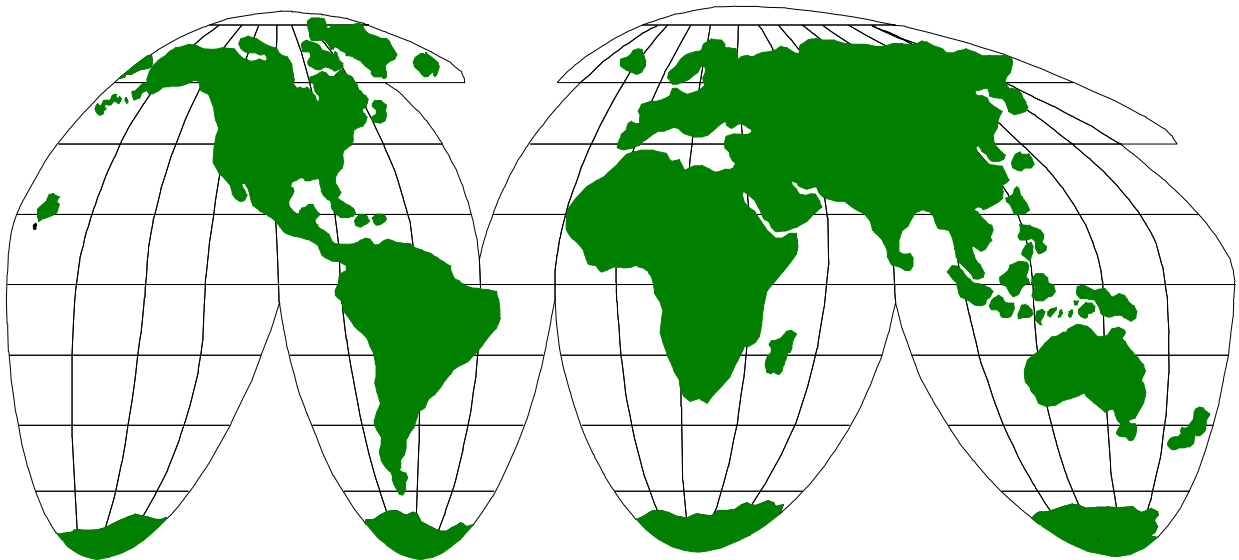


U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE

# INDUSTRIAL HYGIENE SAMPLING GUIDE




*Serving Our Customers Worldwide*

## TECHNICAL GUIDE 141



**February 2005**

## WAYS TO COMMUNICATE WITH DLS

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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 Center for Health Promotion and Preventive Medicine (USACHPPM) laboratories. The information provided describes—

- IH Air and Bulk Material Sample Collection.
- Factors to Consider Before Collecting Samples.
- Required USACHPPM Shipping Forms: USACHPPM Form 8-R-E, Bulk Sample Data; and USACHPPM Form 9-R-E, Industrial Hygiene Air Sample Data.
- Submission of IH Samples to USACHPPM laboratories, USACHPPM Form 330-R-E, Request for Laboratory Services.
- Chain-of-Custody Record, USACHPPM Form 235-R-E.
- Using the USACHPPM DLS-Main Laboratory Comment/Complaint Form.

#### 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 USACHPPM technical guides, and selected scientific publications.

#### 1-3. USACHPPM CONTINENTAL UNITED STATES (CONUS) CUSTOMER SUPPORT SERVICES AND IH PROCEDURE LIST

Appendix B contains two sections—

**Section B-1:** Gives information about the Customer Support Services available at the USACHPPM-Main CONUS laboratory.

**Section B-2:** Lists the USACHPPM CONUS Laboratory Sciences IH Test Procedures and gives specific information about the sampling, collection, and special handling requirements for each analyte.

**1-4. USACHPPM OUTSIDE OF THE CONTINENTAL UNITED STATES (OCONUS) CUSTOMER SUPPORT SERVICES**

Appendix C provides information for OCONUS support services.

**1-5. INFORMATION ABOUT IH MONITORING SUPPLIES**

Appendix D contains two sections—

**Section 1:** Gives 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 dust sampling.

**1-7. USACHPPM FORMS**

Appendix F provides examples of USACHPPM forms referenced in Section 1-1 and throughout this document. Reproducing these forms is permitted and encouraged.

**1-8. ABBREVIATIONS AND TERMS**

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

**1-9. QUALITY ASSURANCE (QA)****a. USACHPPM QUALITY SYSTEMS**

All USACHPPM 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 International Organization for Standardization (ISO). Check with the USACHPPM laboratory you plan to use about their current accreditation status. All USACHPPM laboratories are responsible for ensuring the quality of the work they perform.

**b. Contracted Laboratory Analyses**

(1) When any customer decides to send samples to a commercial contract laboratory



instead of a USACHPPM 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 minimize the possibility of its ability to perform quality work, not just because of the 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.* PE samples are 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 USACHPPM laboratories are given in the following places of this guide:

- The inside front cover.
- Chapter 5, Table 5-3.
- Appendix B, Section B-1.
- Appendix C, Section C-2.

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**CHAPTER 2****IH AIR AND BULK MATERIAL SAMPLE COLLECTION****2-1. GENERAL INFORMATION****a. USACHPPM IH PROCEDURE LISTS**

The IH Procedure List for the USACHPPM CONUS laboratory is in Appendix B, Section B-2 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 USACHPPM Laboratory 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 USEPA.
- The American Society for Testing and Materials (ASTM).
- Manufacturers of sampling media.
- Professional scientific publications.

**2-2. 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 USACHPPM 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 584-3502 or (410) 436-3502.
- c. For sampling and sample collection questions, contact the Division Chief, Radiologic, Classic, and Clinical Chemical Division at DSN 584-3983 or (410) 436-3983.

**2-3. SUBMISSION OF SWIPE, WIPE, AND SWAB SAMPLES**

Prior coordination with the USACHPPM laboratory where the samples are going to be analyzed is needed before these types of samples are submitted to the laboratory. Please contact the Industrial Hygiene Consultant in the Laboratory Consultants' Office at, commercial (410) 436-2637 or DSN 584-2637, for guidance before collecting these types of samples because—

- Specific and specialized types of wipes are needed for different test methods.
- Often the sample collecting material itself causes interferences during analysis, especially if the proper type of wipe has not been used.
- Recent developments in the National Lead Poisoning Prevention Program have provided new procedures for wipes and sample collection (OSHA Technical Manual TED 1-0.15A, Section II, Chapter 2; ASTM, 1995; ASTM, 1996).

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

- a. The sampling parameters recommended in the USACHPPM Laboratory 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<sup>®</sup>) parameter and two times the TLV parameter for most analytes.
- 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—

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TLV<sup>®</sup> is a registered trademark of the American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

- (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) Evaluate sampling plan to help ensure whenever possible that sample volumes based on the mass reporting limit of the method will be a sufficient volume 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 done 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.

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:

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

Where: RL = Analytical Reporting Limit (micrograms (µg))  
 E = Exposure Limit (milligram per cubic meter (mg/m<sup>3</sup>))  
 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% of the TLV, “0.1” would be used. The exposure limit is converted from mg/m<sup>3</sup> to milligram per liter (mg/L) by the conversion factor noted in the equation (1 m<sup>3</sup> = 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 <sup>3</sup>	
	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	* $\frac{1 \text{ mg}}{1000 \text{ } \mu\text{g}}$
				<hr/>
			5 mg	* 0.1 * $\frac{1 \text{ m}^3}{1000 \text{ Liters}}$
			$\text{m}^3$	<hr/>

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

**2-6. 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 than 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, 2004), and in the OSHA Technical Manual, Chapter 11-1 (OSHA, 1999).

**\*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 than 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 ( $\text{mg}/\text{m}^3$ ) to the PEL or the TLV.
- d. For gases and vapors, convert the mass per unit of actual volume ( $\text{mg}/\text{m}^3$ ) to parts per million (ppm) at NPT using the following formula, and compare this result to the PEL or TLV:

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

- 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:

$V_{\text{STP}}$	=	Volume of Air (in L) at Standard Temperature (25°C) and Pressure (760 millimeter (mm) of mercury (Hg))
$V_m$	=	Volume of Air (in L) collected at site
$P_{\text{bar}}$	=	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 ( $^{\circ}\text{C}$ ) at which the sample was collected

\* = Multiplication

For Example:	$V_{\text{STP}}$	=	<b>792 L</b>
When:	$V_m$	=	800 L
	$P_{\text{bar}}$	=	740 mm of Hg
	$P_w$	=	0 mg of Hg (Parameter Disregarded)
	T	=	$20^{\circ}\text{C}$
	*	=	Multiplication
	<b>792 L</b>	=	$800 \text{ L} * [(740 - 0)/760] * [298/(273 + 20)]$

## 2-7. 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 done 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 over estimation of the airborne concentration in the sampling environment.

**2-8. 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 one field blank must be submitted for every 10 samples from the same sampling series, or any fraction thereof, even if there is only one 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 ten.
  - (2) Always refer to the Special Instructions indicated for a specific analyte in the USACHPPM 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.

## **2-9. 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 USACHPPM 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 3 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.

## **2-10. ASBESTOS SAMPLING AND OPTIMAL FILTER LOADING FOR FIBER COUNT ANALYSIS BY PHASE CONTRAST MICROSCOPY**

### **a. OPTIMIZE THE SAMPLE FLOW RATE**

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/mm<sup>2</sup>) 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/mm<sup>2</sup>)
- 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 mm<sup>2</sup>)

For example:

	E	=	<b>102.3 f/mm<sup>2</sup></b>
When:	C	=	0.0511f/cc (fiber count result from past data)
	V	=	770.8 L
	Ac	=	385 mm <sup>2</sup>
	*	=	Multiplication
			0.0511 * 770.8 * 1000
	102.3 f/mm <sup>2</sup>	=	$\frac{\hspace{10em}}{385}$

**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/mm<sup>2</sup> can be calculated using the formula below. This range for fiber density allows for optimum accuracy when performing the fiber count. The OSHA PEL-TWA for asbestos is 0.1 f/cc as of the date of this publication (Federal Register, 1994; Federal Register, 1995).

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

Where:	t	=	Sampling Time (Minutes)
	Ac	=	Collection Area (A 25 mm filter has an effective collection area of 385 mm <sup>2</sup> )
	E	=	Fiber density (f/mm <sup>2</sup> )
	Q	=	Flow rate (LPM)
	C	=	Fiber concentration (f/cc)

For example:	t	=	<b>385.4 Minutes</b>
When:	Ac	=	385 mm <sup>2</sup>
	E	=	102.3 f/mm <sup>2</sup>
	Q	=	2 LPM
	C	=	0.0511 f/cc
	*	=	Multiplication
			385 * 102.3
			-----
			2 * 0.0511 * 1000
	<b>385.4 Minutes</b>	=	

**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 as of the date of this publication.

- (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), such as 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 <sup>2</sup>
16	0.1685	<7.0
100	0.0270	<7.0
300	0.0090	<7.0
1000	0.0027	<7.0

For a Graticule Area of 0.0080119 mm<sup>2</sup> and an effective Collection Area of 385 mm<sup>2</sup> 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.

## 2-11. 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 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 spectrophotometric techniques.

**b. DIFFERENT TYPES OF IH 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 USACHPPM 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, DUST, 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 <sup>3</sup> )
RR	=	Reported Result for Element (mg/m <sup>3</sup> )
MWC	=	Molecular Weight (MW) of Desired Compound

$$\text{MWE} = \frac{\text{Molecular Weight of Reported Element}}{\text{Element}}$$

For Example: To convert a Sodium (Na) result of 100 mg/m<sup>3</sup> to a comparable result for Sodium Hydroxide (NaOH) in mg/m<sup>3</sup>, 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)

#### 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 USACHPPM laboratory where the samples are going to be analyzed before collecting samples for multiple analytes.

#### f. SINGLE ANALYTE SAMPLING

The Special Instructions in the USACHPPM CONUS 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

- (1) There is a *potential* for erroneous trace element quantification when air samples are analyzed by NIOSH Method 7300 (NIOSH, 1994). This method determines trace elements by Inductively Coupled Plasma, Atomic Emission Spectroscopy (ICP-AES) using simultaneous (or scanning) elemental analysis that can determine up to 27 elements on one sample if needed.
  - (a) The method is subject to spectral interferences, which may cause a significant bias for a given sample or element.
  - (b) For example, if the spectral interferences are not known and the appropriate inter-elemental correction factors are not used during the analysis, the

results reported for a given element could be biased and lead to reporting erroneous data. The biased data can indicate either over or under exposure.

- (2) When submitting samples for trace element analysis to the laboratory, the industrial hygienist should alert the laboratory about the potential for spectral interferences by adding a note in the “Comments to Laboratory” block (Item 38) on USACHPPM Form 9-R-E. This comment should inform the laboratory of any elements suspected of being present in the sample(s) that are in addition to the specific elements requested for analysis in Section B, Analysis Information, of USACHPPM Form 9-R-E. When submitting samples, the industrial hygienist should consider the following factors:
  - (a) Interfering elements may be deposited on sampling filter media even when they are not included on the list of requested analytes. For instance, when a sample is analyzed for arsenic, aluminum can cause a positive interference if it is present in the sample. If the laboratory is made aware of the potential interfering elements, the spectral interferences can be eliminated by using the necessary inter-elemental correction factors.
  - (b) Inter-elemental correction factors are particularly important to use when analyzing for elements with very low airborne exposure limits (AELs) (such as, arsenic, cadmium, lead) where biases can have a significant impact on reported results.

## **2-12. 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. 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 USACHPPM Laboratory Procedure List



in 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 USACHPPM laboratory where the samples are going to be analyzed before collecting samples for multiple analytes.

**d. SINGLE ANALYTE SAMPLING**

The Special Instructions in the USACHPPM CONUS 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.

**2-13. IMPINGER SAMPLING**

**a. OVERVIEW**

- (1) In this guide and in the USACHPPM Laboratory IH Procedure List, impinger sampling generally indicates the use of midjet 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.

**b. SAMPLE TRANSFER AFTER COLLECTION**

Samples collected in glass fritted bubblers should be transferred to clean glass-stoppered bottles with Teflon<sup>®</sup>-lined caps. *Rinse the glass fritted bubblers* with a small amount of unused absorption solution and *add the rinse to the sample*.

**\*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.

**2-14. PASSIVE MONITORS**

**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.

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Teflon<sup>®</sup> is a registered trademark of E.I. DuPont de Nemours and Co., Wilmington, DE.

**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 USACHPPM laboratory where the samples are going to be analyzed before collecting samples for multiple analytes.

**d. SINGLE ANALYTE SAMPLING**

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

**e. ETHYLENE OXIDE (ETO) SAMPLE COLLECTION**

Passive monitors for organic solvent vapors shall not be used for ETO.

**2-15. 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) Databases for MSDS information may be accessed on the Internet through the DLS Home Page, <http://chppm-www.apgea.army.mil/dls/links.asp>.

- (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 in MSDS databases, or the MIDI, it may be necessary to obtain the MSDS for the product from the manufacturer. If, after review of the MSDS sample analysis is still required, include the MSDS when the samples are submitted for analysis.

## 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/77-173.html>. Questions concerning an individual analytical method's coefficient of variation should be directed to DLS-Main IH Technical Consultant.

## c. ARMY GUIDANCE FOR AIR EXPOSURE LIMITS

The Army's guidance, as specified in DA Pam 40-11, 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. The following website is available to review the assessment model:

<http://www.denix.osd.mil/denix/Public/News/Army/DOHP/Occhealth/Documents/IHEAM/ihasessmodelv8.html>

**3-2. INFORMATION ABOUT THE USACHPPM LABORATORY IH PROCEDURE LIST****a. CENTRALIZED SOURCE OF INFORMATION**

The USACHPPM Laboratory 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 USACHPPM laboratories.

**b. AVAILABLE TEST METHODOLOGIES**

The USACHPPM laboratories continually update the analyses available to IH customers. If the test methodology desired for a project is not on the USACHPPM Laboratory Procedure List, please contact the IH Consultant at DLS-Main 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. USACHPPM IH PROCEDURE LIST**

- (1) The CONUS Procedure List is Appendix B, Section 2 of this guide.
- (2) The OCONUS Procedure List can be found in the USACHPPM-EUR DLS Customer Guide at:  
<http://www.chppmeur.healthcare.hqusareur.army.mil/news/pubs.asp>
- (3) CONUS lists are available in electronic formats on the USA CHPPM DLS-Main Laboratory Home Page at: <http://chppm-www.apgea.army.mil/dls>.

