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CCP-CM-013

Revision 0

CCP

Transportation HSG Only – Flammable Gas Analysis (FGA)

(Equipment # HSG-FGA-01)

(Equipment # HSG-FGA-02)

(Equipment # HSG-FGA-03)

(Equipment # HSG-FGA-04)

Equipment Description

EFFECTIVE DATE: 05/25/2007

Mark Pearcy

PRINTED NAME

APPROVED FOR USE

RECORD OF REVISION

Revision Number	Date Approved	Description of Revision
0	05/25/2007	Initial issue.

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LIST OF ACRONYMS AND ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
BFB	1-Bromo-4-fluorobenzene
CCP	Central Characterization Project
CCV	Continuing Calibration Verification
DOE	Department of Energy
ED	Equipment Description
GC	Gas Chromatograph
HSG	Headspace Gas
H_2 and CH_4	hydrogen and methane
ICAL	Initial Calibration
MCU	Mobile Characterization Unit
MDL	Method Detection Limit
MS	Mass Spectrometer
NEC	National Electric Code
NFPA	National Fire Protection Association
PLOT	Porous Layer Open Tubular
ppmv	parts per million by volume
psi	pounds per square inch
RSD	Relative Standard Deviation
SNM	Special Nuclear Material
SSC	Systems, Structures, and Components
STD	Standard
TCD	Thermal Conductivity Detector
TRU	Transuranic
TSR	Technical Safety Requirement
VOC	Volatile Organic Compounds
WIPP	Waste Isolation Pilot Plant

1.0 INTRODUCTION

1.1 System Identification

This Equipment Description (ED) is a central coordinating link among the engineering design, the documented safety basis, and the implementing documents. This ED does not originate requirements or basis information, but rather collects that information into a convenient usable form. The ED consolidates information about the Transportation Headspace Gas Only Unit into one document. This ED covers the following equipment:

Transportation Only HSG Unit

Changes to the ED itself are entirely within the purview of the Central Characterization Project (CCP) through the change control process. The ED promotes safe and efficient operations by providing the information necessary for a solid technical understanding of the system.

1.2 Limitations of this ED

This ED is not an authorization basis document. It is a piece of CCP's configuration management program and is intended to be used as technical information for the Host Site's use when incorporating CCP's equipment into their safety basis. This ED was written, in a graded approach, in accordance with U. S. Department of Energy (DOE) Standard (STD), DOE-STD-3024-98, *Content of System Design Descriptions* (Ref. 1). As part of the configuration management change control process, the ED helps ensure consistency among the engineering requirements for the system, the actual installed physical configuration, and the associated documentation.

1.3 Ownership of this ED

CCP is responsible for the technical content of and for reviewing changes to the ED.

1.4 Definitions/Glossary

None.

2.0 GENERAL OVERVIEW

2.1 System Functions

The Transportation Only HSG Unit provides a process for analyzing HSG from Transuranic (TRU) waste containers using a gas chromatograph (GC) with a mass spectrometer (MS) detector and a Thermal Conductivity Detector (TCD). The requirements are addressed in DOE/WIPP 06-3345, (Ref. 2). The analytical process is based on the introduction of samples via a syringe onto a capillary column for Volatile Organic Compounds (VOC) analysis and onto a Porous Layer Open Tubular (PLOT) column for hydrogen and methane (H_2 and CH_4), using fixed-volume injection loops. Internal standards are introduced using a fixed-volume injection loop with each standard and sample. A MS is used for detection of the VOCs and a TCD is used for the detection of H_2 and CH_4.

2.2 System Classification

This system is classified as Balance-of-Plant. Systems, Structures, and Components (SSCs) are as a minimum classified as Balance-of-Plant to assure that proper design, operations, and maintenance requirements are assigned to provide for health and safety of the worker and environment and to ensure compliance with the other Host site requirements. Moreover, the Transportation Only HSG Unit's classification is Mission Critical (Section 2.2, DOE-STD-3024-98, [Ref. 1]).

2.3 Basic Operational Overview

A sample is collected in a gas tight syringe with a luer lock fitting and brought to the Unit. The syringe is attached to the GC via a luer™ lock hub. Using the syringe, two sample loops are filled to approximately ambient pressure. A loop for internal standard is filled to approximately ambient pressure. Then the GC is started and the sample is introduced into two different columns. After passing through the columns, the samples go to the detectors. The GC goes through a temperature ramp starting at 80°C to approximate 240°C as the samples go through the columns. The software (Section 3.2.1) collects the data and analyzes the data giving concentrations of any compounds detected.

