for each method and matrix.
- f. Comments - List any specific special comments or special supplies needed for each method and matrix (e.g., blanks, extra containers, preservatives forms etc.). List individual metals here.

FIGURE G-3. SAMPLE LIDS 330, REQUEST FOR LABORATORY SERVICES (CONTINUED)

GLOSSARY**SECTION-I.
ABBREVIATIONS**

A2LA	American Association for Laboratory Accreditation
ACGIH	American Conference of Governmental Industrial Hygienists
AED	Aerodynamic equivalent diameter
AEL	Airborne Exposure Limit
AIHA	American Industrial Hygiene Association
AIPH	Army Institute of Public Health
APG	Aberdeen Proving Ground
BEI	Biological Exposure Indices
C	Ceiling Level
°C	degrees Celsius
CAS	Chemical Abstracts Service
cc	cubic centimeter
CE	Cellulose ester
CFR	Code of Federal Regulations
COC	Chain of custody
CONUS	Continental United States
CV	Coefficient of variation
DA	Department of the Army
DHEW	Department of Health, Education, and Welfare
DHHS	Department of Health and Human Services
DLS	Directorate of Laboratory Sciences (formerly)
DoD	Department of Defense
DOT	Department of Transportation
DSA	Direct Support Activity
EL	Excursion Limit
ETO	Ethylene oxide
FedEx	Federal Express
F/cc	Fibers per cubic centimeter
F/mm ²	Fibers per square millimeter
GF	Glass fiber

Hg	Mercury
IABC	Impregnated activated beaded carbon
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ID	Identification
IH	Industrial Hygiene/Hygienist
IOM	Institute of Occupational Medicine
ISO	International Organization of Standards
L	Liters
LIDS	Laboratory Information Documentation System
LIMS	Laboratory Information Management System
L/min	Liters per minute
LPM	Liters per minute
LS	Laboratory Sciences
LSP	Laboratory Sciences Portfolio
µg	microgram
MCE	mixed cellulose ester
mg	milligram
mg/L	milligrams per Liter
mg/m ³	milligram per cubic meter
mm	millimeters
mm ²	millimeters squared
MIDI	Military Item Disposal Instruction
min	minute
MSDS	Material Safety Data Sheets
MSHA	Mine Safety and Health Administration
MW	Molecular Weight
Na	Sodium
NaOH	Sodium Hydroxide
NI-CAD	Nickel-cadmium
NIOSH	National Institute for Occupational Safety and Health
NSN	National Stock Number
NTP	Normal temperature and pressure
OCONUS	Outside Continental United States
OEL	Occupational Exposure Limit
OSHA	Occupational Safety and Health Administration

PC	Polycarbonate
P&CAM	Physical and Chemical Analytical Methods from NIOSH Manual of Analytical Methods, 4 th Edition
PCB	Polychlorinated biphenyls
PE	Performance evaluation
PEL	Permissible Exposure Limit
PEL-C	Permissible Exposure Limit-Ceiling
PEL-STEL	Permissible Exposure Limit-Short Term Exposure Limit
PEL-TWA	Permissible Exposure Limit-Time Weighted Average
PM	Particulate Matter
POC	Point of contact
ppm	Parts per million
PTFE	Polymer of tetrafluoroethylene
PVC	Polyvinyl Chloride
QA	Quality assurance
QC	Quality control
STEL	Short-Term Exposure Limit
STP	Standard temperature and pressure
TAT	Turnaround time
TEA-IMS	Triethanolamine-impregnated molecular sieve
TG	Technical Guide
TLV	Threshold Limit Value
TLV-C	Threshold Limit Value-Ceiling
TLV-STEL	Threshold Limit Value-Short Term Exposure Limit
TLV-TWA	Threshold Limit Value-Time Weighted Average
TWA	Time-Weighted Average
UPS	United Parcel Service
USAPHC	U.S. Army Public Health Command
USEPA	U.S. Environmental Protection Agency

**SECTION-II.
TERMS****Air Collection Volume (in Liters)**

The recommended volume of air in liters to be collected for each sample. The value is based on the reference method. In most cases a range for minimum and maximum accepted volumes are given.

Action Level

A substance-specific exposure level applicable to certain OSHA regulated substances whereby certain actions are required (for example, air sampling, employee training, medical monitoring, and record keeping). Where there is a substance-specific OSHA standard, consult the appropriate standard for exact requirements.

Analyte

The element or compound an analyst seeks to determine or measure; the compound of interest.

Batch

A group of samples prepared at the same time in the same location using the same method.

Ceiling (C) Level

A contaminant concentration that should not be exceeded during any part of the working exposure.

Chain-of-Custody (COC)

Legal documentation of the possession and handling of a sample from the time of collection until final disposition.

Code of Federal Regulations (CFR)

A codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government.

Collection Media

The filter, solid sorbent, tube, or liquid specified for sampling.