**d. INFORMATION NOT CONTAINED IN USACHPPM IH PROCEDURE LIST—**

- (1) Pertinent references, such as the ACGIH publication on Threshold Limit Values and Biological Exposure Indices should be consulted for this information. (ACGIH, 2004)
- (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 DLS-Main.
- (3) DA Pam 40-11, *Preventive Medicine*, 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, 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 USACHPPM, 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 DLS TEST CODE

- a. ***What is the DLS Test Code?*** The DLS Test Code is a unique three- or four-digit number assigned by DLS-Main to each laboratory procedure used by the laboratories. This code applies only to those procedures performed at USACHPPM CONUS laboratories. It is indicated as the second item on the USACHPPM CONUS IH Procedure List.
- b. ***Why should the DLS Test Code be used?*** The DLS 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 DLS Test Code offers a unique means of differentiating between these test methods or the compound form, and clearly indicates to the personnel at the USACHPPM laboratories exactly what the customer wants and needs. The DLS Test Code is often the only unique identifying feature for each analyte listed.
- c. ***When should the DLS Test Code be selected and used?***
  - (1) The DLS Test Code should be selected by the customer at the same time the analyte to be tested is determined. The DLS-Main Laboratory IH Technical Consultant can assist customers in making their selection.
  - (2) The DLS Test Code should be used as a point of reference for customers and the DLS-Main laboratory in the communication and correspondence process associated with each project. Consistent use of a specific DLS 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 DLS sample

analysis priorities: Standard, High-priority, and Top-priority. Table 3-1 summarizes the guidelines for DLS 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 DLS-MAIN SAMPLE ANALYSIS PRIORITIES**

	<b>STANDARD</b>	<b>HIGH-PRIORITY</b>	<b>TOP-PRIORITY</b>
<b>BASIC SELECTION CRITERIA</b>	Routine analytical response is involved	Rapid analytical response is desired	Fastest analytical response possible is needed
<b>COSTS</b>	DLS published fee	1.5 times the published fee	2.0 times the published fee
<b>TAT</b>	20 business days from receipt in the laboratory	10 business days from receipt in the laboratory	5 business days or less from receipt in the laboratory
	(1) The TAT for each analysis should be determined as part of the project requirements and by mutual agreement with USACHPPM laboratory performing the analyses. (2) The specific TAT for each sample can be analysis and project dependent. (3) TATs may be affected by the number of samples involved for each analysis.		

### 3-5. SAMPLE SAFETY CONSIDERATIONS

- a. USACHPPM 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 DLS and clearly indicated on all the paperwork (i.e., USACHPPM Forms 8-R-E or 9-R-E) and on the samples.
- b. Databases for MSDS information may be accessed on the Internet through the DLS Home Page at <http://chppm-www.apgea.army.mil/dls/links.asp>.

### 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 USACHPPM CONUS Laboratory IH Procedure List, Appendix B. The DLS-Main 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 DLS 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 form, USACHPPM Form 235-R-E, which must be completed by the project officer. The form can also be accessed at <http://chppm-www.apgea.army.mil/dls/dlsforms>. USACHPPM TG 214, Chapter 7, contains detailed information concerning COC policy. Go to <http://chppm-www.apgea.army.mil/documents/TG/TECHGUID/TG214.PDF>.

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## CHAPTER 4

## COMPLETING REQUIRED USACHPPM SHIPPING FORMS

**4-1. REQUEST FOR SERVICES.** DLS requests that the project officer complete USACHPPM Form 330-R-E, Request for Laboratory Services, before submitting samples for analyses. A sample of this form can be found in Appendix F. For more detailed information, see TG 214 at <http://chppm-www.apgea.army.mil/documents/TG/TECHGUID/TG214.PDF> for completing a request for laboratory services. The information needed to complete this form should be established in the early stages of the project planning and communication process with DLS. USACHPPM Form 330-R-E 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 USACHPPM SHIPPING FORMS.** One of the following forms must accompany IH samples when they are submitted to the laboratory:

- a. USACHPPM FORM 8-R-E, *Industrial Hygiene Bulk Sample Data*  
[http://amedwsapgr51dls\\_forms/8re.aspx](http://amedwsapgr51dls_forms/8re.aspx), or
- b. USACHPPM FORM 9-R-E, *Industrial Hygiene Air Sample Data*  
[http://amedwsapgr51/dls\\_forms/9re.aspx](http://amedwsapgr51/dls_forms/9re.aspx).

**4-3. ADVANCE NOTICE OF INCOMING SAMPLES TO DLS-MAIN**

- a. Advance notification of incoming samples to DLS-Main is requested. IH Customers and other USACHPPM laboratories should submit a duplicate copy of the completed USACHPPM Form 8-R-E or Form 9-R-E as soon as possible when samples are being sent to the DLS-Main laboratory. The completed advance notification form can be submitted either—
  - (1) Electronically using the “sampnews” bulletin boards. 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 form must be sent with the sample shipment (see Chapter 5).

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

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

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

**b. OCONUS CUSTOMERS**

Refer to Appendix C, Section C-1, for information on Customer Support Services available at the USACHPPM-EUROPE and USACHPPM-PACIFIC.

**c. 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. USACHPPM Form 330-R-E, Request for Laboratory Services, serves the purpose of identifying key aspects of the sampling effort and starting the communication process with DLS. USACHPPM Form 330-R-E is used to generate a cost quote for the requested analytical service and alerts DLS of the analysis requirement. It may also identify what supplies need to be provided to support the sampling. USACHPPM Form 330-R-E can be accessed electronically at: <http://chppm-www.apgea.army.mil/dls/dlsforms/330re.htm>. Detailed information on how to complete the form can be found in TG 214, which is available electronically at <http://chppm-www.apgea.army.mil/documents/TG/TECHGUID/TG214.PDF>.

**a. ADVANCE NOTICE OF INCOMING SAMPLES TO DLS-MAIN IS REQUESTED**

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

- (2) IH customers and other USACHPPM laboratories should submit a duplicate copy of a completed USACHPPM Form 8-R-E or USACHPPM Form 9-R-E as soon as possible for samples being sent to the DLS Main laboratory. The original form must be sent with the sample shipment.

**b. SUBMISSION OF COMPLETED FORM**

- (1) Forward form electronically using the “sampnews” bulletin board. 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 DLS-Main immediately for any change to a processed USACHPPM Form 8-R-E or USACHPPM Form 9-R-E.
- b. Submit all changes through “sampnews.” This e-mail system is the most effective means of communicating with USACHPPM DLS-Main laboratory because all staff members have access to this bulletin board.

**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 right to reject samples. The laboratory will initiate contact with the appropriate project officer or industrial hygienist resource. At DLS-Main, a sample rejection form 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 DLS-Main), 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 form and/or other applicable documents.

**5-5. REQUIRED SHIPMENT FORMS**

a. One of the following forms listed below *must* accompany the samples when they are submitted:

- (1) USACHPPM Form 8-R-E, Bulk Sample Data, or
- (2) USACHPPM Form 9-R-E, Industrial Hygiene Sample Data.

b. See Appendix F for sample USACHPPM forms.

**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. Table 5-1 outlines the information needed on each sample label.

**TABLE 5-1. REQUIRED INFORMATION FOR EACH FIELD SAMPLE LABEL**

<p><b>PRINT EACH LABEL NEATLY</b>  <b>USE PERMANENT WATERPROOF INK</b></p>	
(1)	<p><b>SAMPLE FIELD ID NUMBER</b>  <b>(MAXIMUM OF 15 CHARACTERS)</b></p>
(2)	<p><b>COLLECTOR'S INITIALS</b></p>
(3)	<p><b>DATE OF COLLECTION</b></p>

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. Table 5-2 outlines this supplementary information.

**TABLE 5-2. SUPPLEMENTARY INFORMATION REQUESTED FOR EACH SAMPLE**

<p><b>PRINT NEATLY</b> <b>USE PERMANENT WATERPROOF INK</b></p> <p><b>(1) PROJECT NUMBER</b> <b>(2) INSTALLATION OR SITE NAME</b> <b>(3) PROJECT OFFICER'S NAME OR INITIALS</b> <b>(4) DLS-MAIN TEST CODE(S)</b></p>
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**5-7. SAMPLE PACKING INSTRUCTIONS**

- a. Contact the Support Services at the appropriate USACHPPM 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 Lists indicate 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 six-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<sup>®</sup> 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.
- (1) Store samples in refrigerator until just before packing. If samples must be frozen, store in the freezer.
  - (2) Precool shipping containers to 4° C before shipping, if possible.
  - (3) Use prefrozen 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 used, it must be sealed in heavy double-layered plastic bags to prevent leakage as the ice melts. Zip-Lock<sup>®</sup> freezer bags are recommended because of their extra thickness.

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Styrofoam<sup>®</sup> is a registered trademark of the Dow Chemical Company, Midland, MI.  
Zip-Lock<sup>®</sup> is a registered trademark of A.C. United Corps, East Brunswick, NJ.

## 5-8. SHIPMENT REQUIREMENTS AND SPECIFICS

Table 5-3 outlines shipment requirements and specifics.

**TABLE 5-3. SHIPMENT REQUIREMENTS AND SPECIFICATIONS**

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

## CHAPTER 6

SUBMITTING A USACHPPM DLS  
CUSTOMER COMMENT/COMPLAINT FORM**6-1. OVERVIEW**

- a. The DLS Customer Comment/Complaint Form is located at: <http://chppm-www.apgea.army.mil/dls/dlsforms/332-R.htm> and is provided to facilitate feedback concerning issues that include but are not limited to—
  - (1) Complaints, comments, or compliments about service or data.
  - (2) Suggestions for process improvements that will improve the efficiency or quality of DLS work.
  - (3) Health or safety problems and concerns.
  - (4) Known or suspected deficiencies in approved data, including audit samples outside acceptable ranges.
  - (5) Ideas for new services or products.
- b. All comments directed to DLS-Main are answered after appropriate review and corrective action. The originator of the comment will be contacted concerning the action taken.

**6-2. ACCESSING AND TRANSMITTING THE DLS CUSTOMER COMMENT/COMPLAINT FORM**

This form can be—

- (1) Mailed or faxed to DLS-Main. See Appendix B, Section B-1 for fax numbers and addresses.
- (2) Accessed through the DLS-Main Home Page at: <http://chppm-www.apgea.army.mil/dls/> and submitted electronically.
- (3) E-mailed to DLS-Main using the “sampnews” bulletin board. See Appendix B, Section B-1, for details.

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**APPENDIX A**

**RECOMMENDED REFERENCES**  
**AND**  
**INTERNET ADDRESSES OF INTEREST**

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**A-1. RECOMMENDED REFERENCES**

American Conference of Governmental Industrial Hygienists (ACGIH). *Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)*, (2004). (This publication is available from American Conference of Governmental Industrial Hygienists, Kemper Woods Center, 1330 Kemper Meadow Drive, Cincinnati, OH 45240.)

American Society for Testing and Materials (ASTM). ASTM Method E-1792-96a, Standard Specification of Wipe Sampling Materials for Lead in Surface Dust, 1996.

American Society for Testing and Materials (ASTM). ASTM Method-E-1728-95, *Standard Practice for Field Collecting of Settled Dust Samples Using Wipe Sampling Methods for Lead Determination*, 1995.

Department of the Army (DA). DA Pamphlet 40-11, Preventive Medicine.

Department of Defense (DOD). DOD 6050.5-LR, *DOD Hazardous Materials Information System Hazardous Item Listing*. (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. 2002.

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

Department of Defense (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](mailto:eurachem@bam.de) or the Office of Reference Materials, Laboratory of the Government Chemist (LGC), [uk@lgcpromochem.com](mailto:uk@lgcpromochem.com).)

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

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

International Organization for Standardization (ISO), 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. 1992.

National Institute of Occupational Safety and Health (NIOSH), Pocket Guide to Chemical Hazards, February 2004.

National Institute for Occupational Safety and Health (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.

National Institute for Occupational Safety and Health (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.

National Institute for Occupational Safety and Health (NIOSH). *Occupational Exposure Sampling Strategy Manual*, U.S. Department of Health, Education and Welfare (DHEW), Public Health Service, Center for Disease Control, NIOSH Publication No. 77-173. 1977.

National Institute for Occupational Safety and Health (NIOSH). *Exposure Measurement Action Level and Occupational Variability*, DHEW, NIOSH Publication No. 76-131. 1976.

National Institute for Occupational Safety and Health (NIOSH). *Handbook of Statistical Tests for Evaluating Employee Exposure to Air Contaminants*, DHEW, NIOSH Publication No. 75-147. 1975a.

National Institute for Occupational Safety and Health (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.

National Institute of Standards and Technology (NIST). *Standard Reference Materials: Handbook for SRM User*. NIST Special Publication No. 260-100. 1993.

National Institute of Standards and Technology (NIST). *Use of NIST Standard Reference Materials for Decisions on Performance of Analytical Chemical Methods and Laboratories*, NIST Special Publication 829, January 1992.



Occupational Safety and Health Administration (OSHA) TED 1-0.15A, Section II, Sampling, Measurement Methods and Instrumentation; Chapter 2, Sampling for Surface Contamination, January 20, 1999.

Sax, N.I., *Dangerous Properties of Industrial Materials*, Van Nostrand Reinhold Company. 10<sup>th</sup> Edition, 2000.

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.

U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM). *DLS Quality Assurance Manual*, August, 2004.

U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) Europe, *DLS Customer Guide*, Version 1, Revision 8, September 2004.

U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM). TG 230, *Chemical Exposure Guidelines for Deployed Military Personnel*, January 2003; Latest update, August, 2004.

U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM). TG 214, *Customer Service Manual*, July 2001.

U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM). TG 211, *Radiobioassay Collection, Labeling, and Shipping Requirements*, July 1998.

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.

29 CFR Part 1910: Occupational Safety and Health Standards.

40 CFR Part 763: Asbestos.

59 Federal Register 40964, 10 August 1994.

60 Federal Register 33973, 29 June 1995.

## A-2. INTERNET ADDRESSES OF INTEREST

### a. FEDERAL GOVERNMENT SITES—

Army Industrial Hygiene

<http://chppm-www.apgea.army.mil/ihmsm/>

DLS

<http://chppm-www.apgea.army.mil/dls/>

NOISH

<http://www.cdc.gov/niosh/homepage.html>

OSHA

<http://www.osha.gov/>

USACHPPM

<http://chppm-www.apgea.army.mil/>

USEPA

<http://www.epa.gov/>

U.S. Air Force Institute for Operational Health

[http://www.brooks.af.mil/afioh/Laboratories/sdc\\_sdce\\_industrial\\_hygiene.htm](http://www.brooks.af.mil/afioh/Laboratories/sdc_sdce_industrial_hygiene.htm)  
(Tri-Service Lab Subgroup of the Joint Environmental Surveillance Working Group)

U.S. Navy Environmental Health Center

[http://www-nehc.med.navy.mil/lab\\_services.htm](http://www-nehc.med.navy.mil/lab_services.htm)

### b. OTHER HELPFUL SITES—

ACGIH Home Page

<http://www.acgih.org/>

ACS Division of Chemical Health and Safety

<http://membership.acs.org/c/chas/>

AIHA

<http://www.aiha.org/>

American College of Occupational and Environmental Medicine

<http://www.acoem.org/>

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**APPENDIX B**

**USACHPPM CONUS LABORATORY SUPPORT SERVICES  
AND  
IH PROCEDURE LIST**







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**B-1. USACHPPM CONUS LABORATORY SUPPORT SERVICES**

**a. DLS-MAIN CUSTOMER SUPPORT SERVICES**

Table B-1 lists various means of communicating with DLS-Main Laboratory staff members. Please consult USACHPPM TG 214, *DLS Customer Service Manual*, for additional information on DLS-Main laboratory services.

**TABLE B-1. MEANS OF COMMUNICATING WITH THE DLS-MAIN LABORATORY**

WAYS TO COMMUNICATE WITH DLS	
	<p><b>TELEPHONE:</b>                      DSN: 584-2208                      Commercial: 410-436-2208</p>
	<p><b>“SAMPNEWS” BULLETIN BOARD IS AVAILABLE VIA E-MAIL:</b></p> <ul style="list-style-type: none"> <li>• <b>INTERNAL CUSTOMERS:</b>                      In Outlook, click on “New,” in the “To” block type USACHPPM-Sampnews, type in your message, attach USACHPPM Form 330-R-E for sample submission, and click “Send.”</li> <li>• <b>ALL CUSTOMERS:</b>                      Type an e-mail message, attach USACHPPM Form 330-R-E for sample submission, and send to <a href="mailto:chppm-sampnews@apg.amedd.army.mil">chppm-sampnews@apg.amedd.army.mil</a></li> </ul>
 <p><b>Internet</b></p>	<p>DLS Home Page at <a href="http://chppm-www/apgea.army.mil/dls/">http://chppm-www/apgea.army.mil/dls/</a></p>
	<p><b>FAX:</b>                      DSN: 584-4108                      Commercial: 410-436-4108</p>
	<p><b>FOR ROUTINE CORRESPONDENCE/SAMPLES:</b>                      Commander, USACHPPM                      ATTN: MCHB-TS-LID (Sample Management Laboratory)                      5158 Blackhawk Road                      Aberdeen Proving Ground, MD 21010-5403</p>
 <p><b>FedEx®</b>                      <b>UPS®</b></p>	<p><b>FOR SAMPLE SHIPMENTS:</b>                      Commander, USACHPPM                      ATTN: MCHB-TS-LID (Sample Management Laboratory)                      Building E-2100                      Aberdeen Proving Ground, MD 21010-5403</p>

To provide the best customer service possible, the USACHPPM DLS-Main laboratory has established support service designed to help IH Customers with the technical and administrative matters relating to their projects.

