

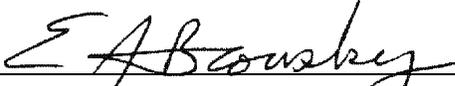


**Statement of Work
For Analytical Measurements**

**INDUSTRIAL HYGIENE
BREATHING AIR**

MODULE IH03-B.1

February 8, 2000

Approved: 
Analytical Services

Reviewed For Classification

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INDUSTRIAL HYGIENE BREATHING AIR MODULE

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INDUSTRIAL HYGIENE BREATHING AIR MODULE

INTRODUCTION

This module specifies the technical requirements, analytical methodologies, and quality control procedures that are used to generate data of known and documented quality for the quantitation of constituents and analytes of interest in breathing air samples.

The Laboratory shall utilize generally accepted good laboratory practices in the performance of contract requirements, and shall follow the quality assurance/quality control (QA/QC) program specified herein and as required by the General Laboratory Requirements Module, GR01.

In general, methods shall meet the analysis requirements for Grade D breathing air as described in the latest version of the Compressed Gas Association Inc. (CGA) Commodity Specification for Air, G-7.1, which will be referred hereafter as ANSI/CGA G-7.1. The U.S. Occupational Safety and Health Administration (OSHA) established Quality Verification Level (QVL) Grade D air as the standard to which workplace environments must comply in situations which come under the authority of this regulatory agency.

The following modules are required for the analysis of Industrial Hygiene Breathing Air under this subcontract: General Laboratory Requirement Module, GR01; Requirements for Analytical Services Electronic Deliverables Module, GR02; and Requirements for Industrial Hygiene Breathing Air Module, IH03. The specifications in Module IH03 shall supersede any Module GR01 specifications in the case of conflicting requirements.

EXHIBIT A
SUMMARY OF REQUIREMENTS

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INDUSTRIAL HYGIENE BREATHING AIR

SUMMARY OF REQUIREMENTS

1. GENERAL REQUIREMENTS

This module comprises eight Exhibits for the determination of constituents and analytes of interest in breathing air samples. Exhibit A provides an overview of the Industrial Hygiene Breathing Air module and its general requirements. Exhibit B contains the reporting and deliverables requirements which are in addition to Module GR01 requirements. Exhibit C contains the constituents of interest, their specification values, and method detection limits (MDLs). Exhibit D contains the specific analytical methods/procedures and defines any specific applications of these procedures for Industrial Hygiene breathing air analysis. Exhibit E contains general and specific laboratory QA/QC requirements. Exhibit F contains the evidentiary requirements, including chain-of-custody and document control requirements that the Laboratory must follow in processing samples under this subcontract, and specifies requirements for written laboratory Standard Operating Procedures (SOPs). To ensure proper understanding of language utilized in this subcontract, Exhibit G contains a glossary of terms which supplements the glossary found in Module GR01, Exhibit G. When a term is used in the text without definition, the glossary meaning shall be applicable. Exhibit H contains the references which are specific to this module.

The Laboratory provides the contractor with suitable air sampling kits. Breathing air is analyzed for oxygen content, concentrations of carbon dioxide and carbon monoxide, and total hydrocarbon content (THC) as an equivalency method for condensed oil. The specifications for these analytes in Type D breathing are cited in Module IH03-A, Exhibit C. When the analyses reveal an out-of-specification condition (oxygen content too high or too low and/or the other analytes exceed specifications), the Laboratory must inform the contractor following the notification requirements cited in Exhibit A, Section 2.

2. NOTIFICATION REQUIREMENTS

The Laboratory shall meet Module GR01, Exhibit A notification requirements for sample protection, sample integrity, and late deliverables. In addition, the following notifications shall be made:

- 2.1. **Out-of-Specification Analytes:** The Laboratory facility shall provide immediate verbal notification to the CTR and follow-up FAX notification to the CTR no later than the close of the next business day for any Industrial Hygiene breathing air sample results that are out of specification (i.e., oxygen content is either too high or too low and/or the other analytes exceed specifications).

3. FACILITY, INSTRUMENTATION, AND KEY PERSONNEL REQUIREMENTS

- 3.1. **Facility:** The Laboratory facility shall meet all requirements of the base analytical methods and the Laboratory Health and Safety Program specified in Module GR01.

3.2. **Instrumentation:** The Laboratory shall have sufficient analytical equipment and capability to meet all terms and conditions of this module and Module GR01, including all equipment requirements specified in base methods used to perform the analyses.

3.3. **Key Personnel Requirements**

3.3.1. The Laboratory shall assign individuals the responsibilities for the technical key positions listed in Module GR01 to perform the minimum functional requirements necessary to meet the terms and conditions of this subcontract. All positions listed in Module GR01 Exhibit A, Section 1, and the Sample Custodian and Document Control Officer (DCO) specified in Module GR01, Exhibit F, Section 4, are considered key positions for this subcontract. A qualifying individual may fill more than one of the key positions.