A more detailed description is given below for the different processes that the Transportation HSG Units perform.

2.3.1 VOC Analysis

Helium is supplied to the GC from a compressed gas cylinder. The helium flows to the GC where the pressure is automatically controlled before passing through six and ten port rotating valves. The six and ten-port valves contain sample loops and an internal

standard loop. The helium flows through a sample and an internal standard loop and then flows to the VOC column. After passing through the column the helium and sample enters the mass spectrometer. The mass spectrometer is under high vacuum. The high vacuum is maintained by a turbomolecular pump and a rough pump. The data from the detector is collected by the software that calculates the results.

2.3.2 Hydrogen/Methane Analysis

Nitrogen is supplied to the GC from either a compressed gas cylinder or a nitrogen generator. The nitrogen flows to the GC where the pressure is automatically controlled before passing through a ten-port valve. The ten-port valve contains a sample loop. The nitrogen flows through the sample loop and then flows to the Hydrogen/Methane column. After passing through the column the nitrogen and sample enters the thermal conductivity detector. The data from the detector is collected by the software which calculates the results.

2.3.3 Sample Analysis

A sample is collected in a gas tight syringe with a luer lock fitting and brought to the Unit. The syringe is attached to the GC via a luer lock hub. Using the syringe the two sample loops (VOC and H_2 and CH_4) are filled to approximately ambient pressure. At the same time the internal standard is being introduced to the internal standard loop. The internal standard comes from a compressed gas cylinder. After the sample loops are filled then the GC is started. The six and ten port valves rotate and introduce the sample and internal standard to the appropriate column. The GC has a temperature program which raises the temperature of the oven from approximately 80°C to 240°C. The temperature program is approximately 13 minutes.

2.3.4 Tune Check

To check the mass spectrometer for operability, a tune check compound, 1-Bromo-4-fluorobenzene (BFB) is introduced and analyzed by the mass spectrometer. The BFB is introduced from a compressed cylinder. The BFB flows from cylinder to a six-port valve where it flows through the internal standard loop. The GC is started and the six-port valve rotates introducing the BFB into the VOC column and on to mass spectrometer. The data from the mass spectrometer is analyzed by the software.

2.3.5 Initial Calibration (ICAL)

Instrument calibration gas standards are introduced to the GC via a syringe with a luer lock. The gas standard comes from a compressed gas cylinder. The calibration standard has the same flow process as the sample introduction.

2.3.6 Continuing Calibration Verification (CCV)

The Continuing Calibration Verification gas standard is introduced to the GC via a gas-tight syringe. The gas standard comes from a compressed gas cylinder. The verification standard has the same flow process as the sample introduction.

3.0 GENERAL REQUIREMENTS

3.1 System Functional Requirements

The requirements are classified as Mission-Critical.

The basis for all of the requirements listed below is DOE/WIPP 06-3345 (Ref. 2).

3.1.1 Tune Check

Requirement: The analysis of the BFB must meet the following ion abundance criteria.

Mass	Ion Abundance Criteria
50	8% to 40% of m/z 95
75	30% to 66% of m/z 95
95	Base peak, 100% relative abundance
96	5% to 9% of m/z 95
173	Less than 2% of m/z 174
174	50% to 120% of m/z 95
175	5% to 9% of m/z 174
176	93% to 101% of m/z 174
177	5% to 9% of m/z 176

3.1.2 Initial Calibration (ICAL)

Requirement: The ICAL must meet a Relative Standard Deviation (RSD) of <35 RSD for VOC analysis and >0.990 coefficient of determination (r^2) for Hydrogen and Methane.

3.1.3 Method Detection Limit (MDL)

Requirement: The MDL for Alcohols and Ketones is ≤ 50 ppmv, all other VOCs ≤15 parts per million by volume (ppmv), and ≤0.1 Volume percent for Hydrogen and Methane.

3.1.4 Continuing Calibration Verification (CCV)

Requirement: The Percent Difference (%D) between the ICAL and CCV must be ≤30%.

3.2 Major Components and Subsystems

3.2.1 Major Components

GC: The GC must have a MS Detector and TCD.