**b. DLS-MAIN IH CONSULTANT**

- (1) 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 the USACHPPM DLS-Main laboratory and interacts with installation IH personnel.

**c. "SAMPNEWS": AN E-MAIL BULLETIN BOARD**

- (1) "Sampnews" is an e-mail bulletin board established to offer DLS-Main Laboratory customers a convenient effective, and efficient way to exchange information with the laboratory.
- (2) The use of this bulletin board facilitates the communication process with DLS-Main laboratory because messages on "sampnews" can be—
  - (a) Accessed simultaneously by all appropriate DLS staff members. Responses can be made quickly and directly.
  - (b) Sent 24 hours a day. Worldwide time zones are not restrictive.
  - (c) Can be 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 completed USACHPPM Forms 8-R-E or 9-R-E can be electronically submitted.



**TABLE B-2. DLS-MAIN LABORATORY IH CUSTOMER SUPPORT SERVICES**

<b>CUSTOMERS NEED</b>	<b>IH CONSULTANT</b>	<b>SAMPNEWS E-MAIL BULLETIN BOARD</b>
Selection of the proper DLS 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 Form 8-R-E or 9-R-E.		X
Notification of PROJECT modifications after a USACHPPM Form 8-R-E has been received or processed.		X
Details concerning sample processing and status reports.		X

**d. DUTY HOURS FOR THE DLS-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 DLS routine duty hours. These arrangements are necessary to ensure appropriate DLS 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) DSN and/or commercial telephone number.
  - (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. CONUS IH PROCEDURE LIST EXPLANATION OF TERMS**

<b>AIR COLLECTION VOLUME:</b>	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.
<b>ANALYTE NAME:</b>	The name of the chemical as it appears in the Reference Method. Most synonyms are listed and cross referenced in this list.
<b>CHEMICAL ABSTRACTS SERVICE (CAS) NUMBER</b>	A number assigned by the CAS, which offers a concise, unique means of material identification, which identifies specific chemicals except when followed by an asterisk (*), which signifies a compound (often naturally occurring) of variable composition.
<b>COLLECTION MEDIA:</b>	The type of collection media required and detailed information concerning the specific requirements for the listed analyte.
<b>DLS TEST CODE:</b>	The unique three- or four-digit number assigned by DLS-Main to each laboratory procedure. These codes only apply to procedures done at USACHPPM CONUS Laboratories. The DLS 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 DLS Test Code and its importance.
<b>REFERENCE METHOD:</b>	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.)
<b>REPORTING LIMIT:</b>	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 nonionizing radiation, health physics, and radiochemical analyses, please contact one of the programs listed below.

- a. Nonionizing 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 for Radiologic, Classic, and Clinical Chemistry, DLS-Main, at DSN 584-3983 or (410) 436-3983.

**TRADEMARKED NAMES USED IN THIS PROCEDURE LIST**

3M<sup>®</sup> is a registered trademark of Minnesota Mining and Manufacturing Co., St Paul, MN.  
Cellosolve<sup>®</sup> is a registered trademark of Union Carbide Corp., 270 Park Ave, New York, NY.  
Chromosorb<sup>®</sup> is a registered trademark of Johns-Mannville Products Corp., Denver, CO.  
Dursban<sup>®</sup> is a registered trademark of Dow Chemical Co., Midland, MI.  
Florisil<sup>®</sup> is a registered trademark of Floridin Company, ITT System, Pittsburgh, PA.  
Freon<sup>®</sup> is a registered trademark of E. I. DuPont de Nemours and Co., Wilmington, DE.  
Ghost Wipes<sup>®</sup> is a registered trademark of Environmental Express, Mt. Pleasant, SC.  
ORBO<sup>®</sup> is a registered trademark of Supelco, Inc., Sigma Aldrich/Supelco, Bellefonte, PA.  
Tenax<sup>®</sup> is a registered trademark of GC-Enka N.V., The Netherlands.  
Teflon<sup>®</sup> is a registered trademark of E.I. DuPont de Nemours and Co., Wilmington, DE.  
XAD-2<sup>®</sup> is a registered trademark of Rohm and Hass, Philadelphia, PA.  
Zefluor<sup>®</sup> is a registered trademark of Pall Corporation, East Hills, NY.

**B-3. CONUS IH PROCEDURE LIST**

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**ACETIC ACID [CAS # 64-19-7]****CONTRACT ONLY****DLS Test Code:** 027**Reference Method:** OSHA ID-186**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 1% acetic acid.*

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**ACETONE [CAS # 67-64-1]****DLS Test Code:** 028**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.*

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**ACETONITRILE [CAS # 75-05-8]****DLS Test Code:** 031**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

## ACETONITRILE [CAS # 75-05-8] (CONTINUED)

**Special Instructions:**

*Sample stability not determined.*

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## ACROLEIN [CAS # 107-02-8]

**DLS Test Code:** 030**Reference Method:** OSHA 52**Reporting Limit:** 1 µg/sample**Collection Media:** Solid Sorbent Tube [2-hydroxymethyl) piperidine  
on XAD-2<sup>®</sup>, 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.*

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## ALUMINUM [CAS # 7429-90-5]

**DLS Test Code:** 033**Reference Method:** Modified NIOSH 7300, 4th Edition**Reporting Limit:** 2.5 µg/sample**Collection Media:** Filter [0.8 micron cellulose ester (CE) membrane]**Sample Flow Rate Minimum - Maximum (LPM):** 1 - 4**Air Collection Volume - Minimum-Maximum (L):** 5 - 100**Special Instructions:**

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

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## AMMONIA [CAS # 7644-41-71]

**DLS Test Code:** 034**Reference Method:** OSHA ID-188**Reporting Limit:** 25 µg/sample**Collection Media:** Solid Sorbent Tube [ORB0 77 or equivalent]**Sample Flow Rate - (LPM):** 0.1 [TWA] (No Range Given in Reference Method)  
0.5 [STEL] (No Range Given in Reference Method)

**AMMONIA [CAS # 7644-41-71] (CONTINUED)**

**Air Collection Volume (L):** 24 [TWA] (No Range Given in Reference Method)  
7.5 [STEL] (No Range Given in Reference Method)

**Special Instructions:**

*None.*

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**n-AMYL ACETATE [CAS # 628-63-7]**

**DLS Test Code:** 155

**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:**

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

**sec-AMYL ACETATE [CAS # 626-38-0]**

**DLS Test Code:** 036

**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.*
- 

**ANTIMONY [CAS # 7440-36-0]**

**DLS Test Code:** 1805

**Reference Method:** Modified NIOSH 7300, 4th Edition

**Reporting Limit:** 0.5 µg/sample

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

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**ANTIMONY [CAS # 7440-36-0] (CONTINUED)**

**Sample Flow Rate - Minimum-Maximum (LPM):** 1 - 4  
**Air Collection Volume - Minimum-Maximum (L):** 50 - 2000  
**Special Instructions:**

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

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**ARSENIC [CAS # 7440-38-2]**

**DLS Test Code:** 663  
**Reference Method:** Modified NIOSH 7300, 4th Edition  
**Reporting Limit:** 0.5 µg/sample  
**Collection Media:** Filter [0.8 micron cellulose ester membrane]  
**Sample Flow Rate - Minimum-Maximum (LPM):** 1 - 4  
**Air Collection Volume - Minimum-Maximum (L):** 5 - 2000  
**Special Instructions:**

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

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**ASBESTOS FIBER COUNT - AIR SAMPLE - BY PHASE CONTACT MICROSCOPY  
[CAS # - VARIOUS]****CONTRACT ONLY**

**DLS Test Code:** 001  
**Reference Method:** NIOSH 7400, Revision 4, Issue 2, 15 Aug 94  
**Reporting Limit:** 5.0 fibers/mm<sup>2</sup>  
**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% 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.*



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**ASBESTOS BULK SAMPLE IDENTIFICATION [CAS # - VARIOUS]****DLS Test Code:** 002**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.*
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**ASBESTOS – BY TEM [CAS # - Various]****DLS Test Code:** 2120**Reference Method:** NIOSH 7402, Revision 4, Issue 2, 15 Aug 94**Reporting Limit:** 2.4 fibers/mm<sup>2</sup>**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<sup>®</sup>, 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 PM-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 [CAS # 7440-39-3]****DLS Test Code:** 040**Reference Method:** Modified NIOSH 7300, 4th Edition**Reporting Limit:** 0.5 µg/sample**Collection Media:** Filter [0.8 micron CE membrane]**Sample Flow Rate - Minimum-Maximum (LPM):** 1 - 4**Air Collection Volume - Minimum-Maximum (L):** 50 - 2000

**BARIUM [CAS # 7440-39-3] (CONTINUED)****Special Instructions:**

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

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**BENZENE [CAS # 71-43-2]****DLS Test Code:** 041**Reference Method:** NIOSH 1501, 4th Edition**Reporting Limit:** 5 µg/sample**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal, 100mg/50mg]**Sample Flow Rate - Minimum-Maximum (LPM):** Equal to or Less Than 0.2**Air Collection Volume - Minimum-Maximum (L):** 5 – 30**Special Instructions:** None

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**BENZENE SOLUBLES, COAL TAR PITCH VOLATILES [CAS # 8007-45-2]      CONTRACT ONLY****DLS Test Code:** 042**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.*

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**1,4-BENZENEDIOL [CAS # 123-31-9]- SEE HYDROQUINONE, DLS TEST CODE: 107**

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**BERYLLIUM AND COMPOUNDS [CAS # 7440-41-7]****DLS Test Code:** 757**Reference Method:** Modified NIOSH 7300, 4th Edition**Reporting Limit:** 0.25 µg/sample**Collection Media:** Filter [0.8 micron CE membrane]**Sample Flow Rate - Minimum-Maximum (LPM):** 1 - 4**Air Collection Volume - Minimum-Maximum (L):** 1250 - 2000**Special Instructions:**

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

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**BULK AND SPECIAL ANALYSES****DLS Test Code:** 1760**Special Instructions:**

*Contact the DLS IH Technical Consultant for information.*

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**2-BUTANONE [CAS # 78-93-3] - SEE METHYL ETHYL KETONE, DLS TEST CODE: 134**

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**2-BUTOXYETHANOL (BUTYL CELLOSOLVE<sup>®</sup>, ETHYLENE GLYCOL MONOBUTYLETHER, EGBE)  
[CAS # 111-76-2]****DLS Test Code:** 025**Reference Method:** NIOSH 1403, 4th Edition**Reporting Limit:** 20 µg/sample**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal, 100mg/50mg]**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.*

*\*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.*

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**n-BUTYL ACETATE [CAS # 123-86-4]****DLS Test Code:** 156**Reference Method:** NIOSH 1450, 4th Edition**Reporting Limit:** 50 µg/sample**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal, 100mg/50mg]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.01 – 0.2**Air Collection Volume - Minimum-Maximum (L):** 1 - 10

**n-BUTYL ACETATE [CAS # 123-86-4] (CONTINUED)****Special Instructions:**

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

**sec-BUTYL ACETATE [CAS # 105-46-4]****DLS Test Code:** 047**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.*
- 

**tert-BUTYL ALCOHOL (2-METHYL-2-PROPANOL) [CAS # 75-65-0]****DLS Test Code:** 1226**Reference Method:** NIOSH 1400, 4th Edition**Reporting Limit:** 20 µg/sample**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal, 100mg/50mg]**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.*
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**Butyl Cellosolve [CAS # 111-76-2] - See 2-Butoxyethanol, DLS Test Code: 025**

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**CADMIUM [CAS # 7440-43-9]****DLS Test Code:** 664**Reference Method:** Modified NIOSH 7300, 4th Edition**Reporting Limit:** 0.25 µg/sample**Collection Media:** Filter [0.8 micron CE membrane]**Sample Flow Rate - Minimum-Maximum (LPM):** 1 - 4**Air Collection Volume - Minimum-Maximum (L):** 13 - 2000**Special Instructions:**

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

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**CARBINOL [CAS # 67-56-1] - SEE METHANOL, DLS TEST CODE: 128**

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**CARBON DISULFIDE (CS<sub>2</sub>, DITHIOCARBONIC ANHYDRIDE) [CAS # 75-15-0]****DLS Test Code:** 051**Reference Method:** NIOSH 1600, 4th Edition**Reporting Limit:** 20 µg/sample**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 one week at 25° C; six weeks at 0° C.*
- 

**CARBON TETRACHLORIDE [CAS # 56-23-5]****DLS Test Code:** 052**Reference Method:** NIOSH 1003, 4th Edition**Reporting Limit:** 50 µg/sample**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal, 100mg/50mg]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.01 - 0.2**Air Collection Volume - Minimum-Maximum (L):** 3 - 150**Special Instructions:**

*Sample stability not determined.*

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**CELLOSOLVE [CAS # 110-80-5] - SEE 2-ETHOXYETHANOL, DLS TEST CODE: 053**

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**CELLOSOLVE ACETATE [CAS # 111-15-9] - SEE 2-ETHOXYETHYL ACETATE, DLS TEST CODE: 026**

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**CHLORDANE (TOXICHLOR, OCTACHLOR) [CAS # 57-74-9]****DLS Test Code:** 1126**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 one week at 25° C.
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**CHLOROBENZENE [CAS # 108-90-7]****DLS Test Code:** 994**Reference Method:** NIOSH 1003, 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):** 1.5 - 40**Special Instructions:***Sample stability not determined.*

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**o-CHLOROBENZYLIDENE MALONITRILE (CS) [CAS # 2698-41-1]****DLS Test Code:** 055**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<sup>®</sup>-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 [CAS # 67-66-3]****DLS Test Code:** 056**Reference Method:** NIOSH 1003, 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 - 50**Special Instructions:***Sample stability not determined.*

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**CHLORPYRIFOS (DURBAN<sup>®</sup>) [CAS # 2921-88-2]****DLS Test Code:** 1304**Reference Method:** OSHA 62**Reporting Limit:** 1.6 µg/sample**Collection Media:** Filter and Solid Sorbent Tube [13-mm, Glass Fiber Filter and XAD-2, 270 mg/140 mg]**Sample Flow Rate (LPM):** 1.0 (No Range Given in Reference Method)**Air Collection Volume (L):** 480 (No Range Given in Reference Method)**Special Instructions:** None

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**CHROMIUM [CAS # 7440-47-3]****DLS Test Code:** 058**Reference Method:** Modified NIOSH 7300, 4th Edition**Reporting Limit:** 1 µg/sample**Collection Media:** Filter [0.8 micron CE membrane]**Sample Flow Rate - Minimum-Maximum (LPM):** 1 - 4**Air Collection Volume - Minimum-Maximum (L):** 5 - 1000**Special Instructions:***Provide one field blank and one media blank for each batch of 10 samples.*

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**CHROMIUM, HEXAVALENT (Cr<sup>+6</sup>) [CAS #18540-29-9]****DLS Test Code:** 1111**Reference Method:** OSHA ID-215**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:***\*Note: See Chapter 2 for a discussion of the Analytical Limitations of the Test Method.*

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**COAL TAR PITCH VOLATILES [CAS #8007-45-2] - SEE BENZENE SOLUBLES DLS TEST CODE: 042**

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**COBALT [CAS # 7440-48-4]****DLS Test Code:** 059**Reference Method:** Modified NIOSH 7300, 4th Edition**Reporting Limit:** 0.5 µg/sample**Collection Media:** Filter [0.8 micron CE membrane]**Sample Flow Rate - Minimum-Maximum (LPM):** 1 - 4**Air Collection Volume - Minimum-Maximum (L):** 25 - 2000**Special Instructions:***Provide one field blank and one media blank for each batch of 10 samples.*

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**COPPER [CAS # 7440-50-8]****DLS Test Code:** 060**Reference Method:** Modified NIOSH 7300, 4th Edition**Reporting Limit:** 0.5 µg/sample**Collection Media:** Filter [0.8 micron CE membrane]**Sample Flow Rate - Minimum-Maximum (LPM):** 1 - 4**Air Collection Volume - Minimum-Maximum (L):** 5 - 1000**Special Instructions:***Provide one field blank and one media blank for each batch of 10 samples.*



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**CRESOL, ALL ISOMERS [CAS # 1319-77-3 (MIXTURE)]****DLS Test Code:** 995**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.*

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**CS [CAS # 2698-41-1] - SEE O-CHLOROBENZYLIDENE MALONITRILE, DLS TEST CODE: 055**

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**CS2 [CAS # 75-15-0] SEE CARBON DISULFIDE, DLS TEST CODE: 051**

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**CYANIDE [CAS # 74-90-8]****CONTRACT ONLY****DLS TEST CODE:** 1289**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 five days.
2. Particulate on fiber may liberate HCN gas.