3.3.2. *Gas Chromatography (GC) Technical Lead/Supervisor:*

Responsibility:	Responsible for the operation and maintenance of GC instrumentation, and chromatogram interpretation.
Academic Training:	A minimum of a bachelor's degree in a science discipline.
Experience:	A minimum of two years of experience in operating and maintaining GC instrumentation.

EXHIBIT B

REPORTING AND DELIVERABLES REQUIREMENTS

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REPORTING AND DELIVERABLES REQUIREMENTS

1. INTRODUCTION

Module IH03, Exhibit B contains reporting and deliverables requirements for the Industrial Hygiene Breathing Air line item code(s) defined in Module IH03, Exhibit C. This exhibit supplements and augments the fundamental deliverable requirements specified in Module GR01, Exhibit B. Requirements for Sample Data Packages, Supporting Documentation Packages (Support Package), and other deliverables specific to Industrial Hygiene Breathing Air are detailed. Three tables in Module IH03 further define some of the deliverables specified in Module GR01, Exhibit B and additional requirements specified in this module:

Table B1. Schedule for Sample Data Package Deliverables

Table B2. Full Sample Data Package Deliverables

Table B3. Other Deliverables

These tables define major deliverable components as *Deliverable Sections* which are each assigned titles. Text accompanying the tables provides structural and content requirements. Tables and text also provide reference lists for Industrial Hygiene Breathing Air deliverable requirements found in this module and other modules of this SOW.

Deliverable requirements and schedules are specified in Table B1 of this module. [The required set of deliverables and turnaround time requirements identified in this module shall take precedence over those specified in Module GR01.](#)

2. SAMPLE DATA PACKAGE REQUIREMENTS

2.1. **Sample Data Package Deliverable Requirements:** The sample data package deliverable requirements for Industrial Hygiene Breathing Air Routine, Priority and Rush Processing differ from those specified in Module GR01. The Routine and Priority Processing schedules for Industrial Hygiene Breathing Air sample data package delivery are provided in Table B1. Module IH03 does not have a Rush Processing deliverable.

2.1.1. All deliverables contained in Table B1 shall be transmitted to the CTR.

2.1.2. The final report shall be completed and in the Site's possession by the requested turnaround time unless otherwise agreed upon in writing by the CTR.

2.1.3. All days are calendar days unless otherwise stated.

Note: Acceptance of samples for Priority Processing is the option of the Laboratory. Acceptance of such samples by the Laboratory shall constitute acceptance of the expedited deliverables schedules listed in Table B1.

TABLE B1 SCHEDULE FOR SAMPLE DATA PACKAGE DELIVERABLES

Processing	Item	Copies	Schedule	Reference
Routine	Quick-turn packet (Narrative, COC copies, and results only)	1	Relayed by FAX 48 hours after Verified Time of Sample Receipt (VTSR)	IH03, Exhibit B/Section 3
Priority	Sample data package	1	14 days after VTSR	IH03, Exhibit B/Section 2
	Quick-turn packet (Narrative, COC copies, and results only)	1	Relayed by FAX within 4 hours of VTSR	IH03, Exhibit B/Section 3
	Sample data package	1	14 days after VTSR	IH03, Exhibit B/Section 2

2.2. **Sample Data Package Components:** Table B2 lists the required deliverable sections for a Sample Data Package for Industrial Hygiene Breathing Air. Each deliverable section is numbered and assigned a title. These *Deliverable Section Numbers* and *Titles* are referenced in the remainder of the accompanying text in Module IH03, Exhibit B, Section 2. The *Reference* column in Table B2 contains designators which refer to modules, exhibits, and sections where more details may be found. This reference column is intended as an aid in locating requirements, but is not expected to be all-inclusive.

TABLE B2 SAMPLE DATA PACKAGE DELIVERABLES

Deliverable Section Number	Deliverable Section Title	Reference (Module, Exhibit/Section or Title)
1	Sample Data Package Cover Page	GR01, Exhibit B/Section 4
2	Table of Contents	GR01, Exhibit B/Section 4
3	COC(s)	GR01, Exhibit B/Section 4
4	Narrative	GR01, Exhibit B/Section 4
5	Sample and QC Results	GR01, Exhibit B/Sections 4 IH03, Exhibit B/Section 2 IH03, Exhibit C

2.3. **Sample Data Package General Requirements**

- 2.3.1. All Sample Deliverable Sections shall meet the general and specific requirements listed in Module GR01, Exhibit B, Section 4 as referenced in Module IH03, Table B2.
- 2.3.2. All Sample Deliverable Sections shall appear in the Sample Data Package in numerical order by *Deliverable Section Number*.
- 2.3.3. Any undocumented misplaced items shall be considered incomplete.
- 2.3.4. All raw data from failed analytical batches or from failed individual analyses shall be clearly labeled as "*Data Not Used*" and shall be included in the appropriate Deliverable Section.