Computer: The computer is connected to the GC through an Ethernet cable. The computer is loaded with software that controls the GC and collects data from the MS and TCD. The software used for data acquisition and quantitation of the target analytes and tentatively identified compounds is called Enhanced Chemstation (G1701CA). The software used to calculate the method detection limits of target analytes is the Flammable Gas Analysis MDL Spreadsheet.

3.2.2 Subsystems

An air compressor is an optional subsystem that can be used in lieu of a compressed air cylinder, compressed nitrogen cylinder, and/or a nitrogen generator. The air compressor must be capable of supplying 80 pounds per square inch (psi) to the nitrogen generator.

A nitrogen generator is an optional subsystem that can be used in lieu of a compressed air cylinder and/or compressed nitrogen cylinder. The nitrogen generator must be capable of supplying 80 psi to the Transportation HSG Only Unit.

3.3 Boundaries and Interfaces

There are no Boundaries and Interfaces required.

3.4 Codes, Standards, and Regulations:

- American National Standards Institute (ANSI)
- National Electric Code (NEC)
- National Fire Protection Association (NFPA)

3.5 Operability

The Transportation Only HSG has no Technical Safety Requirement (TSR) function therefore the HSG Unit has no operability requirements.

3.6 Specific Requirements

3.6.1 Radiation and Other Hazards

No specific radiation safety or other specific safety hazards are associated with the Unit. Industrial hazards are discussed in Section 3.6.4.

3.6.2 As Low As Reasonably Achievable (ALARA)

There are not specific requirements for this system.

3.6.3 Nuclear Criticality Safety

There are no Nuclear Criticality Safety requirements for this system. The Host site is responsible for evaluating criticality.

3.6.4 Industrial Hazards

Compressed Gases: Compressed gas cylinders must be properly labeled, properly tagged when empty, and capped when not in use. Gas lines will be of sufficient rating, and cylinders are required to be stored in an upright position using safety straps. This is based on NFPA 55, *Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders*, for the handling and use of compressed gases (Ref 5).

Heated Zones: The heated zones are contained in Insulated enclosures.

Chemicals: VOCs can emit from drums being sampled.

3.6.5 Operating Environment and Natural Phenomena

There are no operating environment requirements (Attachment 1, Equipment Setup Requirements, lists some recommendations).

3.6.6 Human Interface Requirement

There are no Human Interface Requirements.

3.6.7 Specific Commitments

There are no Specific Commitments.

3.7 Engineering Disciplinary Requirements

3.7.1 Civil and Structural

There are no civil and structural requirements.

3.7.2 Mechanical and Materials

There are no mechanical or materials engineering requirements.

3.7.3 Chemical and Process

There are no chemical or process requirements.

3.7.4 Electrical Power

Electrical power required is 110-120V, 15 and 20 amp circuits. See Attachment 1, *Equipment Setup Requirements.*

3.7.5 Instrumentation and Control

There are no instrumentation and control engineering requirements.

3.7.6 Computer Hardware and Software

There are no computer hardware and software requirements except noted in 3.2.1.

3.7.7 Fire Protection

No fire protection is required.

3.8 Testing and Maintenance Requirements

3.8.1 Testability

No testability is required.

3.8.2 TSR- Required Surveillance

There are no TSR- Required Surveillances established. The Host site is responsible for establishing TSR's if applicable.

3.8.3 Non-TSR Inspections and Testing

There are no Non-TSR Inspections and Testing

3.8.4 Maintenance

The manufacturer recommends the oil in the rough pump be changed annually (Ref. 4).

3.9 Other Requirements

3.9.1 Security and Special Nuclear Material (SNM) Protection

No security or SNM Protection is required.

3.9.2 Special Installation Requirements

No special Installation Requirements are required.

3.9.3 Reliability, Availability, and Preferred Failure Modes

No reliability, availability, or preferred failure modes are required.

3.9.4 Quality Assurance

No Quality Assurance requirements.

3.9.5 Miscellaneous Requirements.

No Miscellaneous Requirements.

4.0 SYSTEM DESCRIPTION

4.1 Configuration Information

4.1.1 Description of System, Subsystems, and Major Components

The System is comprised of a GC, which has an internal TCD and an external MS. The GC has an oven capable of heating to 240°C. The GC and MS are connected to a computer through Ethernet cables and a router. The MS is kept under high vacuum with the use of a rough pump and Turbo molecular pump in series.