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**CYCLONITE [CAS # 121-82-4] - SEE RDX, DLS TEST CODE: 1525**

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**DIACETONE ALCOHOL [CAS #123-42-2]****DLS Test Code:** 1308**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

**DIACETONE ALCOHOL [CAS #123-42-2] (CONTINUED)****Special Instructions:**

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

**DIAZINON [CAS # 333-41-5]****DLS Test Code:** 1309**Reference Method:** OSHA 62**Reporting Limit:** 1.5 µg/sample**Collection Media:** Filter and Solid Sorbent Tube [13-mm Glass fiber filter AND XAD-2 Tube, 270 mg/140 mg]**Sample Flow Rate (LPM):** 1.0 (No Range Given in Reference Method)**Air Collection Volume (L):** 480 (No Range Given in Reference Method)**Special Instructions:** None

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**1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE) [CAS # 106-93-4]****DLS Test Code:** 1310**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 two weeks at minus 25° C or below.*
- 

**o-DICHLOROBENZENE [CAS # 95-50-1]****DLS Test Code:** 161**Reference Method:** NIOSH 1003, 4th Edition**Reporting Limit:** 60 µg/sample**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

**o-DICHLOROBENZENE [CAS # 95-50-1] (CONTINUED)**

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

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

**Special Instructions:**

*Sample stability not determined.*

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**p-DICHLOROBENZENE [CAS # 106-46-7]**

**DLS Test Code:** 174

**Reference Method:** NIOSH 1003, 4th Edition

**Reporting Limit:** 60 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 - 8

**Special Instructions:**

*Sample stability not determined.*

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**DICHLORODIFLUOROMETHANE (FREON 12) [CAS # 75-71-8]**

**DLS Test Code:** 094

**Reference Method:** NIOSH 1018, 4th Edition

**Reporting Limit:** 100 µg/sample

**Collection Media:** Two Solid Sorbent Tubes in Series [Coconut Shell Charcoal, 400 mg/200 mg and 100 mg/50 mg]

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

**Air Collection Volume - Minimum-Maximum (L):** 1 - 4

**Special Instructions:**

1. *Store and ship refrigerated.*
  2. *Sample stable at least seven days at 25° C.*
- 

**1,1-DICHLOROETHANE [CAS # 75-34-3]**

**DLS Test Code:** 1311

**Reference Method:** NIOSH 1003, 4th Edition

**Reporting Limit:** 10 µg/sample

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

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**1,1-DICHLOROETHANE [CAS # 75--34-3] (CONTINUED)****Sample Flow Rate - Minimum-Maximum (LPM):** 0.01 – 0.2**Air Collection Volume - Minimum-Maximum (L):** 0.5 - 15**Special Instructions:***Sample stability not determined.*

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**1,2-DICHLOROETHANE (ETHYLENE DICHLORIDE) [CAS # 107-06-02]****DLS Test Code:** 067**Reference Method:** NIOSH 1003, 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 - 50**Special Instructions:***Sample stability not determined.*

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**DICHLOROMETHANE [CAS # 75-09-2] - SEE METHYLENE CHLORIDE, DLS TEST CODE: 141**

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**1,2-DICHLOROPROPANE [CAS # 78-87-5]****DLS Test Code:** 068**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**Air Collection Volume - Minimum-Maximum (L):** 1 - 50**Special Instructions:***Sample stability not determined.*

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**DICHLORVOS (DDVP) [CAS # 62-73-7]****DLS Test Code:** 1312**Reference Method:** OSHA 62**Reporting Limit:** 0.9 µg/sample**Collection Media:** Filter and Solid Sorbent Tube [13-mm, Glass fiber filter  
AND XAD-2, 270/140 mg]

**DICHLORVOS (DDVP) [CAS # 62-73-7] (CONTINUED)**

**Sample Flow Rate (LPM):** 1.0 (No Range Given in Reference Method)

**Air Collection Volume (L):** 480 (No Range Given in Reference Method)

**Special Instructions:** None

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**DIESEL EXHAUST – PLEASE CALL the DLS IH TECHNICAL CONSULTANT FOR INFORMATION**

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**DIMETHYLDINITROBUTANE (DMDNB) [CAS # 3964-18-9]**

**DLS Test Code:** 1048

**Reference Method:** CAD MUS 8

**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

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**2,4-DINITROTOLUENE (DNT) [CAS # 121-14-2]**

**DLS Test Code:** 1224

**Reference Method:** OSHA 44 for Sampling Requirements  
CAD CAB 13 for Sample Analysis

**Reporting Limit:** 1 µg/sample

**Collection Media:** Solid Sorbent Tube [Filter + Tenax-GC, ORBO<sup>®</sup> 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 Mine Safety and Health Administration (MSHA) as intrinsically safe for use in coal mines.*
  2. *Samples stable at least 19 days at ambient temperature.*
- 

**DIOCTYLPHTHALATE (DOP) [CAS # 117-81-7]**

**DLS Test Code:** 074

**Reference Method:** NIOSH 5020, 4th Edition

**Reporting Limit:** 10 µg/sample

**Collection Media:** Filter [0.8 micron CE membrane]

**Sample Flow Rate - Minimum-Maximum (LPM):** 1.0 - 3.0

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**DIOCTYLPHTHALATE (DOP) [CAS # 117-81-7] (CONTINUED)****Air Collection Volume - Minimum-Maximum (L):** 10 - 200**Special Instructions:**

*Each set of samples should be accompanied by at least 2 field blanks or a 10% frequency, whichever is greater.*

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**DITHIOCARBONIC ANHYDRIDE [CAS # 75-15-0] - SEE CARBON DISULFIDE, DLS TEST CODE: 051**

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**DMDNB [CAS # 3964-18-9] - SEE DIMETHYLDINITROBUTANE, DLS TEST CODE: 1048**

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**DNT (2,4-DINITROTOLUENE) [CAS # 121-14-2]- SEE 2,4-DINITROTOLUENE, DLS TEST CODE: 1224**

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**DOP [CAS # 117-78-6] - SEE DIOCTYLPHTHALATE, DLS TEST CODE: 074**

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**DURBAN<sup>®</sup> [CAS # 2921-88-2] - SEE CHLOROPYRIFOS, DLS TEST CODE: 1304**

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**DUST, NUISANCE (RESPIRABLE)****DLS Test Codes:** 175 for IH, 1188 for Metals**Reference Method:** Modified NIOSH 0600, 4th Edition**Reporting Limit:** 100 µg/sample**Collection Media:** Cyclone and Filter [10-mm Nylon Cyclone or Higgins-Dewell Cyclone and Tared 5 micron PVC membrane]**Sample Flow Rate (LPM):**

For Nylon Cyclone: 1.7 (No Range Given in Reference Method)

For HD Cyclone: 2.2 (No Range Given in Reference Method)

**Air Collection Volume - Minimum-Maximum (L):** 20 - 400**Special Instructions:**

*Sample stable indefinitely.*

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**DUST, NUISANCE (TOTAL)****DLS Test Code:** 189 for IH, 1227 for Metals**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

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**DUST, NUISANCE (TOTAL) (Continued)****Special Instructions:**

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

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**EGBE [CAS # 111-76-2] - SEE 2-BUTOXYETHANOL, DLS TEST CODE: 025**

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**EGDN [CAS # 628-96-6] - SEE ETHYLENE GLYCOL DINITRATE, DLS TEST CODE: 1162**

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**EGEE [CAS # 110-80-5] - SEE 2-ETHOXYETHANOL, DLS TEST CODE: 053**

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**ENDRIN [CAS # 72-20-8]****DLS Test Code:** 1315**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<sup>®</sup> 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 one week at 25° C.*

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**ENFLURANE (ETHRANE) [CAS # 13838-16-9]****DLS Test Code:** 075**Reference Method:** OSHA 103**Reporting Limit:** 4 µg/sample**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.*

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**EPICHLOROHYDRIN [CAS # 106-89-8]****DLS Test Code:** 081**Reference Method:** NIOSH 1010, 4th Edition

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

**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

**Special Instructions:**

*Sample stable at least two weeks at 25° C.*

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

**DLS Test Code:** 084

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

**DLS Test Code:** 053

**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.*
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**2-ETHOXYETHANOL (CELLOSOLVE, ETHYLENE GLYCOL MONOETHYLEETHER, EGEE)  
[CAS # 110-80-5] (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.*
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**2-ETHOXYETHYL ACETATE (CELLOSOLVE ACETATE) [CAS # 111-15-9]**

**DLS Test Code:** 054

**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.*
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**ETHRANE [CAS # 13838-16-9] - SEE ENFLURANE, DLS TEST CODE: 075**

**ETHYL ALCOHOL [CAS # 64-17-5] - SEE ETHANOL, DLS TEST CODE: 084**

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**ETHYL ACETATE [CAS # 141-78-6]**

**DLS Test Code:** 083

**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 six days at 5° C.*
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**ETHYL BENZENE [CAS # 100-41-4]**

**DLS Test Code:** 085

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**ETHYL BENZENE [CAS # 100-41-4] (CONTINUED)**

**Reference Method:** NIOSH 1501, 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):** Equal To or Less Than 0.20

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

**Special Instructions:** None

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

**DLS Test Code:** 1098

**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.*
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**ETHYL ETHER [CAS # 60-29-7]**

**DLS Test Code:** 754

**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*
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**ETHYLENE DICHLORIDE [CAS # 107-06-2]- SEE 1,2-DICHLOROETHANE, DLS TEST CODE: 067**

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**ETHYLENE GLYCOL [CAS # 107-21-1]****DLS Test Code:** 1700**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 Instruction:***Samples stable at least 14 days at 5° C.*

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**ETHYLENE GLYCOL DINITRATE (EGDN, ETHYLENE DINITRATE) [CAS # 628-96-6]****DLS Test Code:** 1162**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**Air Collection Volume - Minimum-Maximum (L):** 3 - 100**Special Instructions:***Stable at least 25 days at 25° C.*

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**ETHYLENE GLYCOL MONOBUTYLEETHER [CAS # 111-76-2] - SEE 2-BUTOXYETHANOL, DLS TEST CODE: 025**

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**ETHYLENE GLYCOL MONOMETHYLEETHER (EGME) [CAS # 109-86-4] - SEE 2-METHOXYETHANOL, DLS TEST CODE: 649**

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**ETHYLENE GLYCOL MONOMETHYL ETHER ACETATE [CAS # 110-49-6] - SEE 2-METHOXYETHYL ACETATE, DLS TEST CODE: 998**

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**ETHYLENE GLYCOL MONOETHYLEETHER [CAS # 110-80-5] - SEE 2-ETHOXYETHANOL, DLS TEST CODE: 053**

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**ETHYLENE OXIDE (ETO) [CAS # 75-21-8]****CONTRACT ONLY****DLS Test Code:** 088**Reference Method:** NIOSH 1614, 4th Edition

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**ETHYLENE OXIDE (ETO) [CAS # 75-21-8] (CONTINUED)****CONTRACT ONLY****Reporting Limit:** 0.5µg/sample**Collection Media:** Solid Sorbent Tube [HBr-Coated Petroleum Charcoal, 100 mg/  
50 mg) or 3M<sup>®</sup> 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.*

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**ETHYLENE TRICHLORIDE [CAS # 79-01-6] - SEE TRICHLOROETHYLENE, DLS TEST CODE: 184**

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**ETO [CAS # 75-21-8] - ETHYLENE OXIDE, DLS TEST CODE: 088**

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**FIBERGLASS DUST [CAS # 65997-17-3]****DLS Test Code:** 090**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 ten samples should be accompanied by 2 field blanks.*
2. *Sample stable indefinitely.*
3. *Fibers are not identified in this procedure.*

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**FLUORIDES (AEROSOL AND GAS) [CAS # (HF) 7664-39-3]****DLS Test Code:** 1254**Reference Method:** NIOSH 7906, 4th Edition**Reporting Limit:** 10 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

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

**Air Collection Volume - Minimum-Maximum (L):** 1 - 800  
**Special Instructions:** None

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**FLUORIDES (PARTICULATE) [CAS # VARIOUS]**

**DLS Test Code:** 1253  
**Reference Method:** NIOSH 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

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**FLUOROTRICHLOROMETHANE (FREON 11, MONOFLUOROTRICHLOROMETHANE) [CAS # 75-69-4] SEE TRICHLOROFLUOROMETHANE, DLS TEST CODE: 996**

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**FORANE (ISOFLURANE) [CAS # 2667-54-67]**

**DLS Test Code:** 091  
**Reference Method:** Modified OSHA 103  
**Reporting Limit:** 10 µg/sample  
**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.*

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

**DLS Test Code:** 092  
**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

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**FORMALDEHYDE (HCHO) [CAS # 50-00-0] (CONTINUED)****Special Instructions:**

*Samples need to be shipped on ice; tubes have a 30-day holding time at 5° C.*

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**FREON<sup>®</sup> 11 [CAS # 75-69-4] - SEE TRICHLOROFLUOROMETHANE, DLS TEST CODE: 996**

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**FREON 12 [CAS # 75-71-8] - SEE DICHLORODIFLUOROMETHANE, DLS TEST CODE: 094**

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**FREON 113 [CAS #76-13-1] - SEE 1,1,2- TRICHLORO-1,2,2-TRIFLUOROETHANE, DLS TEST CODE: 093**

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**FUEL OIL #2 [CAS # 68476-30-2]****DLS Test Code:** 096**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:**

*Stable at least one week at 25° C. Provide bulk sample for quantification standard.*

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**GASOLINE [CAS # 8006-61-9]****DLS Test Code:** 097**Reference Method:** NIOSH 1550, 4th Edition**Reporting Limit:** 100µg/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:**

*Stable at least one week at 25° C. Provide bulk sample for quantification standard.*

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**GLUTARIC DIALDEHYDE [CAS # 111-30-8] SEE GLUTARALDEHYDE, DLS TEST CODE: 099**

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**GLUTARALDEHYDE (GLUTARIC DIALDEHYDE, 1,5-PENTANEDIAL) [CAS # 111-30-8]****DLS Test Code:** 1316**Reference Method:** NIOSH 2532, 4th Edition**Reporting Limit:** 0.3 µg/sample

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

**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.*

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**GLYCOL MONOMETHYL ETHER ACETATE [CAS # 110-49-6] - SEE 2-METHOXYETHYL  
ACETATE, DLS TEST CODE: 998**

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**H<sub>2</sub>SO<sub>4</sub>, [CAS # 7664-93-9]- SEE SULFURIC ACID, DLS TEST CODE: 182**

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**H<sub>3</sub>PO<sub>4</sub>, [CAS # 7664-38-2]- SEE PHOSPHORIC ACID, DLS TEST CODE: 170**

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**HALOTHANE [CAS # 151-67-7]**

**DLS Test Code:** 101  
**Reference Method:** OSHA 103  
**Reporting Limit:** 4 µg/sample  
**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.*

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**HCHO [CAS # 50-00-0] - SEE FORMALDEHYDE, DLS TEST CODE: 092**

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**HCl [CAS # 7647-01-0] - SEE HYDROGEN CHLORIDE, DLS TEST CODE: 105**

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**HDI [CAS # 822-06-0] - SEE 1,6-HEXAMETHYLENE DIISOCYANATE, DLS TEST CODE: 019**

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**n-HEPTANE [CAS # 142-82-5]**

**DLS Test Code:** 997  
**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  
**Air Collection Volume (L):** 4 (No Range Given in Reference Method)

**n-HEPTANE [CAS # 142-82-5] (CONTINUED)****Special Instructions:**

*Stable at least two weeks at 25° C.*

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**HEXACHLOROETHANE [CAS # 62-72-1]**

**DLS Test Code:** 103

**Reference Method:** NIOSH 1003, 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):** 3 - 70

**Special Instructions:**

*Sample stability not determined.*

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**1,6-HEXAMETHYLENE DIISOCYANATE (HDI) [CAS # 822-06-0]**