- 2.3.5. *Raw Data Labeling Requirements:* Results must be presented with all raw data necessary for the CTR to assess their validity. This assessment involves such processes as recalculating reported values and qualifiers from raw data and tracing all standards to valid reference materials. In order to perform this assessment, all preparation, instruments, and other raw data must meet the labeling requirements given in Module GR01, Exhibit F, Section 4.
- 2.4. **Sample Data Package Cover Page Requirements**
(Requirements for Sample Data Package Deliverable Section Number 1)
Sample Data Package Cover Pages shall be included as specified in Module GR01, Exhibit B, Section 4.
- 2.5. **Table of Contents**
(Requirements for Sample Data Package Deliverable Section Number 2)
A Table of Contents for the Sample Data Package shall be included as specified in Module GR01, Exhibit B, Section 4.
- 2.6. **Chain of Custody (COC)**
(Requirements for Sample Data Package Deliverable Section Number 3)
COC documentation shall be included in the Sample Data Package as specified in Module GR01, Exhibit B, Section 4.
- 2.7. **Sample Data Package Narrative**
(Requirements for Sample Data Package Deliverable Section Number 4)
Sample Data Package Narratives shall be included in the Sample Data Package as specified in Module GR01, Exhibit B, Section 4.
- 2.8. **Sample and QC Results**
(Requirements for Sample Data Package Deliverable Section Number 5)
- 2.8.1. **Cover Sheets**
The *Sample and QC Results* Section and each of the two respective Subsections, 5a and 5b, shall be preceded by a Cover Sheet that is titled exactly as given under this section. The Cover Sheet shall be paginated along with the rest of the Sample Data Package.
- 2.8.2. **QC Summary** [Data Review Checklist Item 5a]
The requirements for the QC summary are specified in the method descriptions. Variations from such method-specific QC should be documented in the laboratory SOP and approved in writing by the CTR.
- 2.8.3. **Sample Results Summary** [Data Review Checklist Item 5b]
Analytical results shall include the following information in a tabulated format:
- RIN
 - Release #
 - Site Sample #
 - Custody Seal #
 - Laboratory Project #
 - Laboratory Sample #

- Limit of Quantification
- Analyst Name
- Analyte
- Analytical results in appropriate units

3. QUICK-TURN PACKET REQUIREMENTS

Quick-turn packets as designated in Table B1 shall include all items specified in the *COC* and *Narrative* sections of the Sample Data Package and shall include only the *Sample Results Summary* from the *Sample and QC Sample Results* Section of the Sample Data Package.

4. REQUIREMENTS FOR OTHER DELIVERABLES

Requirements for other deliverables are specified in Module GR01, Table B2. The following table defines other required deliverables for Industrial Hygiene breathing air samples.

TABLE B3 OTHER DELIVERABLES

Deliverable Title	Schedule	Recipient	Reference (Module, Exhibit/Section)
Standards/SRM Certificates as required by method	Available during audits and within 7 days of request	CTR	GR01, Exhibit E/Section 6
Performance Evaluation Sample Analysis Results	7 days from receipt of results Minimum frequency quarterly	CTR	GR01, Exhibit B/Section 2 GR01, Exhibit B/Section 9 IH03, Exhibit E/Section 7
Out-of-Specification Analytes	Immediate verbal and FAX notifications no later than the close of next day's business	CTR	IH03, Exhibit A/Section 2
Sampling Kits	24 kits delivered to the Site at time of subcontract award, and upon written request by the CTR	CTR	IH03, Exhibit D/Section 1

- 4.1. **Electronic Data Deliverable (EDD):** [An Electronic Data Deliverable \(EDD\) is not required for IH 03.](#)

5. SUPPORTING DOCUMENTATION PACKAGE (SUPPORT PACKAGE) REQUIREMENTS

- 5.1. **Support Package Schedules and Maintenance:** See Module GR01, Exhibit B, Section 5 for delivery schedules and maintenance requirements for Supporting Documentation Packages (Support Packages).
- 5.2. **Support Package Components:** Module GR01, Table B4 lists required components for the Support Package for Industrial Hygiene Breathing Air. Each section is assigned a title. These titles are referenced in the remainder of the accompanying text in Module GR01, Exhibit B, Section 5.

EXHIBIT C

ANALYSIS REQUIREMENTS AND REPORTING UNITS

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ANALYSIS REQUIREMENTS AND REPORTING UNITS

1. BREATHING AIR CONSTITUENTS/REQUIREMENTS LIST

The following table provides constituents of interest, method detection limits, and specification values. All data shall be reported in the units given for the specification values.

TABLE C1 BREATHING AIR CONSTITUENTS

Line Item Code		IH03B001
Approved Method Source		ANSI/CGA G-7.1
Constituent	Specification Value	Method Detection Limit
oxygen (% by volume)	19.5 - 23.5%	<0.5%
nitrogen (% by volume)	balance	N/A
carbon dioxide	<1000 ppm	<100 ppm
carbon monoxide	<10 ppm	<1 ppm
total hydrocarbon content (THC) (as methane)	<50 ppm	<5 ppm
oil (condensed) (mg/m ³ at NTP)	<5 mg/m ³	<0.5 mg/m ³

NOTES:

The specification requirements for atmospheric breathing air differ from other gas specifications because atmospheric air is naturally occurring and not a manufactured product. Atmospheric air contains a large variety of trace constituents. It is impractical to set individual limits for many of these; however, the ANSI/CGA G-7.1 specification qualifies Grade E type breathing air by limiting the concentrations of specific trace constituents.