4.1.1.1 Description of Process

A sample is collected in a syringe and brought to the Unit. The syringe is attached to the GC via a luer lock fitting. Using the syringe, two sample loops are filled to approximately ambient pressure. A loop for internal standard is filled to approximately ambient pressure. Then the GC is started and the sample is introduced into the two different columns. After passing through the columns, the samples go to the detectors. The GC goes to a temperature ramp starting at 80°C to approximate 240°C as the samples go through the columns. The software collects the data and analyzing the data giving concentrations of any compounds detected.

4.1.2 Boundaries and Interfaces

There are no Boundaries and Interfaces.

4.1.3 Physical Layout and Location

The Unit is portable. The footprint for the Unit is approximately 3-feet deep, 5-feet wide and 5-feet high. If a computer cabinet is used the footprint is approximately 2-feet deep, 2-feet wide, and 6-feet high. If a cylinder rack is used the footprint is approximately 4-feet deep, 4-feet wide, and 5-feet high.

4.1.4 Physical Layout and Location

This has previously been discussed throughout this document.

4.1.5 System Reliability Features

There are no Reliability Features.

4.1.6 System Control Features

4.1.6.1 System Monitoring

The System is self-monitored and readiness is displayed on the monitor of GC and/or the computer monitor. The self-monitoring also displays error codes to help in troubleshooting. The keyboard on the GC can be used to manually monitor the GC. When troubleshooting, the touchpad on the MS can be used to control the MS.

4.1.6.2 Control Capability and Locations

After manually starting the GC and MS detector the GC and MS are controlled by the software on the computer and software on the GC. The GC and MS each have a keyboard to manually control the equipment.

4.1.6.3 Automatic and Manual Actions

These features were discussed above.

4.1.6.4 Set points and Ranges

A set of set points and ranges have been established and are provided in equipment method VOGAS.m.

4.1.6.5 Interlocks, Bypasses, and Permission

There are no interlocks, bypasses, and permissions required.

4.2 Operations

4.2.1 Initial Configuration (Pre-startup)

The initial configuration that is verified at pre-startup is that the Helium, Nitrogen, BFB, and Internal Standard compressed gases have been connected to supply lines.

4.2.2 System Startup

The system is startup by plugging in the equipment, manually turning on the GC, MS, and computer, and starting the software that controls the GC. The software automatically downloads the setting to the GC and MS detector.

4.2.3 Normal Operations

Procedure DOE/WIPP 06-3345 describes what operations are performed routinely.

4.2.4 Off-Normal Operations

There are no Off-Normal Operations.

4.2.5 System Shutdown

Before turning off the MS, it must be vented by powering down the turbomolecular pump. The venting is initiated through the software on the computer or the keyboard on the MS.

4.2.6 Safety Management Programs and Administrative Controls

The configuration management of the Transportation Only HSG Unit is performed in accordance with CCP-CM-001, *CCP Equipment Change Authorization and Documentation* (Ref 3).

4.3 Testing and Maintenance

4.3.1 Temporary Configurations

There are no temporary configurations for the Unit.

4.3.2 TSR-Required Surveillances

There are no TSR-Required Surveillances established. The Host site is responsible for establishing TSR's if applicable.

4.3.3 Non-TSR Inspections and Testing

There are no non-TSR inspections and testing.

4.3.4 Maintenance

The maintenance on the Unit is performed in accordance with CCP-TP-140, *CCP Equipment Maintenance* (Ref 4).

4.3.4.1 Post Maintenance Testing

Post-maintenance testing is comprised of performing a normal start-up.

4.4 Supplemental Information

There is no supplemental information.

5.0 REFERENCES

1. DOE-STD-3024-98, *Content of System Design Descriptions*
2. DOE/WIPP 06-3345, *Waste Isolation Pilot Plant Flammable Gas Analysis*
3. CCP-CM-001, *CCP Equipment Change Authorization and Documentation*
4. CCP-TP-140, *CCP Equipment Maintenance*
5. NFPA 55, *Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders*

Attachment 1 – Equipment Setup Requirements

Central Characterization Project (CCP)

Mobile Characterization Unit (MCU) Installation Specifications

Equipment: Transportation Only HSG (Flammable Gas Analysis – FGA)

Summary: Table A contains information regarding general site installation and preparation information for the Transportation Only HSG MCU.