**DLS Test Code:** 019

**Reference Method:** OSHA 42

**Reporting Limit:** 0.3 µg/sample

**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.*

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**n-HEXANE [CAS # 110-54-3]**

**DLS Test Code:** 102

**Reference Method:** NIOSH 1500, 4th Edition

**Reporting Limit:** 10 µg/sample

**DLS Test Code:** 102

**Reference Method:** NIOSH 1500, 4th Edition

**Reporting Limit:** 10 µg/sample

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

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

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**n-HEXANE [CAS # 110-54-3] (CONTINUED)****Air Collection Volume:** 4 (No Range Given in Method)**Special Instructions:***Stable at least two weeks at 25° C.*

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**2-HEXANONE [CAS # 591-78-6]****DLS Test Code:** 1319**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.*

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**HEXAVALENT CHROMIUM, (Cr<sup>+6</sup>) [CAS #18540-29-9] - SEE CHROMIUM HEXAVALENT, DLS TEST CODE: 1111**

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**HYDROCHLORIC ACID [CAS # 7647-01-0] - SEE HYDROGEN CHLORIDE, DLS Test CODE: 105**

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**HYDROFLUORIC ACID [CAS # 7664-39-3] - SEE HYDROGEN FLUORIDE, DLS TEST CODE: 106**

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**HYDROGEN CHLORIDE (HYDROCHLORIC ACID, HCl) [CAS # 7647-01-0]****DLS TEST CODE:** 105**Reference Method:** NIOSH 7903, 4th Edition**Reporting Limit:** 2 µg/sample**Collection Media:** Solid Sorbent Tube [High-Purity Washed Silica Gel, 400/200 mg, ORBO 53 tube or equivalent]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.2 – 0.5**Air Collection Volume - Minimum-Maximum (L):** 3 - 100**Special Instructions:***Stable at least 21 days at 25° C.*

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**HYDROGEN CYANIDE [CAS # 74-90-8]****CONTRACT ONLY****DLS Test Code:** 108**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 five days.
  2. Particulate on filter may liberate Hydrogen Cyanide gas.
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**HYDROGEN FLUORIDE (HYDROFLUORIC ACID) [CAS # 7664-39-3]****DLS Test Code:** 106**Reference Method:** NIOSH 7903, 4th Edition**Reporting Limit:** 2 µg/sample**Collection Media:** Solid Sorbent Tube [High Purity Washed Silica Gel, 400/200 mg, ORBO 53 tube or equivalent]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.2 - 0.5**Air Collection Volume - Minimum-Maximum (L):** 3 - 100**Special Instructions:***Stable at least 21 days at 25° C.*

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**HYDROGEN SULFIDE [CAS# 7783-06-04]****DLS Test Code:** 1649**Reference Method:** NIOSH 6013, 4th Edition**Reporting Limit:** 11 µg/sample**Collection Media:** Filter + Solid Sorbent Tube [Zefluor<sup>®</sup>, 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

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**HYDROQUINOL [CAS # 123-31-9] - SEE HYDROQUINONE, DLS TEST CODE: 107**

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**HYDROQUINONE (HYDROQUINOL, 1,4-BENZENEDIOL) [CAS # 123-31-9]****DLS Test Code:** 107**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% acetic acid solution. The blanks must be treated in the same manner.*

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

2. Stable at least seven days at 25° C.
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**INDUSTRIAL HYGIENE ORGANICS UNKNOWNNS****DLS Test Code:** Varies**Special Instructions:**

*Contact the DLS IH Technical Consultant for information.*

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**IRON [CAS # 1309-37-1]****DLS Test Code:** 117**Reference Method:** Modified NIOSH 7300, 4th Edition**Reporting Limit:** 2.5 µg/sample**Collection Media:** Filter [0.8 micron CE membrane]**Sample Flow Rate: -Minimum-Maximum (LPM):** 1 - 4**Air Collection Volume: - Minimum-Maximum (L):** 5 - 100**Special Instructions:**

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

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**ISOAMYL ACETATE [CAS # 123-92-2]****DLS Test Code:** 1320**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.*
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**ISOBUTYL ACETATE [CAS # 110-19-0]****DLS Test Code:** 119**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.*
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**ISOPHORONE [CAS # 78-59-1]****DLS Test Code:** 121**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**Air Collection Volume - Minimum-Maximum (L):** 2 - 25**Special Instructions:** *Stable at least seven days at 25° C.*

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**ISOFLURANE [CAS # 2667-54-67]- SEE FORANE, DLS TEST CODE: 091**

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

**DLS Test Code:** 1497 (Alcohols I)

**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):** 0.3 - 3

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

**Special Instructions:**

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

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**JP-4 [CAS # 94742-47-9]**

**DLS Test Code:** 124

**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:**

*Stable at least one week at 25° C. Provide bulk sample for quantification standard.*

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**JP8 - See Kerosene.**

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**KEROSENE [CAS # 8008-20-6]**

**DLS Test Code:** 064

**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:**

*Stable at least one week at 25° C. Provide bulk sample for quantification standard.*

**LEAD [CAS # 7439-92-1]****DLS Test Code:** 125**Reference Method:** Modified NIOSH 7300, 4th Edition**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):** 50 - 2000**Special Instructions:**

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

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**LEAD [CAS # 7439-92-1]****DLS Test Code:** 1412/1524**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.*

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**LEAD [CAS # 7439-92-1]****DLS Test Code:** 887/1524**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<sup>®</sup> to collect the sample.
  2. Send blank wipes at a 20% frequency.
  3. Place each wipe in a 50 mL plastic centrifuge tube (preferred), plastic tube or bag prior to shipment.
-

**MAGNESIUM [CAS # 1309-48-4]****DLS Test Code:** 126**Reference Method:** Modified NIOSH 7300, 4th Edition**Reporting Limit:** 2.5 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):** 5 - 67**Special Instructions:**

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

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**MALATHION [CAS # 121-75-5]****DLS Test Code:** 1323**Reference Method:** OSHA 62**Reporting Limit:** 1.8 µg/sample**Collection Media:** Filter and Solid Sorbent Tube [13-mm Glass fiber filter  
AND XAD-2, 270/140 mg]**Sample Flow Rate (LPM):** 1.0 (No Range Given in Reference Method)**Air Collection Volume (L):** 60 (No Range Given in Reference Method)**Special Instructions:** None**MANGANESE [CAS # 7439-96-5]****DLS Test Code:** 127**Reference Method:** Modified NIOSH 7300, 4th Edition**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):** 5 - 200**Special Instructions:**

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

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**MDI [CAS # 101-68-8] - SEE METHYLENE BISPHENYL ISOCYANATE, DLS TEST CODE: 073****MEK [CAS # 78-93-3] - See Methyl Ethyl Ketone, DLS TEST CODE: 134****MEK PEROXIDE - PLEASE CALL THE DLS TECHNICAL CONSULTANT FOR INFORMATION.****MERCURY [CAS # 7439-97-6] - PLEASE CALL THE DLS TECHNICAL CONSULTANT FOR INFORMATION.**

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**METHANOL (METHYL ALCOHOL, CARBINOL, WOOD ALCOHOL) [CAS # 67-56-1]****DLS Test Code:** 128**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 six weeks.*

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**2-METHOXYETHANOL (METHYL CELLOSOLVE, ETHYLENE GLYCOL MONOMETHYL ETHER, EGME) [CAS # 109-86-4]****DLS Test Code:** 1500**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):** 6 - 50**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.*
- 

**METHYL ACETATE [CAS # 79-20-9]****DLS Test Code:** 130**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



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**METHYL ACETATE [CAS # 79-20-9] (CONTINUED)****Special Instructions:**

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

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**METHYL ALCOHOL [CAS # 67-56-1] - SEE METHANOL, DLS TEST CODE: 128**

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**METHYL-2-CYANOACRYLATE (MCA) [CAS# 137-05-3]****DLS Test Code:** 1097**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.*

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**METHYL CELLOSOLVE [CAS # 109-86-4] - SEE 2-METHOXYETHANOL, DLS TEST CODE: 649**

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**METHYL CELLOSOLVE ACETATE [CAS # 110-49-6] - SEE 2-METHOXYETHYL ACETATE, DLS TEST CODE: 998**

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**METHYL ISOAMYL KETONE ( 5-METHYL-2-HEXANONE) - SEE MIAK [CAS # 110-12-3], DLS TEST CODE: 1078**

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**METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE) [CAS # 71-55-6]****DLS Test Code:** 021**Reference Method:** NIOSH 1003, 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):** 0.1 - 8**Special Instructions:***Sample stability not determined.*

**METHYLENE BISPHENYL ISOCYANATE (MDI) [CAS # 101-68-8]****DLS Test Code:** 073**Reference Method:** OSHA 47**Reporting Limit:** 2.6 µg/sample**Collection Media:** Treated filter [ORBO 80 filter or equivalent]**Sample Flow Rate (LPM):** 1 (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.*

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**METHYLENE CHLORIDE (DICHLOROMETHANE, METHYLENE DICHLORIDE) [CAS # 75-09-2]****DLS Test Code:** 141**Reference Method:** NIOSH 1005, 4th Edition**Reporting Limit:** 20 µg/sample**Collection Media:** TWO Solid Sorbent Tubes in Series

[Coconut Shell Charcoal, 100/50mg]

**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.*
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**METHYLENE DICHLORIDE [CAS # 75-09-2] SEE METHYLENE CHLORIDE, DLS TEST CODE: 141**

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**METHYL ETHYL KETONE (2-BUTANONE, MEK) [CAS # 78-93-3]****DLS Test Code:** 134**Reference Method:** OSHA 16**Reporting Limit:** 30 µg/sample**Collection Media:** TWO Solid Sorbent Tubes in Series [Silica Gel, 150/75 mg]**Sample Flow Rate:** 0.1 (No Range Given in Reference Method)**Air Collection Volume:** 3 (No Range Given in Reference Method)

**METHYL ETHYL KETONE (2-BUTANONE, MEK) [CAS # 78-93-3] (CONTINUED)****Special Instructions:**

*Separate the front and back tubes and cap each tube before shipment to prevent migration of methyl ethyl ketone between tubes.*

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**METHYL ETHYL KETONE PEROXIDE - PLEASE CALL THE DLS TECHNICAL CONSULTANT FOR INFORMATION.**

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**METHYL ISOBUTYL KETONE (MIBK) [CAS # 108-10-1]****DLS Test Code:** 138**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:** None

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**METHYL METHACRYLATE [CAS # 80-62-6]****DLS Test Code:** 140**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 seven days at 25° C; greater than 32 days at 4° C.*
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**2-Methyl-2-Propanol (CAS # 75-65-0) - SEE TERT-BUTYL ALCOHOL, DLS TEST CODE: 1226**

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**MIAK (METHYL ISOAMYL KETONE, 5-METHYL-2HEXANONE) [CAS # 110-12-3]****DLS Test Code:** 1078**Reference Method:** Modified NIOSH 1300, 4th Edition**Reporting Limit:** 20 µg/sample**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]

**MIAK (METHYL ISOAMYL KETONE, 5-METHYL-2HEXANONE) [CAS # 110-12-3]**  
(CONTINUED)**Sample Flow Rate - Minimum-Maximum (LPM):** 0.01 – 0.2**Air Collection Volume - Minimum-Maximum (L):** 1 - 10**Special Instructions:** None

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**MIBK [CAS # 108-10-1] - SEE METHYL ISOBUTYL KETONE, DLS TEST CODE: 138**

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**MINERAL SPIRITS [CAS # 8052-41-3]****DLS Test Code:** 142**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 one week at 25° C.*
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**MOLYBDENUM [CAS # 7439-98-7]****DLS Test Code:** 143**Reference Method:** Modified NIOSH 7300, 4th Edition**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):** 5 - 67**Special Instructions:**

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

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**MONOFLUOROTRICHLOROMETHANE [CAS # 75-69-4] SEE TRICHLOROFLUOROMETHANE,**  
**DLS TEST CODE: 996**

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**NAPHTHALENE [CAS # 91-20-3]****DLS Test Code:** 149**Reference Method:** NIOSH 1501, 4th Edition

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**NAPHTHALENE [CAS # 91-20-3] (CONTINUED)**

**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

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**NICKEL [CAS # 7440-02-0]**

**DLS Test Code:** 652  
**Reference Method:** Modified NIOSH 7300, 4th Edition  
**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):** 5 - 1000  
**Special Instructions:**

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

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**NITRIC ACID [CAS # 7697-37-2]**

**DLS Test Code:** 152  
**Reference Method:** NIOSH 7903, 4th Edition  
**Reporting Limit:** 5 µg/sample  
**Collection Media:** Solid Sorbent Tube [High-Purity Washed Silica Gel, 400/200 mg, ORBO 53 tube or equivalent]  
**Sample Flow Rate - Minimum-Maximum (LPM):** 0.2 - 0.5  
**Air Collection Volume - Minimum-Maximum (L):** 3 - 100  
**Special Instructions:**

*Stable at least 21 days at 25° C.*

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**Nitric Oxide and Nitrogen Dioxide (NO/NO<sub>2</sub>)[CAS # 10102-43-9 and 10102-44-0]**

**DLS Test Code:** 109  
**Reference Method:** OSHA-ID-190  
**Reporting Limit:** 1.2 µg/sample  
**Collection Media:** A THREE tube sampling device, containing TWO Solid Sorbent

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**Nitric Oxide and Nitrogen Dioxide (NO/NO<sub>2</sub>)[CAS # 10102-43-9 and 10102-44-0]**  
(CONTINUED)

Tubes [Triethanolamine-impregnated Molecular Sieve (TEA-IMS), 400 mg, SKC 3226-40-special order, water-washed or equivalent] and a middle Chromate Oxidizer tube.

**Sample Flow Rate (LPM):** 0.025 (No Range Specified in Reference Method)

**Air Collection Volume (L):** 6 (No Range Specified in Reference Method)

**Special Instructions:**

*Each TEA-IMS tube is analyzed separately. The first tube measures nitrogen dioxide and the second tube measures nitric oxide.*

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**NITROUS OXIDE - PLEASE CALL THE DLS TECHNICAL CONSULTANT FOR INFORMATION.**

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

**DLS Test Code:** 018

**Reference Method:** NIOSH 2507, 4th Edition

**Reporting Limit:** 0.6 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.*

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**NUISANCE DUST (RESPIRABLE) - SEE DUST, NUISANCE (RESPIRABLE), DLS TEST CODES: 1188/175**

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**NUISANCE DUST (TOTAL) - SEE DUST, NUISANCE (TOTAL), DLS TEST CODES: 1227/189**

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**OCTACHLOR [CAS # 57-74-9] - SEE CHLORDANE, DLS TEST CODE: 1126**

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**OIL MIST**

**DLS TEST CODE:** 159

**Reference Method:** Modified NIOSH 0500, 4th Edition

(Note: This analysis is performed gravimetrically.)