Atmospheric breathing air samples are provided by the contractor; consequently, an oil-equivalency method that is based on gas chromatography (GC) determination of alkane (C₁ to C₄) hydrocarbons as methane (defined as the single carbon atom equivalent) is substituted for the specification for the determination of condensed oil at the origin (air compressor supply line or supply tank).

EXHIBIT D

ANALYTICAL METHODS

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ANALYTICAL METHODS

1. INTRODUCTION

This Exhibit contains the analytical method requirements for breathing air analysis. Atmospheric breathing air samples representative of the air supply are taken by the contractor and submitted for analysis to the Laboratory. The Laboratory, however, shall supply the sampling kits required for low-pressure (5-200 p.s.i.) breathing air. The sampling kit generally contains a valved bag constructed of Mylar, which has a one-time sampling use, but other suitable (and reusable) sampling containers, such as a Summa® canister or other vacuum-tight gas-sampling container.

Atmospheric air contains a large variety of trace constituents. It is impractical to set individual limits for many of these; however, this specification qualifies Grade D type breathing air by limiting the concentrations of specific trace constituents. Analytical methodologies are based upon the specification requirements for atmospheric breathing air which qualify Grade D type breathing air. Additionally, an oxygen content specification must be met. Analytical methods are selected from applicable methods cited in ANSI/CGA-7.1.

Because the contractor does not supply the Laboratory with an additional sample for determining condensed oil content, the specification for condensed oil is replaced by an oil-equivalency method. The oil-equivalency method is based on total hydrocarbon content (THC) by gas chromatographic determination of alkane (C₁ to C₄) hydrocarbons in the gas sample provided, which is an ANSI/CGA-7.1 specification for several other grades of breathing air.

A gas chromatograph (GC) may be used to determine many of the limiting characteristics listed in this section. The analyzer must be capable of separating and detecting the specified component with a sensitivity of 1 ppm or 10% of the specified maximum amount of the constituent, whichever is greater. Appropriate impurity concentrating techniques may be used to attain this sensitivity. The analyzer is to be calibrated at appropriate intervals by the use of calibration gas standards.

2. METHOD SELECTION AND APPLICATION

2.1. **Selection of Base Method:** Methods used for analysis must meet all the following requirements:

- 2.1.1. Atmospheric breathing air samples are provided by the contractor, so no sampling or sample pretreatment is necessary by the subcontractor Laboratory. Samples are divided into aliquots (if required) and directly analyzed by appropriate analytical methods. For GC analysis, samples are generally introduced into a gas manifold and injected into appropriate GC columns using gas sampling valves.
- 2.1.2. Methods must be selected from the analytical procedures cited in ANSI/CGA-7.1. Analyses performed meet requirements of the methods selected from ANSI/CGA-7.1 and must be documented in the Laboratory's SOPs. Standard methods may be modified or alternative methods substituted only with the written consent of the CTR.
- 2.1.3. Analysis procedures must achieve the detection limits specified for each listed constituent in Module IH03-A, Exhibit C. The Laboratory shall document any anomalies that inhibit achieving the detection limits in the Narrative section of the Sample Data Package.

2.2. Analytical Procedures:

- 2.2.1. The parameters for analytical techniques contained in this section are: percent (mole/mole) = mole percent; ppm (mole/mole) = parts per million (micromole/mole); and total hydrocarbon content (THC) “as methane” for the purposes of this specification is defined as the single carbon atom equivalent.
- 2.2.2. Calibration gas standards containing the applicable gaseous components and traceable to the National Institute of Standards and Technology (NIST) are required to calibrate analytical instruments used to determine the limiting characteristics of air.
- 2.2.3. The accuracy of measuring equipment used in preparing these standards is to be traceable to the National Institute of Standards and Technology (NIST).
- 2.2.4. Analytical equipment is to be operated and properly calibrated in accordance with the manufacturer’s instructions.
- 2.2.5. Analytical equipment and methodologies are to be controlled by standard operating procedures (SOPs) or an all-inclusive SOP to cover all methodologies for performing the requisite analyses as outlined in Section 2.3, Analytical Methods.
- 2.2.6. Suitable QA/QC methodologies will be presented in the SOP(s) to ensure the minimum detection limits, accuracy, and precision required for the constituents cited in Module IH03-A, Section C, Table C1 are met. QA/QC are integral parts of this SOW. Necessary components of a complete QA/QC program include internal QC criteria that demonstrate acceptable levels of performance for the methodologies used.