Table A Installation Specifications	
Weight (Approximate)	Gas Rack/Bottle Cart: 470 lb GC/MS & Tool Cart: 200 lb Computer Rack: 150 lb
Primary Electrical Requirements (including overcurrent protection and grounding)	GC/MS: 1 x 20 amp x 120 Volt circuit 3 x 15 amp x 120 Volt circuit Computer (computer, monitor, printer): 1 x 15 amp x 120 Volt circuit 1 x 15 amp x 120 Volt circuit 1 x 15 amp x 120 Volt circuit
Fire Suppression	N/A. There is no fire suppression system involved for this unit. The fire suppression system in the building where this unit is operated will cover the fire suppression needs for this system.
Communication	N/A. There are no comm's included with this unit. Operator communication lines should be provided in the area where the unit is used.
Footprint	Gas Rack/Bottle Cart: The size is 42" x 32" x 68" (LxWxH). GC/MS & Tool Cart: The size is 71" x 34" x 49" (LxWxH). Computer Rack: The size is 26" x 24" x 64" (LxWxH). The operating area for this unit would need to be large enough to support two operators. Samples analyzed by this unit are collected from drums in syringes. Drums are not staged for this unit.

Attachment 1 – Equipment Setup Requirements (Continued)

Environmental Limits (temperature, water, dust, etc.)	The Transportation Only HSG Unit should be protected from the environment (precipitation, dust, etc.) The operating temperature should be maintained between 59^{o} F and 95^{o} F. The Unit is designed for indoor use.
Leveling	N/A.
Anchoring Points	N/A.

Attachment 2 – Figures

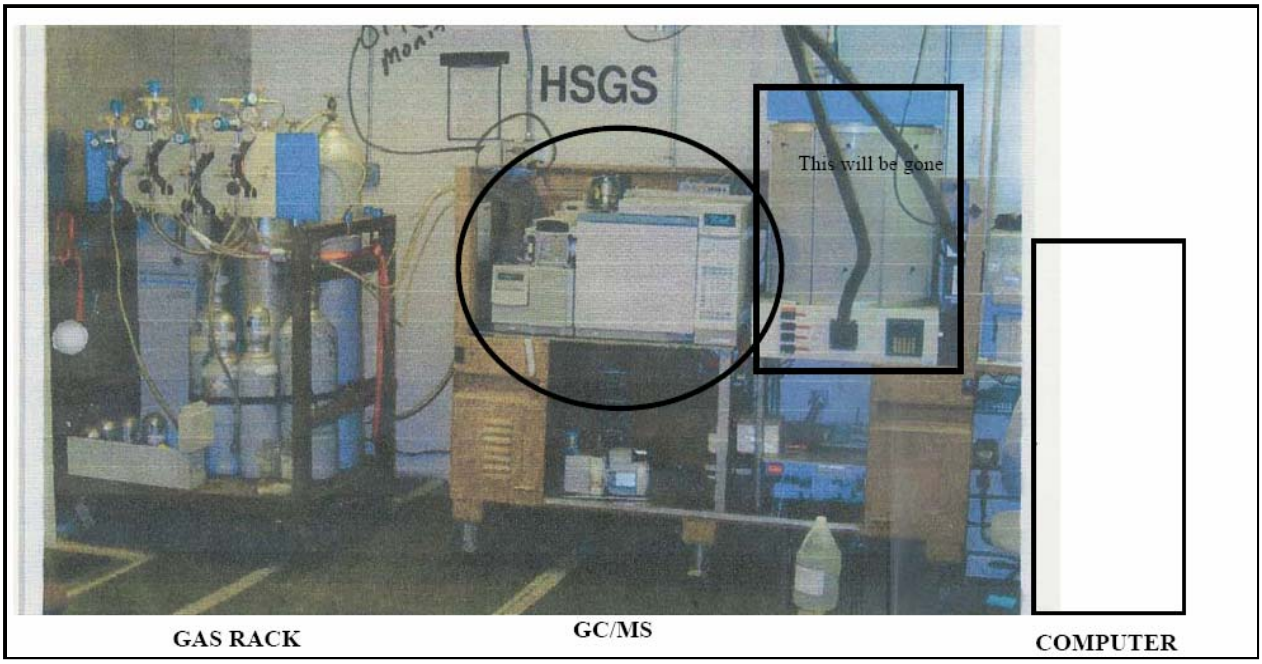

Figure 1. Rough illustration of Transportation Only HSG (FGA)