**Reporting Limit:** 100 µg/sample

**Collection Media:** Filter [PVC 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) [CAS # VARIOUS]**

**INCLUDES CHLORPYRIFOS (DURSBAN), DDVP (DICHLORVOS), DIAZINON, MALATHION, AND PARATHION**

**DLS Test Code:** 531

**Reference Method:** OSHA 62

**Reporting Limit:** Varies by Pesticide

**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)

**Air Collection Volume (L):** 480 (except for Malathion)  
60 (for Malathion)

(No Range Given in Reference Method)

**Special Instructions:** None

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**OZONE [CAS # 10028-15-6]**

**DLS Test Code:** 160

**Reference Method:** OSHA ID-214

**Reporting Limit:** 5 µg/sample

**Collection Media:** TWO Treated Filters, SKC-225-9014 or equivalent. Limited shelf-life (within four weeks of preparation)

**Sample Flow Rate (LPM):** 0.25 - 0.5

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

**Special Instructions:** None

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**PAHS [CAS # Various] - SEE POLYNUCLEAR AROMATIC HYDROCARBONS DLS TEST CODE: 020**

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**PARATHION [CAS # 56-38-2]**

**DLS Test Code:** 1325

**Reference Method:** OSHA 62

**Reporting Limit:** 0.2 µg/sample

**Collection Media:** Filter AND Solid Sorbent Tube [13 mm, Glass fiber filter AND XAD-2, 270/140 mg]

**Sample Flow Rate (LPM):** 1.0 (No Range Given in Reference Method)

**Air Collection Volume (L):** 480 (No Range Given in Reference Method)

**Special Instructions:** None

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**PCBs [CAS # VARIOUS] - SEE POLYCHLORINATED BIPHENYLS, DLS TEST CODE: 524**

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**PCP [CAS # 87-86-5] - SEE PENTACHLOROPHENOL, DLS TEST CODE: 999**

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**PENTACHLOROPHENOL (PCP) [CAS # 87-86-5]****DLS TEST CODE:** 999**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)**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 filters after sampling. Please contact the DLS USACHPPM-Main IH Technical Consultant for additional guidance.*

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**N-PENTANE [CAS # 111-65-9]****DLS Test Code:** 1000**Reference Method:** NIOSH 1500, 4th Edition**Reporting Limit:** 30 µg/sample**Collection Media:** Solid Sorbent Tubes [Coconut Shell Charcoal, 100 mg/50 mg]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.01 – 0.2**Air Collection Volume:** 4 (No Range Given in Reference Method)**Special Instructions:** None

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**1,5-PENTANEDIAL [CAS # 111-30-8] - SEE GLUTARALDEHYDE, DLS TEST CODE: 099**

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**PERCHLOROETHYLENE (TETRACHLOROETHYLENE) [CAS # 127-18-4]****DLS TEST CODE:** 165**Reference Method:** NIOSH 1003, 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 - 40**Special Instructions:**

*Sample stability not determined.*



**PETROLEUM DISTILLATES****DLS Test Code:** 166**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 sampling tubes.*
  2. *Stable at least one week at 25° C.*
- 

**PETROLEUM NAPHTHA****DLS TEST CODE:** 167**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 sampling tubes.*
  2. *Stable at least one week at 25° C.*
- 

**PHENOL [CAS # 108-95-2]****DLS Test Code:** 169**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 (H<sub>3</sub>PO<sub>4</sub>) [CAS # 7664-38-2]****DLS Test Code:** 170**Reference Method:** NIOSH 7903, 4th Edition**Reporting Limit:** 5 µg/sample**Collection Media:** Solid Sorbent Tube [High-Purity Washed Silica Gel, 400/200 mg, ORBO 53 tube or equivalent]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.2 - 0.5**Air Collection Volume - Minimum-Maximum (L):** 3 - 100**Special Instructions:***Stable at least 21 days at 25° C.*

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**PHOSPHORUS, WHITE OR YELLOW [CAS # 7723-14-0]****DLS Test Code:** 917**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.*

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**PNAS [CAS # VARIOUS] - SEE POLYNUCLEAR AROMATIC HYDROCARBONS, DLS TEST CODE: 020**

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**POLYCHLORINATED BIPHENYLS (PCBs) [CAS # VARIOUS]****DLS Test Code:** 524**Reference Method:** NIOSH 5503, 4th Edition**Reporting Limit:** 0.05 µg/sample**Collection Media:** Filter AND Solid Sorbent Tube [13 mm Glass fiber filter AND Florisil<sup>®</sup> tube, 100mg/50 mg]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.05 - 0.2**Air Collection Volume - Minimum-Maximum (L):** 1 - 50**Special Instructions:**

1. Glass fiber filter must be transferred to glass vial for shipment to laboratory.
  2. Sample stability for filters unknown; two months for Florisil.
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**POLYNUCLEAR AROMATIC HYDROCARBONS [CAS #: VARIOUS]****DLS Test Code:** 1507**Reference Method:** NIOSH 5506, 4th Edition**Reporting Limit:** As low as possible**Collection Media:** Filter and Solid Sorbent Tube [37 mm PTFE, 2 micron AND XAD-2, 100mg/50mg]**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.
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**POTASSIUM [CAS # 7440-09-7]****CONTRACT ONLY****DLS Test Code:** 172**Reference Method:** Modified NIOSH 7300, 4th Edition**Reporting Limit:** 15 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:**

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

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**N-PROPYL ALCOHOL (1-PROPANOL) [CAS # 71-23-8]****DLS Test Code:** 1326**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

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**N-PROPYL ALCOHOL (1-PROPANOL) [CAS # 71-23-8] (CONTINUED)****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.*
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**RDX (CYCLONITE) [CAS # 121-82-4]****DLS Test Code:** 1525**Reference Method:** OSHA 44 for Sampling Requirements  
CAD CAB 13 for Sample Analysis**Reporting Limit:** 0.5 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.*
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**RESPIRABLE DUST, NUISANCE - SEE DUST, NUISANCE (RESPIRABLE), DLS TEST CODE: 1188****SELENIUM [CAS # 7782-49-2]****DLS Test Code:** 989**Reference Method:** Modified NIOSH 7300, 4th Edition**Reporting Limit:** 1 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):** 13 - 2000**Special Instructions:**

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

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**SILICA-CRYSTALLINE, RESPIRABLE [CAS # 7631-86-9]****CONTRACT ONLY****DLS Test Code:** 1337**Reference Method:** NIOSH 7500, 4th Edition**Reporting Limit:** 10 µg/sample**Collection Media:** Cyclone and Filter [10 mm Nylon Cyclone OR  
Higgins-Dewell Cyclone and Tared 5 micron PVC membrane]**Sample Flow Rate - Minimum-Maximum (LPM):**

For Nylon Cyclone: 1.7 (No Range Given in Reference Method)

For Higgins-Dewell Cyclone: 2.2 (No Range Given in Reference Method)

**Air Collection Volume - Minimum-Maximum (L):** 400 - 1000**Special Instructions:***Blanks should accompany samples at a 10% frequency rate.***SILVER [CAS # 7440-22-4]****DLS Test Code:** 177**Reference Method:** Modified NIOSH 7300, 4th Edition**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:***Provide one field blank and one media blank for each batch of 10 samples.***SODIUM [CAS # 7440-23-5]****CONTRACT ONLY****DLS Test Code:** 178**Reference Method:** Modified NIOSH 7300, 4th Edition**Reporting Limit:** 30 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):** 13 - 2000**Special Instructions:***Provide one field blank and one media blank for each batch of 10 samples.*

**STODDARD SOLVENT [CAS # 8052-41-3]****DLS Test Code:** 180**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**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 sampling tubes.
  2. Stable at least one week at 25° C.
- 

**STYRENE [CAS # 100-42-5]****DLS Test Code:** 181**Reference Method:** NIOSH 1501, 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):** Equal to or Less Than 1.0**Air Collection Volume - Minimum-Maximum (L):** 1 - 14**Special Instructions:** None

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**SULFUR DIOXIDE [CAS # 7446-09-5]****DLS Test Code:** 183**Reference Method:** OSHA ID-200**Reporting Limit:** 10 µg/sample**Collection Media:** Prefilter + Solid Sorbent Tube [Impregnated Activated Beaded Carbon (IABC), SKC 226-80, or equivalent]**Sample Flow Rate - (LPM):** 0.1 (No Range Given in Reference Method)**Air Collection Volumes (L):** 12 [TWA] (No Range Given in Reference Method)

1.5 [STEL\*] (No Range Given in Reference Method)

**Special Instructions:** None*\*Note: STEL - Short-Term Exposure Limit*

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**SULFURIC ACID (H<sub>2</sub>SO<sub>4</sub>) [CAS # 7664-93-9]****DLS Test Code:** 182**Reference Method:** NIOSH 7903, 4th Edition**Reporting Limit:** 1 µg/sample**Collection Media:** Solid Sorbent Tube [High-Purity Washed Silica Gel, 400/200 mg, ORBO 53 tube or equivalent]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.2 - 0.5**Air Collection Volume - Minimum-Maximum (L):** 3 - 100**Special Instructions:***Stable at least 21 days at 25° C.*

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**TCE [CAS # 79-01-6] - SEE TRICHLOROETHYLENE, DLS TEST CODE: 184**

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**TDI [CAS # Various] - SEE TOLUENE DIISOCYANATES, DLS TEST CODE: 188**

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**TETRACHLOROETHYLENE [CAS # 127-18-4] SEE PERCHLOROETHYLENE, DLS TEST CODE: 165**

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**1,1,2,2-TETRACHLOROETHANE [CAS # 79-34-5]****DLS Test Code:** 1001**Reference Method:** NIOSH 1019, 4th Edition**Reporting Limit:** 10 µg/sample**Collection Media:** Solid Sorbent Tube [Petroleum Charcoal, 100 mg/50 mg]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.01 - 0.2**Air Collection Volume - Minimum-Maximum (L):** 3 - 30**Special Instructions:***Sample stability not determined.*

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**TETRAHYDROFURAN [CAS # 109-99-9]****DLS Test Code:** 185**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 [CAS# 7440-28-0]****DLS Test Code:** 1805**Reference Method:** Modified NIOSH 7300, 4th Edition**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):** 25 - 2000**Special Instructions:**

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

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**TIN [CAS# 7440-31-5]****CONTRACT ONLY****DLS Test Code:** 1189**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:**

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

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**TITANIUM [CAS # 7440-32-6]****DLS Test Code:** 1027**Reference Method:** Modified NIOSH 7300, 4th Edition**Reporting Limit:** 0.15µg/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 - 100**Special Instructions:**

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

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**TNT [CAS # 118-96-7] - SEE 2,4,6-TRINITROTOLUENE, DLS TEST CODE: 013**

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**TOLUENE [CAS # 108-88-3]****DLS Test Code:** 187**Reference Method:** NIOSH 1501, 4th Edition**Reporting Limit:** 10 µg/sample**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal, 100 mg/50 mg]**Sample Flow Rate (LPM):** Equal to or Less Than 0.20**Air Collection Volume - Minimum-Maximum (L):** 1 - 8**Special Instructions:** None

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**TOLUENE DIISOCYANATES (TDI) [CAS # VARIOUS]****DLS Test Code:** 188**Reference Method:** OSHA 42**Reporting Limit:** 0.3 µg/sample**Collection Media:** Filter [ORBO 80 filter, or equivalent]**Sample Flow Rate - Minimum-Maximum (LPM):**

1.0 (No Range Given in Reference Method)

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

15 (No Range Given in Reference Method)

**Special Instructions:***Sampling media must be stored in refrigerator prior to use.*

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**TOTAL DUST, NUISANCE - SEE DUST, NUISANCE (TOTAL), DLS TEST CODE: 1227**

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**TOXICHLOR [CAS # 57-74-9] - SEE CHLORDANE, DLS TEST CODE: 1126**

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**1,1,1-TRICHLOROETHANE [CAS # 71-55-6] - SEE METHYL CHLOROFORM, DLS TEST CODE: 133**

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**1,1,2-TRICHLOROETHANE [CAS # 70-00-5]****DLS Test Code:** 190**Reference Method:** 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**Air Collection Volume - Minimum-Maximum (L):** 2 - 60**Special Instructions:***Sample stability not determined.*

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**1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE (FREON 113, REFRIGERANT 113) [CAS #76-13-1]****DLS Test Code:** 093**Reference Method:** NIOSH 1020, 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 - 0.05**Air Collection Volume - Minimum-Maximum (L):** 0.1 - 3**Special Instructions:***Ship refrigerated.*

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**TRICHLOROETHENE [CAS # 79-01-6] - SEE TRICHLOROETHYLENE, DLS TEST CODE: 184**

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**TRICHLOROETHYLENE (TCE, TRICHLOROETHENE, ETHYLENE TRICHLORIDE)  
[CAS # 79-01-6]****DLS Test Code:** 184**Reference Method:** NIOSH 1022, 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 - 30**Special Instructions:***Sample stability not determined.*

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**TRICHLOROFLUOROMETHANE (FREON 11, MONOFLUOROTRICHLOROMETHANE)  
[CAS # 75-69-4]****DLS Test Code:** 996**Reference Method:** NIOSH 1006, 4th Edition**Reporting Limit:** 10 µg/sample**Collection Media:** Solid Sorbent Tube [Coconut Shell Charcoal, 400/200 mg]**Sample Flow Rate - Minimum-Maximum (LPM):** 0.01 - 0.05**Air Collection Volume - Minimum-Maximum (L):** 0.3 - 7**Special Instructions:**

1. *Store and ship refrigerated.*
2. *Quantitative recovery after 8 days at 25° C.*

**2,4,6-TRINITROTOLUENE (TNT) [CAS # 118-96-7]****DLS Test Code:** 013**Reference Method:** OSHA 44 for Sampling Requirements,  
CAD CAB 13 for Sample Analysis**Reporting Limit:** 0.05µg/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.*
- 

**TURPENTINE (TURPENE) [CAS # 8006-64-2]****DLS Test Code:** 1327**Reference Method:** NIOSH 1551, 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 - 10**Special Instructions:***Stable at least one week at 25° C.*

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

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**VANADIUM [CAS # 7440-62-2]****DLS Test Code:** 194**Reference Method:** Modified NIOSH 7300, 4th Edition**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):** 5 - 2000

## VANADIUM [CAS # 7440-62-2] (CONTINUED)

**Special Instructions:**

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

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## VINYL CHLORIDE (CHLOROETHYLENE, CHLOROETHENE) [CAS # 75-01-4]

**DLS Test Code:** 993**Reference Method:** NIOSH 1007, 4th Edition**Reporting Limit:** 4 µg/sample**Collection Media:** Solid Sorbent Tube [Two Tandem Tubes,  
Each with 150 mg Activated Coconut Shell Charcoal]**Sample Flow Rate:** 0.05 (No Range Given in Reference Method)**Air Collection Volume - Minimum-Maximum (L):** 0.7 - 5**Special Instructions:**

- 1. Before shipment, separate the primary and the back-up tube and securely cap each. Clearly indicate which one is the primary tube.*
  - 2. Stable 10 days at 25° C.*
- 

## VM&amp;P NAPHTHA [CAS # 8032-32-4]

**DLS Test Code:** 196**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 sampling tubes.*
  - 2. Stable at least one week at 25° C.*
- 

## WELDING FUMES, TOTAL

**DLS Test Code:** 197**Reference Method:** Modified NIOSH 0500, 4th Edition**Reporting Limit:** 100 µg/sample

**WELDING FUMES, TOTAL (CONTINUED)**

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

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

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

**Special Instructions:**

*Secure sampling cassette inside welder's helmet.*

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**WELDING FUMES, PROFILE**

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

**DLS 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.*

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**WOOD ALCOHOL [CAS # 67-56-1] - SEE METHANOL, DLS TEST CODE: 128**

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**XYLENES [CAS # 1330-20-7]**

**DLS Test Code:** 199

**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 Less Than 0.20

**Air Collection Volume - Minimum-Maximum (L):** 2 - 23

**Special Instructions:** None

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**ZINC [CAS # 1314-13-2]**

**DLS Test Code:** 200

**Reference Method:** Modified NIOSH 7300, 4th Edition

**Reporting Limit:** 2.5 µg/sample

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**ZINC [CAS # 1314-13-2] (CONTINUED)**

**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 - 200

**Special Instructions:**

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

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APPENDIX C

OCONUS U.S. SUPPORT SERVICES

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**C-1. CUSTOMER SUPPORT SERVICES**

Good lines of communication with customers offer the USACHPPM laboratories the ability to respond to customer needs. Communication and interaction with the USACHPPM 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. USACHPPM-Europe**

**IH customers in Europe, Africa, and the Middle East** should coordinate their sampling activities with the USACHPPM-Europe laboratory at the addresses listed below:

- (1) APO address—

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

- (2) Commercial or civilian address—

USACHPPM-EUROPE  
Department of Laboratory Sciences  
ATTN: MCHB-AE-LD (CSD)  
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](mailto:usachppmeur.dlshotline@amedd.army.mil)

**b. USACHPPM-PACIFIC**

**IH customers in Asia, Alaska and Hawaii** should coordinate their sampling activities with the USACHPPM-Pacific laboratory at the addresses listed below:

- (1) APO address—

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

- (2) Commercial or civilian address—

USACHPPM-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: 0462-51-1520, Ext. 263-8418  
Commercial from outside Japan: 011 81 3117 63 8418

Fax: DSN: 8-315-263-8597  
Commercial within Japan: 0462-51-1520, Ext. 263-8507  
Commercial from outside Japan: 011 81 3117 63 8597

E-Mail: CHPPMPAC-LAB@jpn.amed.army.mil

**APPENDIX D**  
**INFORMATION ABOUT IH MONITORING SUPPLIES**

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**D-1. SUGGESTED SOURCES FOR IH 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 08360  
(800) 223-4524  
<http://www.aceglass.com>

**AMERICAN CHEMICAL SOCIETY  
ENVIRONMENTAL BUYER'S GUIDE**

1155 16th Street, NW  
Washington, DC 20036  
(800)-245-3182  
<http://www.rimbach.com>

**FISHER SCIENTIFIC**

Telephone: (800)-766-7000  
<http://www.fisher1.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  
<http://www.vwrsp.com>

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

**D-2. EXAMPLES OF ACCEPTABLE IH MONITORING SUPPLIES**

The following tables give examples of different types of monitoring supplies which are acceptable for use with the test methods used at USACHPPM 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**

<b>SAMPLER TYPE</b>	<b>SIZE (mm)</b>	<b>POROSITY (microns)</b>	<b>SUGGESTED SOURCE</b>	<b>CATALOG NUMBER</b>
Cellulose Ester (CE) (*Note: For Asbestos use a 25 mm monitor with 50 mm conductive extension cowl.)	25	0.8	Pall/Gelman <sup>®</sup>	64677 (GN-4)
	25	0.8	Millipore <sup>®</sup>	AAWP-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

Gelman<sup>®</sup> is a registered trademark of Pall Corp., Ann Arbor, MI.