2.3. Analytical Methods:

- 2.3.1. Percent Oxygen Concentration. The percent oxygen concentration shall be determined by one of the following methods:
 - *By a gas chromatograph capable of separating and detecting oxygen in nitrogen*
The system must be able to distinguish oxygen from argon when testing atmospheric air. The system is to be calibrated by the use of calibration gas standards containing an appropriate known amount of oxygen (20.0 to 23.0 percent in nitrogen base gas). The accuracy shall be at least $\pm 0.5\%$ oxygen (absolute).
 - *By a paramagnetic type analyzer*
The accuracy shall be at least $\pm 0.5\%$ oxygen (absolute). The analyzer is to be calibrated (zeroed and spanned) at appropriate intervals by the use of calibration gas standards having nitrogen as the base gas.
 - *By an electrochemical type analyzer containing a solid or aqueous electrolyte*
The accuracy shall be at least $\pm 0.5\%$ oxygen (absolute). The analyzer is to be calibrated at appropriate intervals by the use of calibration gas standards having nitrogen as the base gas.
 - *By a thermal conductivity type analyzer*
The accuracy shall be at least $\pm 0.5\%$ oxygen (absolute). The analyzer is to be calibrated (zeroed and spanned) at appropriate intervals by the use of calibration gas standards having nitrogen as the base gas.
 - *By a volumetric (Orsat type) gas analysis apparatus*
The apparatus shall use a suitable oxygen-absorbing reagent and its accuracy shall be at least $\pm 0.5\%$ oxygen (absolute). The analyzer is to be calibrated (zeroed and spanned) at appropriate intervals by the use of calibration gas standards having nitrogen as the base gas.

2.3.2. Oil (Condensed) = Total Hydrocarbon Content (THC). One of the following oil-equivalency methods based on the determination of alkane (C₁ to C₄) hydrocarbons (THC “as methane” for the purposes of this specification is defined as the single carbon atom equivalent) shall be used:

- *By a gas chromatograph with techniques specific to the separation and analysis of trace hydrocarbons*

The GC shall be operated so that its sensitivity for methane is either 1 ppm or 10% of the specified maximum amount, whichever is greater. Appropriate impurity concentrating techniques may be used to attain this sensitivity.

- *By a flame-ionization type analyzer*

The analyzer is to be calibrated at appropriate intervals by the use of calibration gas standards. The range used shall be no greater than ten times the specified maximum gaseous hydrocarbon content expressed as methane.

- *By a gas cell-equipped dispersive or nondispersive infrared analyzer*

The analyzer is to be calibrated at appropriate intervals by the use of calibration gas standards at a wavelength of approximately 3.5 microns or 2850 cm⁻¹ (the characteristic absorption wavelength for hydrocarbon C-H stretching). The analyzer shall be operated so that its sensitivity for methane is either 1 ppm or 10% of the specified maximum amount, whichever is greater.

2.3.3. Carbon Monoxide Content. The carbon monoxide content shall be determined by one of the following methods:

- *By a gas chromatograph*

The GC shall be capable of separating and detecting the specified component with a sensitivity of 1 ppm or 10% of the specified maximum amount of the constituent, whichever is greater. Appropriate impurity concentrating techniques may be used to attain this sensitivity. The analyzer is to be calibrated at appropriate intervals by the use of calibration gas standards.

- *By a catalytic methanator gas chromatograph*

The analyzer is to be calibrated at appropriate intervals by the use of calibration gas standards. The sensitivity for carbon monoxide shall be either 1 ppm or 10% of the specified maximum amount, whichever is greater.

- *By a gas cell-equipped infrared gas analyzer*

The analyzer is to be calibrated at appropriate intervals by the use of calibration gas standards at a wavelength of approximately 4.6 microns or 2175 cm⁻¹ (the characteristic absorption wavelength for carbon monoxide C-O stretching). The analyzer shall be operated so that its sensitivity for carbon monoxide is either 1 ppm or 10% of the specified maximum amount, whichever is greater.

- *By an electrochemical type analyzer specific for carbon monoxide*

The analyzer is to be calibrated at appropriate intervals by the use of calibration gas standards. The analyzer shall be operated so that its sensitivity for carbon monoxide is either 1 ppm or 10% of the specified maximum amount, whichever is greater.

- *By a thermal conductivity type analyzer*

The accuracy shall be at least ±0.5% oxygen (absolute). The analyzer is to be calibrated (zeroed and spanned) at appropriate intervals by the use of calibration gas standards having nitrogen as the base gas.

- *By an apparatus employing a detector tube filled with a color-reactive chemical*

The degree of accuracy is dependent on the precision of the measurements and the analytical bias of the tube.

2.3.4. Carbon Dioxide Content. The carbon dioxide content shall be determined by one of the following methods:

- *By a gas chromatograph*

The GC shall be capable of separating and detecting the carbon dioxide with a sensitivity of 1 ppm or 10% of the specified maximum amount of the constituent, whichever is greater. Appropriate impurity concentrating techniques may be used to attain this sensitivity. The analyzer is to be calibrated at appropriate intervals by the use of calibration gas standards.

- *By a gas cell-equipped dispersive or nondispersive infrared analyzer*

The analyzer is to be calibrated at appropriate intervals by the use of calibration gas standards at a wavelength of approximately 4.3 microns or 2325 cm^{-1} (the characteristic absorption wavelength for carbon dioxide C-O stretching). The analyzer shall be operated so that its sensitivity for carbon dioxide is either 1 ppm or 10% of the specified maximum amount, whichever is greater.