Duplicate Samples

Samples collected simultaneously from the same source, under identical conditions, into separate containers. They are analyzed independently.

Excursion Limit (EL)

In health and safety regulations, the maximum exposure an individual may have over a short

period (usually 30 minutes), as opposed to a Short Term Exposure Limit (STEL), which has shorter averaging period. For substances that have an 8-hour TWA, but no STEL, excursions in worker exposure levels may exceed 3 times the 8-hour TWA for no more than a total of 30 minutes during a work day, and under no circumstances should exceed 5 times the 8-hour TWA.

Field Blanks

Quality control samples introduced into the sampling process to detect contamination that can occur during shipping and storage. Field blanks are required for every type of collection media. They must always be from the same lot number as the sample tubes, filters, or monitors used for sampling. If more than one lot number is used for sampling, then blanks from each lot number are required. Field blanks are created exactly like “normal” samples except they are only opened briefly in the field, and they do not have air pumped through them.

Hazardous Material

Any substance having the potential to cause a physical or health hazard. This is based on its potential for burning, exploding, or otherwise causing an injury to workers or the likelihood that exposure will result in acute or chronic health effects among employees.

Limit of Detection (LOD)

The lowest concentration level (of a contaminant) that can be determined to be statistically different from zero concentration (a blank). The LOD is defined as 3 times the standard deviation and is approximately equal to the Method Detection Limit, which is a more commonly used name. It can refer to the analytical measurement only or to the entire sampling and analytical measurement method. LOD is the commonly used expression in NIOSH methods to report the expected analytical method sensitivity. This guide uses reporting level in lieu of LOD to report actual method sensitivity.

Limit of Quantification (LOQ)

The constituent concentration that produces a signal sufficiently greater than the blank that it can be detected with the specified limits by good laboratories during routine operating conditions. Typically, it is the concentration that produces a signal 10 times the standard deviation above the blank sample. The concentration above which quantitative results may be obtained with a specific degree of confidence. It is approximately equal to the Method Reporting Limit or Reporting Limit, which are more frequently used names.

Matrix

The predominant material of which the sample to be analyzed is composed. Matrix is not synonymous with phase (liquid or solid).

Material Safety Data Sheet (MSDS)

A concise, descriptive chemical data sheet that follows the guidelines established by OSHA. It serves as the basis for written hazard communication programs.

Media Blanks

Media blanks are quality control samples that are often necessary in addition to field blanks when adsorbent (or sorbent) collection media is used. They detect contaminants that may be in the sorbent and they may be needed as a reference in spectrophotometric methods. Media blanks must always be from the same lot number as the sample tubes or monitors used for sampling. If more than one lot number is used for sampling, then blanks from each lot number are required. The media blank is never opened until it is received by the laboratory for analysis.

Method Detection Limit (MDL)

The minimum concentration of a substance, when processed through the entire analytical method, that can be identified, measured, and reported with 99 percent confidence that the substance concentration is greater than zero. The MDL is usually determined from analysis of a sample in a given matrix containing the substance. A common procedure for determination of an MDL requires analysis of 7 replicate samples at a concentration that is 1 to 5 times the estimated MDL. The data from these 7 replicates are statistically treated to arrive at the method MDL by calculating the standard deviation of the 7 replicates and multiplying the standard deviation by 3.143 (the Students' t-value at the 99 percent confidence level for 7 replicates).

***Note:** Once the MDL is determined, the laboratory then uses that information to establish a Reporting Limit, a Practical Quantitation Limit, or an Estimated Quantitation Limit. There are other terms for this limit, including Limit of Quantification, Detection Limit, and Reportable Quantitation Limit. All of these terms are used interchangeably to refer to the lowest concentration of a measured contaminant that the laboratory will routinely report.

Occupational Exposure Limit (OEL)

A general term for the amount of a workplace health hazard that most workers can be exposed to without harming their health. There are different OELs for different workplace health hazards, such as the amount of a chemical in the air or the loudness of noise. OELs have many sources; among them are legal standards (i.e., set by OSHA), professional association guidelines (ACGIH) TLVs or German MAKs, and government recommendations (NIOSH Recommended Exposure Limits).

Permissible Exposure Limit (PEL)

A legally enforceable (in the U.S.) occupational exposure standard established by OSHA or by a state-run program accepted by OSHA. Most PELs are time-weighted average concentrations for a normal 8-hour workday and a 40-hour work week, which shall not be exceeded. However,

PELs may also be “Ceiling” values or “Excursion Limits.” PELs are accepted to be a concentration to which nearly all workers may be repeatedly exposed, day after day, over a working lifetime, without adverse effects.

Permissible Exposure Limit-Ceiling (PEL-C)

The employee’s exposure, which shall not be exceeded during any part of the workday. If instantaneous monitoring is not feasible, then the ceiling shall be assessed as a 15-minute TWA exposure, which shall not be exceeded at any time over a working day.