Millipore<sup>®</sup> is a registered trademark of Millipore Filter Corp., Billerica, MA.

**TABLE D-2. PASSIVE MONITORS**

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

TABLE D-3. SOLID SORBENT TUBES

SAMPLER TYPE	SIZE (mm)	SUGGESTED SOURCE	CATALOG NUMBER
Alumina	400/200	SKC	ST 226-18
Ammonia	500/250	Sigma Aldrich	ORBO-77
Charcoal (for Solvents)	100/50	SKC	ST 226-01
	100/50	Sigma Aldrich	ORBO-32 small
Chromosorb 102 (for Pesticides)	66/33	SKC	ST 226-49-102
	100/50	Sigma Aldrich	ORBO-42 large
	66/33	Sigma Aldrich	ORBO-42 small
Chromosorb P (for Acids)	335-185	Sigma Aldrich	ORBO-70
Ethylene Oxide	400/200	Sigma Aldrich	ORBO-78
Florisil	100/50	SKC	ST 226-39
Formaldehyde	300/150	SKC	ST 226-119
Inorganic Acids (High-Purity Silica Gel)	400/200	Sigma Aldrich	ORBO-53
	400/200	SKC	ST 226-10-03
Nitrogen Dioxide	400/200	SKC	ST 226-40-02 (SP)
Polyaromatic Hydrocarbons	100/50	Sigma Aldrich	ORBO-43
Silica Gel	520/260	SKC	ST 226-15
Silica Gel, H <sub>2</sub> SO <sub>4</sub> Treated	200/100	SKC	ST 226-10-06
Sulfur Dioxide	100/50	SKC	ST 226-80
Tenax	100/50	SKC	ST 226-35-03
Tenax with Built-in Filter	140/70	SKC	ST 226-56
XAD-2	400/200	SKC	ST 226-30-06

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APPENDIX E

PARTICLE SIZE-SELECTIVE DUST SAMPLING

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## E-1. Background

Historically, particulates have been measured and expressed as "total particulates" or "total dust". Total dust covers 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 dust generally includes particle sizes in the range of 1  $\mu\text{m}$  to 50  $\mu\text{m}$  aerodynamic equivalent diameter (AED), but particulates up to 100  $\mu\text{m}$  in size typically collect in the nasal region. Dust particles of a size less than 1  $\mu\text{m}$  tend not to be deposited in the lung as their small size keeps them airborne; they move in and out with the air.

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 (typically 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. ACGIH PARTICLE SIZE CRITERIA FOR AIRBORNE DUSTS**

<b>PARTICULATE MASS</b>	<b>AED</b>	<b>HAZARDOUS DEPOSITION AREA</b>	<b>50% AED CUT POINT</b>
Total	1 $\mu\text{m}$ - 100 $\mu\text{m}$	Respiratory tract from nasal passages to the gas exchange region	100 $\mu\text{m}$
Inhalable	1 $\mu\text{m}$ - 100 $\mu\text{m}$	Respiratory tract from nasal passages to the gas exchange region	100 $\mu\text{m}$
Thoracic	1 $\mu\text{m}$ - 25 $\mu\text{m}$	Lung airways and gas exchange region	10 $\mu\text{m}$
Respirable	1 $\mu\text{m}$ - 10 $\mu\text{m}$	Gas exchange region of lung	4 $\mu\text{m}$
	<1 $\mu\text{m}$	Tend not to be deposited in the lung	<1 $\mu\text{m}$

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

## E-2. INHALABLE PARTICLE SIZE DUSTS

Substances that have been reviewed by the ACGIH are now reported as "inhalable" where appropriate. Inhalable dusts are materials that are hazardous when deposited anywhere in the respiratory tract. These are particles having a 50 percent cut-point of 100  $\mu\text{m}$ . Inhalable dust standards (2004) are listed in Table E-2. The list includes numerous pesticides such as diazinon and malathion, materials such as magnesium oxide and talc, as well as some metal compounds of molybdenum and nickel.

TABLE E-2. INHALABLE DUST STANDARDS (2004)

ITEM	SUBSTANCE	CAS No.	TWA
1	Asphalt, benzene soluble aerosol	8052-42-4	0.5 mg/m <sup>3</sup>
2	Azinphos-methyl	86-50-0	0.2 mg/m <sup>3</sup>
3	Butylated hydroxytoluene	128-37-0	2 mg/m <sup>3</sup>
4	Caprolactam dust	105-60-2	1 mg/m <sup>3</sup>
5	Captan	133-06-2	5 mg/m <sup>3</sup>
6	Carbofuran	1563-66-2	0.1 mg/m <sup>3</sup>
7	Chlorpyrifos	2921-88-2	0.1 mg/m <sup>3</sup>
8	Demeton	8065-48-3	0.05 mg/m <sup>3</sup>
9	Demeton-S-methyl	919-86-8	0.05 mg/m <sup>3</sup>
10	Diazinon	333-41-5	0.01 mg/m <sup>3</sup>
11	2,2-Dichloropropionic acid	75-99-0	5 mg/m <sup>3</sup>
12	Dichlorvos	62-73-7	0.1 mg/m <sup>3</sup>
13	Dicrotophos	141-66-2	0.05 mg/m <sup>3</sup>
14	Dioxathion	78-34-2	0.1 mg/m <sup>3</sup>
15	Diquat (Inhalable)	2764-72-9	0.5 mg/m <sup>3</sup>
16	Disulfoton	298-04-4	0.05 mg/m <sup>3</sup> (V)
17	EPN	2104-64-5	0.1 mg/m <sup>3</sup>
18	Ethion	563-12-2	0.05 mg/m <sup>3</sup>
19	2-Ethylhexanoic acid	149-57-5	5 mg/m <sup>3</sup> (V)
20	Flour dust	NA	0.5 mg/m <sup>3</sup>
21	Glyoxal	107-22-2	0.1 mg/m <sup>3</sup> (V)
22	Hexahydrophthalic anhydride, All isomers	13149-00-3	0.005 mg/m <sup>3</sup> (V)
23	Hexahydrophthalic anhydride, All isomers	14166-21-3	0.005 mg/m <sup>3</sup> (V)
24	Hexahydrophthlic anhydride, All isomers	85-42-7	0.005 mg/m <sup>3</sup> (V)
25	Isobutyl nitrite	542-56-3	STEL C 1 ppm (V)
26	Magnesium oxide (fume)	1309-48-4	10 mg/m <sup>3</sup>
27	Malathion	121-75-5	1 mg/m <sup>3</sup> (V)
28	Mevinphos	7786-34-7	0.01 mg/m <sup>3</sup> (V)
29	Molybdenum, metal and insoluble compounds	7439-98-7	10 mg/m <sup>3</sup>
30	Monocrotophos	6923-22-4	0.05 mg/m <sup>3</sup>
31	Naled	300-76-5	0.1 mg/m <sup>3</sup> (V)

**TABLE E-2. INHALABLE DUST STANDARDS (2004) (CONTINUED)**

ITEM	SUBSTANCE	CAS No.	TWA
32	Natural rubber latex, as Total proteins	4/6/9006	0.001 mg/m <sup>3</sup>
33	Nickel, elemental	7440-02-0	1.5 mg/m <sup>3</sup>
34	Nickel, soluble inorganic compounds		0.1 mg/m <sup>3</sup>
35	Nickel, insoluble inorganic compounds		0.2 mg/m <sup>3</sup>
36	Nickel subsulfide, as Ni	12035-72-2	0.1 mg/m <sup>3</sup>
37	p,p'-Oxybis(benzenesulfonyl hydrazide)	80-513	0.1 mg/m <sup>3</sup>
38	Parathion	56-38-2	0.05 mg/m <sup>3</sup> (V)
39	Silica, amorphous - diatomaceous earth (uncalcined)	61790-53-2	10 mg/m <sup>3</sup>
40	Silicon carbide, nonfibrous (inhalable)	409-21-2	10 mg/m <sup>3</sup> (E)
41	Synthetic vitreous fibers- continuous filament glass fibers	NA	5 mg/m <sup>3</sup>
42	Terbufos	13071-79-9	0.01 mg/m <sup>3</sup> (V)
43	Trichlorphon	52-68-6	1 mg/m <sup>3</sup>
44	Xylidine, mixed isomers	1330-73-8	0.5 ppm

Notes:

V - Vapor and aerosol.

E - Particulate matter containing no asbestos and &lt;1% crystalline silica.

**E-3. THORACIC PARTICLE SIZE DUSTS**

Thoracic dusts are dusts deposited anywhere within the lung airways and the gas-exchange region. These dust particles have a 50 percent cut-point of 10 µm. There is one thoracic dust standard (2004) – sulfuric acid - listed below in Table E-3.

**TABLE E-3. THORACIC DUST STANDARD (2004)**

Item	Substance	CAS No.	TWA
1	Sulfuric acid	7664-93-9	0.2 mg/m <sup>3</sup>

**E-4. RESPIRABLE PARTICLE SIZE DUSTS**

Respirable dusts are dusts that are hazardous when deposited anywhere in the gas-exchange region of the lung. These dust particles have a 50 percent cut-point of 4 µm. Respirable dust standards (2004), which include a series of silicas, are listed in Table E-4.

**TABLE E-4. RESPIRABLE DUST STANDARDS (2004)**

ITEM	SUBSTANCE	CAS No.	TWA	STEL
1	Cadmium and compounds	7440-43-9	0.002 mg/m <sup>3</sup>	
2	Coal dust-Anthracite		0.4 mg/m <sup>3</sup>	
3	Coal dust-Bituminous		0.9 mg/m <sup>3</sup>	
4	Diquat (Respirable)	2764-72-9	0.1 mg/m <sup>3</sup>	
5	Glycerin-mist	56-81-5	3 mg/m <sup>3</sup>	
6	Graphite (all forms except graphite fibers)	7782-42-5	2 mg/m <sup>3</sup>	
7	Kaolin	1332-58-7	2 mg/m <sup>3</sup> (E)	
8	Magnesium oxide (respirable dust and fume), as Mg	1309-48-4	3 mg/m <sup>3</sup>	10 mg/m <sup>3</sup>
9	Mica	12001-26-2	3 mg/m <sup>3</sup>	
10	Molybdenum, soluble compounds	7439-98-7	0.5 mg/m <sup>3</sup>	
11	Molybdenum, metal and insoluble compounds	7439-98-7	3 mg/m <sup>3</sup>	
12	Paraquat	4685-14-7	0.1 mg/m <sup>3</sup>	
13	Silica, amorphous - fume (uncalcined)	69012-64-2	3 mg/m <sup>3</sup>	
14	Silica, amorphous - diatomaceous earth (uncalcined)	61790-53-2	3 mg/m <sup>3</sup>	
15	Silica, amorphous - silica fume	69012-64-2	1.5 mg/m <sup>3</sup>	
16	Silica, amorphous - silica, fused	60776-86-0	2 mg/m <sup>3</sup>	
17	Silica, crystalline - Cristobalite	14464-46-1	0.05 mg/m <sup>3</sup>	
18	Silica, crystalline - Quartz	14808-60-7	0.05 mg/m <sup>3</sup>	
19	Silica, crystalline - Tridymite	15468-32-3	0.05 mg/m <sup>3</sup>	
20	Silica, crystalline - Tripoli, as Quartz	1317-95-9	0.1 mg/m <sup>3</sup>	
21	Silicon carbide, nonfibrous (respirable)	409-21-2	3 mg/m <sup>3</sup> (E)	
22	Soapstone	NA	3 mg/m <sup>3</sup> (E)	
23	Talc - containing no asbestos fibers	14807-96-6	2 mg/m <sup>3</sup> (E)	
24	Vanadium pentoxide, dust and fume, as V2O5	1314-62-1	0.05 mg/m <sup>3</sup>	
25	Zinc oxide	1314-13-2	2 mg/m <sup>3</sup>	10 mg/m <sup>3</sup>

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

A total dust sample is usually collected on standard 37 mm polyvinyl chloride (PVC) filters in a 3-stage cassette, using airflow in the range of 2 Liters per minute (L/min). A respirable dust 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 dust sample with a Dorr-Oliver cyclone is 1.7 L/min.

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  $\mu\text{m}$  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<sup>TM</sup> foam disc and filter converts the IOM into a multipurpose personal dust 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.

**\*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.

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MultiDust<sup>TM</sup> is a trademark of SKC, Inc., Eighty Four, PA.

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**APPENDIX F**

**USACHPPM FORMS**

FIGURE 1. USACHPPM FORM 8-R-E, INDUSTRIAL HYGIENE BULK SAMPLE DATA.

FIGURE 2. USACHPPM FORM 9-R-E, INDUSTRIAL HYGIENE AIR SAMPLE DATA.

FIGURE 3. USACHPPM FORM 235-R-E, CHAIN OF CUSTODY RECORD.

FIGURE 4. USACHPPM FORM 330-R-E, REQUEST FOR LABORATORY SERVICES

FIGURE 5. USACHPPM DLS CUSTOMER COMMENT/COMPLAINT FORM.

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<h2 style="margin: 0;">INDUSTRIAL HYGIENE BULK SAMPLE DATA</h2> <p style="margin: 0;"><i>(For use of this form, see USACHPPM TG 141; the proponent is MCHB-TS-LLC)</i></p>	<p><b>FOR DLS USE ONLY</b></p> <p>LIMS Workorder#: _____</p> <p>Date Received: _____</p> <p>Date Accepted: _____</p> <p>Processor's Initials/Date: _____</p>
<p><b>SECTION A: GENERAL INFORMATION</b></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, CHPPM ONLY (2 Characters): <input type="text"/>      3. Subjono (4 Characters): <input type="text"/></p>	
<p><b>POC Information</b></p> <p>4. POC Name <input style="width: 150px;" type="text"/> <input style="width: 150px;" type="text"/>  <span style="display: inline-block; width: 150px; text-align: center;">First Name</span> <span style="display: inline-block; width: 150px; text-align: center;">Last name</span></p> <p>5. Voice Phone Number (30 Characters Maximum): <input style="width: 150px;" type="text"/> <input style="width: 150px;" type="text"/>  <span style="display: inline-block; width: 150px; text-align: center;">Voice</span> <span style="display: inline-block; width: 150px; text-align: center;">DSN</span></p> <p>6. Voice DSN (30 Characters Maximum): <input style="width: 150px;" type="text"/></p> <p>7. Fax Number: (30 Characters Maximum): <input style="width: 150px;" type="text"/></p> <p>8. E-mail Address (80 Characters Maximum): <input style="width: 300px;" type="text"/></p> <p>9. Street (30 Characters Maximum): <input style="width: 150px;" type="text"/> <input style="width: 150px;" type="text"/>  <span style="display: inline-block; width: 150px; text-align: center;">Street</span> <span style="display: inline-block; width: 150px; text-align: center;">City</span></p> <p>10. City (20 Characters Maximum): <input style="width: 150px;" type="text"/></p> <p>11. State (2 Characters Maximum): <input style="width: 50px;" type="text"/></p> <p>12. Zip Code + 4 (9 Characters Maximum): <input style="width: 100px;" type="text"/></p> <p>13. Country (30 Characters Maximum): <input style="width: 150px;" type="text"/></p>	
<p>14. Name of Sampled Installation (50 Characters Maximum): <input style="width: 350px;" type="text"/></p> <p>15. Associated Complaints/Investigative DOEHS &amp; Comments to the Lab (Be Specific/State "NONE" if applicable) (255 Characters Max.):  <input style="width: 650px; height: 40px;" type="text"/></p>	
<p>16. Priority Requested:   <input type="radio"/> Standard,   <input type="radio"/> High,   <input type="radio"/> Top (Standard: 20 business days; High: 10 business days, prior approval required; Top: 5 business days, prior approval required)</p> <p>17. Requested Due Date: <input style="width: 100px;" type="text"/></p> <p>18. Was Project Coordinated w/DLS?Y (Yes) or N (No) (1 Character): <input type="checkbox"/></p> <p>19. DLS Technical Consultant: <input style="width: 150px;" type="text"/> <input style="width: 150px;" type="text"/>  <span style="display: inline-block; width: 150px; text-align: center;">First Name</span> <span style="display: inline-block; width: 150px; text-align: center;">Last name</span></p> <p>20. Sample Collector: <input style="width: 150px;" type="text"/> <input style="width: 150px;" type="text"/>  <span style="display: inline-block; width: 150px; text-align: center;">First Name</span> <span style="display: inline-block; width: 150px; text-align: center;">Last name</span></p> <p>21. Are there associated Air Samples?: Y (Yes) or N (No) (1 Character): <input type="checkbox"/></p> <p>22. Field ID of first Air Sample, if applicable (30 Characters Maximum): <input style="width: 150px;" type="text"/></p> <p style="margin-left: 20px;"><b>Note: Air Samples Must Be Shipped In a Separate Container from Bulk Samples.</b></p> <p>23. Date Shipped (mm/dd/yyyy) (10 Characters): <input style="width: 100px;" type="text"/></p>	
<p>CHPPM Form 8-R-E, Jan 05 (MCHB-TS-LLC)      Replaces CHPPM Form 8-R-E, May 96, which is obsolete.</p>	