- *By an apparatus employing a detector tube filled with a color-reactive chemical*

The degree of accuracy is dependent on the precision of the measurements and the analytical bias of the tube. greater.

3. SAMPLE HOLDING TIMES AND PRESERVATION REQUIREMENTS

There are no requirements for sample holding times and preservation of breathing air samples as long as the required analysis times (4 hours to 14 days depending upon schedules) are not exceeded. See Module IH03, Exhibit C, Table B2 for schedules.

EXHIBIT E

QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

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QUALITY ASSURANCE /QUALITY CONTROL REQUIREMENTS

1. INTRODUCTION

The purpose of this Exhibit is to describe the minimum QA/QC operations necessary to satisfy the analytical requirements associated with the determination of industrial hygiene breathing air.

2. QUALITY ASSURANCE PLAN

Requirements for the quality assurance plan are specified in Module GR01, Exhibit E.

3. ANALYTICAL STANDARDS AND REAGENTS REQUIREMENTS

- 3.1. Requirements for analytical standards and reagents are specified in Exhibit E of the General Laboratory Requirements Module, GR01. Calibration gas standards containing the applicable gaseous components and traceable to the National Institute of Standards and Technology (NIST) are required to calibrate analytical instruments used to determine the limiting characteristics of air.
- 3.2. The accuracy of measuring equipment used in preparing these standards is to be traceable to the National Institute of Standards and Technology (NIST). Analytical equipment is to be operated and properly calibrated in accordance with the manufacturer's instructions.

4. METHOD-SPECIFIC QC REQUIREMENTS

Method-specific QC requirements are listed under the appropriate analytical methodologies in Modules IH03, Exhibit D.

5. MEASURING AND TESTING EQUIPMENT REQUIREMENTS

Requirements for measuring and testing equipment requirements are specified in Module GR01. The accuracy for oxygen content shall be at least $\pm 0.5\%$ oxygen (absolute). The accuracy for impurities of interest shall be at least 10 percent (relative) of the maximum specified amount.

6. DATA MANAGEMENT

Requirements for site data management are specified in Module GR01.

7. LABORATORY EVALUATION SAMPLES

- 7.1. **Requirements:** The Laboratory shall participate in an interlaboratory comparison study that includes each analyte reported. The compounds present and their respective concentrations shall be blind to the Laboratory until results are reported and evaluated.

- 7.2. **Frequency:** The minimum required frequency of participation in interlaboratory comparison studies is quarterly.
- 7.3. **Acceptable PE Programs:** Participation in one or more of the following evaluation programs are acceptable under this statement of work.
- 7.3.1. Commercial interlaboratory round-robin performance evaluation comparison studies, such as those conducted by Environmental Resource Associates, Analytical Products Group, Inc., or Resource Technology Corporation (NSI/RTC).
- 7.3.2. In-house “blind” performance evaluation programs involving quarterly (or more often) sample submissions based on NIST-traceable reference standards.
- 7.4. **Other:** Additional requirements for laboratory evaluation samples are specified in the General Laboratory Requirements Module, GR01.

8. ON-SITE LABORATORY EVALUATIONS

Requirements for on-site laboratory evaluations are specified in the General Laboratory Requirements Module, GR01.

9. PERFORMANCE CRITERIA

Laboratory performance will be continually assessed by the CTR. Performance areas will include those outlined in the General Laboratory Requirements Module GR01, Exhibit E, Section 13, and those outlined below:

- 9.1. Analytes of interest: oxygen and trace impurities (CO, CO₂, and THC).
- 9.2. Analytical methodologies: instrumentation used for analyte-specific quantitation.

10. CERTIFICATIONS AND APPROVALS

Laboratories are encouraged to provide proof of certifications or approvals for any programs in which the Laboratory is participating. Proof of laboratory certifications (or approvals) delivered to the CTR according to the schedule in Module GR01, Exhibit B, Table B2 may increase the potential sample load for Laboratories providing this proof.

- 10.1. In particular, proof of one or more of the following laboratory certifications or approvals to the CTR according to the schedule in Module GR01, Exhibit B, Table B2 may increase a laboratory’s potential sample load:
- 10.1.1. American Association for Laboratory Accreditation.
- 10.1.2. Specific State Certification or Accreditation for Analytical Chemistry Laboratories.

EXHIBIT F

EVIDENTIARY REQUIREMENTS

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EVIDENTIARY REQUIREMENTS

1. INTRODUCTION

The purpose of this Exhibit is to describe the evidentiary requirements that must be followed for the preparation and analysis of Site samples for Industrial Hygiene breathing air under this subcontract.

2. SAMPLE CHAIN OF CUSTODY

Requirements for sample identification are specified in Module GR01.

3. DOCUMENT CONTROL PROCEDURES

Document control requirements are specified in Module GR01.

4. STANDARD OPERATING PROCEDURES

4.1. **General Requirements:** Requirements for written SOPs are specified in Module GR01.