Permissible Exposure Limit-Short-Term Exposure Limit (PEL-STEL)

The employee’s 15-minute time weighted average exposure which shall not be exceeded at any time during a work day unless another time limit is specified in a parenthetical notation below the limit. If another time period is specified, the TWA exposure over that time period shall not be exceeded at any time during the working.

Permissible Exposure Limit-Time-Weighted Average (PEL-TWA)

The employee’s average airborne exposure in any 8-hour work shift of a 40-hour workweek which shall not be exceeded.

Preservation

Techniques that retard physical and/or chemical changes in a sample after it has been collected.

Quality Assurance (QA)

All planned and systematic actions necessary to ensure that the overall quality control program is being effectively implemented and that laboratory data are of the requisite accuracy.

Quality Control (QC)

A planned system of activities which provides a level of quality that meets the needs of users. It is also the process through which a laboratory measures its performance, compares its performance with standards, and acts on those differences.

Quality System

The organizational structure, responsibilities, procedures, activities, capabilities, and resources that together ensure that laboratory services satisfy data requirements.

Reporting Limit (RL) or Method Reporting Limit (MRL)

As used in this document, the lowest concentration of a contaminant that the laboratory will routinely report for all samples, barring sample-related interferences. It normally is set higher than the experimentally determined MDL. Laboratories must achieve an MDL for a contaminant, which is less than the RL since the MDL will vary somewhat, depending on the analyst, instrument, day, et cetera.

Sample Flow Rate (Liter/minute; LPM)

The recommended range in Liters of air per minute (LPM), which can be used in collection of the sample. After selection of the sampling flow rate, the appropriate sampling time can be determined by dividing the recommended collection volume by the sampling rate.

Sample Set

One or more samples that are collected and submitted for analysis at the same time for the same contaminant(s). A sample set is also referred to as a sample batch.

Short-Term Exposure Limit (STEL)

A STEL is defined as a 15-minute TWA exposure which should not be exceeded at any time during a workday even if the 8-hour TWA is within the TLV-TWA. Exposure above the TLV-TWA up to the STEL should not be longer 15 minutes and should not occur more than four times per day. There should be at least 60 minutes between successive exposures in this range. An average period other than 15 minutes may be recommended when this is warranted by observed biological effects. The STEL is not an independent exposure limit, but rather supplements the 8-hour TWA in cases where there are recognized acute effects from a substance whose toxic effects are primarily chronic.

Threshold Limit Value (TLV)

TLVs are the most common type of OEL. The American Conference of Governmental Industrial Hygienists (ACGIH) sets the TLVs to help evaluate work-place health hazards. They are designed as guidelines to be used by industrial hygienists, and many workplace hazards including chemical, vibration, heat, ultraviolet light, etc.

Threshold Limit Value Excursion Limit

If the short-term exposure values in a given situation have a geometric standard deviation of 2.0, 5 percent of all values will exceed 3.13 times the geometric mean. If a process displays a variability greater than this, it is not under good control and efforts should be made to restore control. This concept is the basis for the following excursion limit recommendations which apply to those TLV-TWAs that do not have STELs.

Excursions in worker exposure levels may exceed 3 times the TLV-TWA for no more than a total of 30 minutes during a workday, and under no circumstances should they exceed 5 times the TLV-TWA, provided that the TLV-TWA is not exceeded.

The approach is a considerable simplification of the idea of the log-normal concentration distribution, but it is considered to be more convenient to use by the practicing industrial hygienist. If the exposure excursions are maintained within the recommended limits, the

geometric standard deviation of the concentrations will be near 2.0 and the goal of the recommendations will be accomplished. When the toxicological data for a specific substance are available to establish a STEL, this value takes precedence over the excursion limit, regardless of whether it is more or less stringent.

Threshold Limit Value-Ceiling (TLV-C)

The concentration that should not be exceeded during any part of the working exposure. In conventional industrial hygiene practice, if instantaneous monitoring is not feasible, then the TLV-C can be assessed by sampling over a 15-minute period except for those substances that may cause immediate irritation when exposures are short.

Threshold Limit Value-Short-Term Exposure Limit (TLV-STEL)

The concentration to which workers can be exposed continuously for a short period of time without suffering from: (1) irritation, (2) chronic or irreversible tissue damage, or (3) narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue, or materially reduce work efficiency, and provided that the daily TLV-TWA is not exceeded.

It is not a separate independent exposure limit; rather, it supplements the TWA limit where there are recognized acute effects from a substance whose toxic effects are primarily from a chronic nature. STELs are recommended only where toxic effects have been reported from high short-term exposures in either humans or animals.

Threshold Limit Value-Time-Weighted Average (TLV-TWA)

The time-weighted average concentration for conventional 8-hour workday and a 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

Torr

The pressure exerted by 1 mm of mercury. Standard atmospheric pressure is 760 torr

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