Figure 1. Sample USACHPPM Form 8-R-E

SECTION B: ANALYSIS & SAMPLE INFORMATION				
24. a. Field Sample ID (30 Characters Maximum)	b. Laboratory Number	c. Date Collected (mm/dd/yyyy)	d. Requested Analysis (10 Char Max) <i>DLS Acode or analysis or requested</i>	e. Remarks (60 Characters Maximum)

SECTION C: LOCATION AND OPERATION INFORMATION
25. Building/Area (20 Characters Maximum): <input style="width: 100%;" type="text"/>
26. Location Name (50 Characters Maximum): <input style="width: 100%;" type="text"/>
27. Operation Name (50 Characters Maximum): <input style="width: 100%;" type="text"/>
28. Operation Employee(s) Perform (255 Characters Maximum): <div style="border: 1px solid black; height: 80px; margin-top: 5px;"></div>
29. Source of Contaminant (255 Characters Maximum): <div style="border: 1px solid black; height: 100px; margin-top: 5px;"></div>
CHPPM Form 8-R-E, Jan 05 (MCHB-TS-LLC) <span style="float: right;">Replaces CHPPM Form 8-R-E, May 96, which is obsolete.</span>

<h2 style="margin: 0;">INDUSTRIAL HYGIENE AIR SAMPLE DATA</h2> <p style="margin: 0;"><i>(For use of this form, see USACHPPM TG 141; the proponent is MCHB-TS-LLC)</i></p>	<p><b>FOR DLS USE ONLY</b></p> <p>LIMS Workorder#: _____</p> <p>Date Received: _____</p> <p>Date Accepted: _____</p> <p>Processor's Initials/Date: _____</p>
<b>SECTION A: GENERAL INFORMATION</b>	
<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, CHPPM ONLY (2 Characters): <input type="text"/>      3. Subjono (4 Characters): <input type="text"/></p>	
<p><b>POC Information:</b></p> <p>4. POC Name: <input style="width: 150px;" type="text"/> <input style="width: 150px;" type="text"/>  <span style="display: flex; justify-content: space-between; font-size: small;"> <span>REQUIRED      REQUIRED</span> <span>First Name      Last name</span> </span></p> <p>5. Voice Phone Number (30 Characters Maximum): <input style="width: 150px;" type="text"/> <span style="float: right; font-size: small;">REQUIRED</span></p> <p>6. Voice DSN (30 Characters Maximum): <input style="width: 150px;" type="text"/></p> <p>7. Fax Number: (30 Characters Maximum): <input style="width: 150px;" type="text"/></p> <p>8. E-mail Address (80 Characters Maximum): <input style="width: 300px;" type="text"/></p> <p>9. Street (30 Characters Maximum): <input style="width: 150px;" type="text"/> <span style="float: right; font-size: small;">REQUIRED</span></p> <p>10. City (20 Characters Maximum): <input style="width: 150px;" type="text"/> <span style="float: right; font-size: small;">REQUIRED</span></p> <p>11. State (2 Characters Maximum): <input style="width: 80px;" type="text"/> <span style="float: right; font-size: small;">REQUIRED</span></p> <p>12. Zip Code + 4 (9 Characters Maximum): <input style="width: 100px;" type="text"/> <span style="float: right; font-size: small;">REQUIRED</span></p> <p>13. Country (30 Characters Maximum): <input style="width: 150px;" type="text"/></p>	
<p>14. Name of Sampled Installation (50 Characters Maximum): <input style="width: 300px;" type="text"/> <span style="float: right; font-size: small;">REQUIRED</span></p> <p>15. Associated Complaints/Investigative DOEHS &amp; 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: 20 business days; High: 10 business days, prior approval required; Top: 5 business days, prior approval required)</p> <p>17. Requested Due Date: <input style="width: 80px;" type="text"/></p> <p>18. Was Project Coordinated w/DLS? Y (Yes) or N (No) (1 Character): <input type="checkbox"/></p> <p>19. DLS Technical Consultant Name (20 Characters Maximum): <input style="width: 150px;" type="text"/> <input style="width: 150px;" type="text"/>  <span style="display: flex; justify-content: space-between; font-size: small;"> <span>First Name</span> <span>Last name</span> </span></p> <p>20. Sample Collector Name (20 Characters Maximum): <input style="width: 150px;" type="text"/> <input style="width: 150px;" type="text"/>  <span style="display: flex; justify-content: space-between; font-size: small;"> <span>First Name</span> <span>Last name</span> </span></p> <p>21. Are there associated 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 style="width: 150px;" type="text"/></p> <p style="font-size: 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 style="width: 200px;" type="text"/> <span style="float: right; font-size: small;">REQUIRED</span></p> <p>24. Date Shipped (mm/dd/yyyy) (10 Characters): <input style="width: 100px;" type="text"/></p>	
<p>CHPPM Form 9-R-E, Jan 05 (MCHB-TS-LLC) <span style="float: right;">Replaces CHPPM Form 9-R-E, May 96, which is obsolete.</span></p>	

Figure 2. Sample USACHPPM Form 9-R-E

SECTION B: ANALYSIS INFORMATION										
NOTE: 1) ALL SAMPLES IN SECTION C WILL BE ANALYZED FOR ALL THE TESTS INDICATED IN THIS SECTION.										
25.	a. DLS Test (acode)	b. Analysis Requested								
	REQUIRED									
SECTION C: SAMPLE INFORMATION										
NOTE: ALL SAMPLES WILL BE ANALYZED FOR ALL THE TESTS INDICATED IN SECTION B.										
26.	a. Field Sample ID#	b. Spl Type GA/ BZ*	c. Date Collected	d. Employee ID	e. Pump Serial #	f. Pump Time On	g. Pump Time Off	h. Total Time (Minute s)	i. Flow Rate (LPM)	j. Total Volume(L) [Flow Rate X Total Time]
	REQUIRED		REQUIRED			B	L	A	N	K
*GA: General air sample; BZ: Breathing zone										
CHPPM Form 9-R-E, Jan 05 (MCHB-TS-LLC)					Replaces CHPPM Form 9-R-E, May 96, which is obsolete.					

SECTION D: CALIBRATION INFORMATION						
27. Calibrator's Name : <input style="width: 150px; height: 15px;" type="text"/> <input style="width: 150px; height: 15px;" type="text"/>						
First Name			Last name			
29. Note: See TG 141, Chapter 2, Section 2-7f for Information on Sampling, Pump Flow Rate Calibrations and Reporting						
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; height: 15px;" type="text"/>						
31. Location Name (50 Characters Maximum): <input style="width: 280px; height: 15px;" type="text"/>						
32. Operation Name (50 Characters Maximum): <input style="width: 280px; height: 15px;" type="text"/>						
33. Operation Employee(s) Perform (255 Characters Maximum):						
34. Number of Persons Exposed (3 Characters Maximum): <input style="width: 50px; height: 15px;" type="text"/>						
35. Exposure Duration and Frequency:						
			a. Minutes (4 Char.):	<input style="width: 50px; height: 15px;" type="text"/>		
			b. Time(s) per Day (4 Char.):	<input style="width: 50px; height: 15px;" type="text"/>		
			c. Total Minutes/Day (4 Char.):	<input style="width: 50px; height: 15px;" type="text"/>		
			d. Days/Week (1 Char.):	<input style="width: 50px; height: 15px;" type="text"/>		
			e. Days/Month (2 Char.):	<input style="width: 50px; height: 15px;" type="text"/>		
			f. Months/Year (2 Char.):	<input style="width: 50px; height: 15px;" 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; height: 15px;" type="text"/>						
38. Field Notes/Comments:						
CHPPM Form 9-R-E, Jan 05 (MCHB-TS-LLC) <span style="float: right;">Replaces CHPPM Form 9-R-E, May 96, which is obsolete.</span>						

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<h2 style="margin: 0;">Request For Laboratory Services</h2> <p style="margin: 0;"><i>(For use of this form, see USACHPPM TG 214; the proponent is MCHB-TS-LID)</i></p>	<p><b>FOR DLS USE ONLY</b></p> <p>LIMS Workorder#: _____</p> <p>Date Received: _____</p> <p>Date Accepted: _____</p> <p>Processor's Initials/Date: _____</p>
<b>SECTION A: PROJECT INFORMATION</b>	
<p>1. Request submitted by: <input type="text"/> <input type="text"/> <input type="text"/></p> <p style="text-align: center; font-size: small;">Title      First Name      Last name</p>	
<p>2. Send a copy of this request to E-mail Address: <input style="width: 100%;" type="text"/></p>	
<p>3. Program Number, CHPPM ONLY: <input type="text"/>    4. JONO: <input type="text"/>    5. SUBJONO: <input type="text"/></p>	
<p><b>Project Officer Information</b></p>	
<p>6. Project Officer Name: <input type="text"/> <input type="text"/> <input type="text"/></p> <p style="text-align: center; font-size: small;">Title      First Name      Last name</p>	
<p>7. Voice Phone Number: <input style="width: 100%;" type="text"/></p>	
<p>8. Voice DSN: <input style="width: 100%;" type="text"/></p>	
<p>9. Cell Phone: <input style="width: 100%;" type="text"/></p>	
<p>10. Fax Number: <input style="width: 100%;" type="text"/></p>	
<p>11. E-mail Address: <input style="width: 100%;" type="text"/></p>	
<p>12. Field Contact Person: <input type="text"/> <input type="text"/> <input type="text"/></p> <p style="text-align: center; font-size: small;">Title      First Name      Last name</p>	
<p>13. Field Phone: <input style="width: 100%;" type="text"/></p>	
<p>14. Was Project Coordinated w/DLS?Y (Yes) or N (No): <input type="checkbox"/></p>	
<p>15. DLS Technical Consultant: <input type="text"/> <input type="text"/> <input type="text"/></p> <p style="text-align: center; font-size: small;">Title      First Name      Last name</p>	
<p>16. Standard Fund Source: <input style="width: 100%;" type="text"/>    17. Special Fund Source: <input style="width: 100%;" type="text"/></p>	
<p>18. Date range that samples are expected to arrive at DLS (mm/dd/yyyy) : <input type="text"/> To <input type="text"/></p>	
<p>19. Project Name: <input style="width: 100%;" type="text"/></p>	
<p>20. Project Installation: <input style="width: 100%;" type="text"/></p>	
<p>21. Installation State: <input type="text"/>    22. Installation Country: <input style="width: 100%;" type="text"/></p>	
<p>23. Project Associations:    <input type="checkbox"/> a. Regulatory    <input type="checkbox"/> b. QAPP</p> <p style="margin-left: 20px;"><input type="checkbox"/> c. Other Special Conditions: <input style="width: 500px; height: 30px;" type="text"/></p>	
<p>24. Project Description / Objective: <input style="width: 100%; height: 40px;" type="text"/></p>	
<p>25. Will samples contain residual chlorine?    <input type="checkbox"/> All    <input type="checkbox"/> None</p> <p style="margin-left: 20px;"><input type="checkbox"/> Some    Explain: <input style="width: 500px; height: 30px;" type="text"/></p>	

Figure 4. Sample USACHPPM Form 330-R-E

26. Sample or Site History (High toxicity, etc.):

**SECTION B: PROJECT COORDINATION INFORMATION**

27. Are sampling kits/ supplies needed?  No,  Yes

28. Date the kit/supplies are requested by:

29. Kit handling preference:  Pick-Up  Ship

**Shipping Address Information**

30. Name:     
Title First Name Last name

31. Company:

32. Street:

33. City:  34. State:  35. Zip Code + 4:

36. Country:

37. Voice Phone Number:

38. Number of coolers requested:

39. Expected Number of Shipments:

**Special Handling Requirements**

40.  Chain-Of-Custody

41.  Safety Considerations Specify:

42.  Analyses with short holding times

List specific analyses:

43. Other Special Handling Requirements:

**SECTION C: REPORT DELIVERY OPTIONS**

44. Desired methods for delivery for results. Check all that apply:

Hardcopy (required)  Email  FAX

45. Desired electronic format (if applicable):

Electronic Report (pdf)  Excel file (xls)  Access file (mdb)

46. Name:

47. Company:

48. Street:

49. City:



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## Customer Comment/Complaint Form

Please provide comments (positive and negative) concerning DLS services on this form so the DLS can pursue the highest quality product possible. Your feedback enables us to identify strength and weakness in our current process and to appropriately direct resources for continuous quality improvement. Once you have completed the form on-line, select the "Submit" button to electronically forward the comments to the DLS Quality Compliance Manager.

**1. PERSON MAKING COMMENT:** (required fields)

Last Name:  First Name:

**2. DATE:**

**3. ORGANIZATION/ADDRESS:**

**4. PHONE NUMBERS = Com:**  **DSN:**  **FAX:**

**5. E-Mail Address:** (required field)

**6. COMMENT/COMPLAINT/PROBLEM (Who, What, When, Where, How):**

**7. SUGGESTED IMPROVEMENTS (if applicable):**

**8. Thank you for your comments/suggestions. Please send this form to:**

Figure 5. Sample DLS Customer Comment/Complaint Form

Commander, USACHPPM  
5158 Blackhawk Road  
ATTN: MCHB-TS-L, Quality Compliance Manager  
APG, MD 21010-5036

Press  to send your comment.      OR      Press  to clear the form and start again.

Note: Submitted forms are E-mailed to Rosemary.Gaffney@apg.amedd.army.mil;  
a copy of the submitted form will be sent to the E-mail address entered above.      ▲

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**[Return to DLS Home Page](#)**



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**GLOSSARY****GLOSSARY-1. ABBREVIATIONS**

A2LA	American Association for Laboratory Accreditation
AED	Aerodynamic equivalent diameter
AEL	Airborne Exposure Limit
AIHA	American Industrial Hygiene Association
ACGIH	American Conference of Governmental Industrial Hygienists
APG	Aberdeen Proving Ground
ASTM	American Society for Testing and Materials
BEI	Biological Exposure Indices
C	Celsius
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
DoD	Department of Defense
DOT	Department of Transportation
DSA	Direct Support Activity
ETO	Ethylene oxide
F/cc	Fibers per cubic centimeter
F/mm <sup>2</sup>	Fibers per square millimeter
GF	Glass fiber
Hg	Mercury
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
LIMS	Laboratory Information Management System
L/min	Liters per minute
LPM	Liters per minute
µg	microgram
MCE	mixed cellulose ester
mg	milligram
mg/L	milligrams per Liter
mg/m <sup>3</sup>	milligram per cubic meter
mm	millimeters
mm <sup>2</sup>	millimeters squared
MIDI	Military Item Disposal Instruction
min	minute
MSDS	Material Safety Data Sheets
MSHA	Mine Safety and Health Administration
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
OSHA	Occupational Safety and Health Administration
QA	Quality assurance
QC	Quality control
PC	Polycarbonate
P&CAM	Physical and Chemical Analytical Methods from NIOSH Manual of Analytical Methods, 4 <sup>th</sup> 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	Passive monitor
POC	Point of contact
ppm	Parts per million
PTFE	Polymer of tetrafluoroethylene
PVC	Polyvinyl Chloride

---

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
UPS	United Parcel Service
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USEPA	U.S. Environmental Protection Agency

## **GLOSSARY-2. 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 (e.g., 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.

### **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.

**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.

**Permissible Exposure Limit-Ceiling (PEL-C)**

The employee's exposure, which shall not be exceeded during any part of the work day. 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 work week which shall not be exceeded.

**Preservation**

Techniques, which 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 air to 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 of 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.

**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 three times the TLV-TWA for no more than a total of 30 minutes during a workday, and under no circumstances should they exceed five minutes 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.

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.

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

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

**LOCAL REPRODUCTION IS  
AUTHORIZED AND ENCOURAGED**

**FEBRUARY 2005**



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