4.2. **Required Procedures:** Each of the following operations shall be included in laboratory SOPs in addition to those operations specified in Module GR01:

- Instrument Calibration
- Initial Calibration Verification
- Instrument Blanks
- Laboratory Control Sample Analysis
- Performance Evaluation (PE) Sample Studies
- Method Detection Limit (MDL) Determination
- Sample Concentration (if required)

EXHIBIT G

GLOSSARY OF TERMS AND ACRONYMS

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GLOSSARY OF TERMS AND ACRONYMS

1. INTRODUCTION

The glossary of terms and acronyms contained in parameter-specific analytical module(s) supplement those found in the General Laboratory Requirements Module, GR01. Any definitions provided in this Exhibit, however, shall supersede the definitions provided in Module GR01 in cases of conflicting definitions.

2. GLOSSARY OF TERMS

Refer to General Requirements Module GR01, Exhibit G for additional terms.

CERTIFIED REFERENCE MATERIAL: A reference material, directly traceable to or certified by NIST, of which one or more properties are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

CHARACTERIZATION: A determination of the approximate concentration range of compounds of interest used to choose the appropriate analytical protocol and/or necessary dilution factors.

DATA SYSTEM: For the purpose of this module, a computer system that allows the continuous acquisition and printout of data throughout the chromatographic program.

GAS CHROMATOGRAPH (GC): An instrument used to separate compounds that are in the gas phase utilizing interaction with a stationary phase within a chromatographic column. A GC may be used to determine many of the limiting characteristics listed in this section. The analyzer must be capable of separating and detecting the specified component with a sensitivity of 1 ppm or 10% of the specified maximum amount of the constituent, whichever is greater. Appropriate impurity concentrating techniques may be used to attain this sensitivity. The analyzer is to be calibrated at appropriate intervals by the use of calibration gas standards.

INFRARED (IR) GAS ANALYZER: A commercial instrument used to detect and quantitate a specific gas constituent by measuring its absorbance at a specific wavelength and correlating to concentration via a Beer-Lambert calibration curve. The instrument may be dispersive or nondispersive over an entire wavelength region as in a commercial scanning IR spectrophotometer or FTIR spectrometer, or may be a gas cell-equipped infrared gas analyzer calibrated at a specific wavelength for a particular analyte as in a MIRAN analyzer. The analyzer is to be calibrated at appropriate intervals by the use of calibration gas standards and operated so that its sensitivity for a particular analyte is either 1 ppm or 10% of the specified maximum amount, whichever is greater.

INITIAL CALIBRATION: The analytical curve generated by plotting concentration vs. some determinable (measurable) attribute such as gas chromatogram peak area or infrared absorbance at a specific wavelength. The initial calibration defines the working range of the method.

OIL (CONDENSED): The oil condensed in atmospheric breathing air is determined at the point of origin (either an air compressor supply line or a supply tank) by passing at least 500 liters of air through a glass-fiber filter and determining gravimetrically. Because samples are provided by the contractor, which precludes sampling by the subcontractor Laboratory, determination of condensed oil at the origin is impractical. The specification for condensed oil is replaced by an oil-equivalency method based on total hydrocarbon content (THC) by gas chromatographic determination of alkane (C₁ to C₄) hydrocarbons, which is an ANSI/CGA-7.1 specification for several other grades of breathing air.

QUALITY VERIFICATION LEVEL (QVL): The limiting characteristics for air as given in Module IH03-A, Exhibit C, Table C1, the component maxima, in parts per million [ppm (mole/mole)] for the QVLs of air. The absence of a listed QVL does not mean to imply that the limiting characteristic is or is not present, but merely indicates that the test is not required for compliance with the specification.

REFERENCE MATERIAL: A material or substance of which one or more properties are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

SITE-SPECIFIC PERFORMANCE EVALUATION (PE) SAMPLES: Where a large number of laboratories are participating in an assessment program, performance evaluation (PE) samples provide a cost-effective alternative to the use of Certified Reference Materials.

TOTAL HYDROCARBON CONTENT (THC): THC “as methane” for the purposes of this specification is defined as the single carbon atom equivalent.

3. ACRONYMS

Refer to General Requirements Module GR01, Exhibit G for additional acronyms.

ANSI/CGA G-7.1: Compressed Gas Association Commodity Specification for Air

COC: chain of custody

CFR: Code of Federal Regulations

CTR: Contractor Technical Representative

EDD: electronic data deliverable

GC: gas chromatograph or gas chromatography

IR: infrared

MDL: method detection limit

NIST: National Institute of Standards and Technology (formerly National Bureau of Standards, NBS)

PE: performance evaluation

ppm: parts per million (micromole/mole), a concentration unit

QA/QC: quality assurance/quality control

QVL: quality verification level

SOP: standard operating procedure

THC: total hydrocarbon content

VTSR: verified time of sample receipt

EXHIBIT H

REFERENCES

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REFERENCES

1. REFERENCES

- 1.1. **ANSI/CGA G-7.1 (Latest Version):** *Commodity Specification for Air*, Compressed Gas Association, Inc. (CGA), 1235 Jefferson Davis Highway, Arlington, VA 22202.
- 1.2. **Code of Federal Regulations:** Title 46 CFR Part 197, U.S. Coast Guard, General Provisions—Commercial Diving Operations, 46 CFR 197.340, “Breathing Gas Supply,” Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.
- 1.3. **Module, GR01-A - General Laboratory Requirements:** Statement of Work for Analytical Measurements, December 10, 1996, Analytical Services Division, Rocky Flats Environmental Technology Site, Golden, Colorado 80402.

A P P E N D I X A

Data Review Checklist

IH03 SAMPLE DATA PACKAGE

Data Review Checklist

IH03 Sample Data Package

1. SAMPLE DATA PACKAGE COVER PAGE	Reply	√	C#
a) The laboratory name, code, subcontract number, RIN, Site sample numbers, analyses, report dates, custody seal number, and name of industrial hygienist requesting sample are accurately recorded.			
b) All Site sample identifications are cross-referenced with all lab identifications.			
c) The verbatim compliance and authorization statement is present with the dated signature of the Laboratory Manager or designee.			
d) Any problems with the receipt are explained.			
2. TABLE OF CONTENTS	Reply	√	C#
a) The Table of Contents contains all Sample Data Package Deliverable Section Titles and the page numbers.			
3. DATA REVIEW CHECKLIST - IH03 SAMPLE DATA PACKAGE	Reply	√	C#
a) The Sample Data Package structural requirements specified in IH03 have been met. All discrepancies were identified and documented, accordingly.			
b) All QA/QC anomalies and missing information are explained in the Narrative.			
4. CHAIN-OF-CUSTODY	Reply	√	C#
a) The continuity of each sample's custody is evidenced by the chain of the date, time, and signatures of each transaction from sample receipt to final disposition.			
b) If the continuity was corrupted, there is documentation and evidence of correspondence with the CTR.			
c) All samples are identified on the COC with the corresponding analysis.			
e) Any conflicting, incorrect, or missing information is identified and documented, and there is documentation of the resolution.			
5. NARRATIVE	Reply	√	C#
a) Contains a synopsis of the methodology, analysis, appropriate certification, and identifies base methods used.			
b) Contains a description of the samples.			
c) Contains synopsis of Analytical Batch QC assessment. All anomalies, caveats, deficiencies, interferences, reanalyses, and deviations from approved SOPs related to the analysis are explained.			
d) Samples requiring reanalysis are identified with the reason for reanalysis, and the original and reanalysis Analytical Batch Identification Numbers. A synopsis of the reanalysis Analytical Batch QC assessment is included.			
e) For any deviations that required CTR approval, the correspondence and approval are documented.			
6. SAMPLE AND QC RESULTS SUMMARY	Reply	√	C#
a) <i>QC Summary</i> is present and includes:			
1. All QC information for oxygen (O ₂) determination			
• QC specified (identifies method and calibration technique, standards/controls data)			

RIN: _____ Lab Name: _____ Initials: _____

Analytical Batch Identification No(s): _____

Data Review Checklist

IH03 Sample Data Package

(continued)	Reply	√	C#
2. All QC information for carbon dioxide (CO ₂) determination			
• QC specified (identifies method and calibration technique, standards/controls data).			
3. All QC information for carbon monoxide (CO) determination			
• QC specified (identifies method and calibration technique, standards/controls data)			
4. All QC information for THC determination			
• QC specified (identifies method and calibration technique, standards/controls data)			
b) <i>Analyses Results</i> are present and include:			
1. Oxygen content			
• O ₂ is within specification (19.5 - 23.5 %)			
2. Carbon dioxide concentration			
• CO ₂ is within specification (<1000 ppm)			
3. Carbon monoxide concentration			
• CO is within specification (<10 ppm)			
4. THC concentration (condensable oil)			
• THC (as methane) is within specification (<50 ppm)			

7. NOTIFICATION REQUIREMENT	Reply	√	C#
a) Analytical Results Indicate Out-of-Specification Condition			
b) Immediate Verbal Notification			
c) FAX Notification Within Close of Next Business Day			

8. ELECTRONIC DATA DELIVERABLE (EDD)	Reply	√	C#
a) The EDD accurately reflects the data contained in the Sample Data Package			
b) The hard copy of the EDD as specified in Exhibit B Section 2 is included with the Sample Data Package.			
c) An automated EDD verification check has been performed.			

Shaded areas are for Site use only.

Respond to each checklist item in the "Reply" column with a Y (yes), N (no), or NA (not applicable).

Complete footer information, including the initials of the laboratory manager or designee on each page.

Refer to Module GR01, Exhibit B, Section 4 for instructions to complete this form.

I certify that all responses to this checklist accurately reflect the completeness and quality aspects of this sample data package as outlined in GR01 and IH01. Furthermore, I understand that inaccuracies in the completion of this checklist will be considered a nonconformance to Subcontract Requirements as evidenced by the following signature of the Laboratory manager or designee.

Print/Typed Name: _____ Title: _____

Signature _____ Date _____

For Site Use Only

RIN: _____ Lab Name: _____ Initials: _____

Analytical Batch Identification No(s): _____

