Casting Emission Reduction Program

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*US Army Contract DAAE30-02-C-1095*
*FY2002 Tasks*

# HAP and VOC Emissions from Sand Mixing, Core Making and Storage

## Core Room Vendor Test Ashland 389/689
## Technikon Test #1409-111 ER

Originally Published
**December 20, 2002**
*This document has been revised for public distribution.*

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# HAP and VOC Emissions From Sand Mixing, Core Making, and Core Storage

# 1409-111 Test ER

This report has been reviewed for completeness and accuracy and approved for release by the following:

| | | |
|---|---|---|
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The data contained in this report were developed to assess the relative emissions profile of the product or process being evaluated against a standardized baseline process profile. You may not obtain the same results in your facility. Data was not collected to assess casting quality, cost, or producibility.

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## Executive Summary

This report contains the results of HAP and VOC emission testing during phenolic urethane Cold Box core making. This is identified as CERP Test ER. The results from the vendor product tested for this report are compared to the results from the phenolic urethane Cold Box core making baseline, CERP Test EQ. All testing was conducted in the Technikon, LLC Production foundry core making facility.

The tests were divided into three segments, core mixing, core blowing, and core storage. Core mixing was performed using a Redford/Carver 50 pound core sand mixer. During the core-blowing portion of the test, the gassing and purge emissions and the "fugitive" emissions were measured together. The storage emissions represent the VOCs released to the environment from the time of core removal from the core box until the core is used to produce a casting. For this study, a five (5) hour storage time was established. All components of mold making were conducted within enclosures meeting the criteria for a temporary total enclosure (TTE) as specified in US EPA Method 204.

Each test segment of Test ER consisted of six (6) replicate runs at 1.2% binder and six (6) replicate runs at 1.75% binder. Only the 1.75% binder level was tested during the baseline Test EQ. In both tests, samples were collected on sorbent tubes during each run for selected VOCs and HAPs for subsequent laboratory analysis in accordance with US-EPA Method 18. All sampling locations were consistent with US EPA Method 1 except for core storage. The storage segment of the test used a laminar flow-through enclosure to sweep all of the emissions to the Method 18 sampling manifold. US EPA Method 25A, Total Gaseous Organic Concentration (TGOC), was used to monitor all segments of the test.

The table below summarizes the results for each of the test segments in lbs/lb of binder.

| **Analyte** | **Mixing** | | | **Gas/Purge Fugitives** | | | **Storage** | | | **Total** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **ER** | | **EQ** | **ER** | | **EQ** | **ER** | | **EQ** | **ER** | | **EQ** |
| | **1.20%** | **1.75%** | **1.75%** | **1.20%** | **1.75%** | **1.75%** | **1.20%** | **1.75%** | **1.75%** | **1.20%** | **1.75%** | **1.75%** |
| **TGOC as Propane** | 0.0054 | 0.0038 | 0.0041 | NA | NA | NA | NA | NA | NA | 0.0054 | 0.0038 | 0.0041 |
| **HC as Hexane** | 0.0021 | 0.0014 | 0.0021 | 0.0939 | 0.0650 | 0.0752 | 0.0272 | 0.0188 | 0.0171 | 0.1232 | 0.0852 | 0.0944 |
| **Sum of VOCs** | 0.0001 | 0.0067 | <0.0001 | 0.0009 | 0.0675 | 0.0014 | 0.0001 | <0.0001 | 0.0008 | 0.0011 | <0.0743 | <0.0023 |
| **Sum of HAPs** | 0.0001 | <0.0067 | <0.0001 | 0.0009 | 0.0675 | 0.0014 | 0.0001 | <0.0001 | 0.0008 | 0.0011 | <0.0743 | <0.0023 |
| **Sum of POMs** | ND | ND | ND | 0.0002 | 0.0002 | 0.0010 | 0.0001 | <0.0001 | 0.0007 | 0.0003 | <0.0003 | 0.0017 |

NA = Not Applicable. TGOC measures all carbon-containing organic compounds. The predominant organic in these test segments was the triethylamine catalyst which was not a target analyte. ND = Not Detected.

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# 1.0 Introduction

## 1.1 Background

Technikon LLC is a privately held contract research organization located in McClellan, California, a suburb of Sacramento. Technikon offers emissions research services to industrial and government clients specializing in the metal casting and mobile emissions areas. Technikon operates the Casting Emission Reduction Program (CERP). CERP is a cooperative initiative between the Department of Defense (US Army) and the United States Council for Automotive Research (USCAR). Its purpose is to evaluate alternative casting materials and processes that are designed to reduce air emissions and/or produce more efficient casting processes. Other technical partners directly supporting the project include: the American Foundry Society (AFS), the Casting Industry Suppliers Association (CISA), the US Environmental Protection Agency (USEPA), and the California Air Resources Board (CARB).

## 1.2 Technikon Objectives

The primary objective of Technikon is to evaluate materials, equipment, and processes used in the production of metal castings. Technikon's facility was designed to evaluate alternate materials and production processes designed to achieve significant air emission reductions, especially for the 1990 Clean Air Act Amendment. The facility has two principal testing arenas: a Pre-Production Foundry designed to measure airborne emissions from individually poured molds, and a Production Foundry designed to measure air emissions in a continuous full scale production process. Each of these testing arenas has been specially designed to facilitate the collection and evaluation of airborne emissions and associated process data.

The Production Foundry provides simultaneous detailed individual emission measurements using methods based on USEPA protocols for the melting, pouring, sand preparation, mold making, and core making processes. The core making area of the Production foundry contains three core blowers, a Georg Fischer for the preparation of automotive block cores, a Redford that is used for the production of step cores, and a second smaller Redford to produce dogbone tensile test specimens.

## 1.3 Report Organization

This report has been designed to document the methodology and results of a specific test plan that was used to evaluate HAP and VOC emissions from the Cold Box core making process. Section 2 of this report includes a summary of the methodologies used for data collection and analysis, emission calculations, QA/QC procedures, and data management and reduction methods. Specific data collected during this test are summarized in Section 3 of this report, with detailed data included in Appendix B of this report. Section 4 of this report contains a discussion of the results and the laboratory data validation log.

The raw data for this test series are included in a data binder that is maintained at the Technikon facility.

### 1.4 Specific Test Plan and Objectives

This report contains the results of testing performed to provide data on selected VOC emissions from the core making process. Table 1-1 provides a summary of the test plan for the mixing, core making, and storage phase. The details of the approved test plan are included in Appendix A.

**Table 1-1 Test Plan Summary**

| | Test Plan | Test Plan |
|---|---|---|
| Type of Process tested | Core Room Baseline | Core Room Vendor Test |
| Test Plan Number | 1409-123 (EQ) | 1409-111 (ER) |
| Binder System | Phenolic Urethane Cold Box | Phenolic Urethane Cold Box |
| Binder Level | 1.75%BOS | 1.2%BOS and 1.75%BOS |
| Number of tests | 9 each at core blowing, core mixing, and core storage | 6 each at core blowing, core mixing, and core storage |
| Test Date | 8/19/02 > 9/13/02 | 9/16/02 > 10/1/02 |
| Emissions Measured | TGOC as Propane, HC as Hexane, o-Cresol, Phenol, Formaldehyde, Naphthalene, 1-Me Naphthalene, 2-Me Napthalene | TGOC as Propane, HC as Hexane, o,m,p-Cresol, Phenol, Formaldehyde, Naphthalene, 1-Me Naphthalene, 2-Me Napthalene |
| Process Parameters Measured | Sand, and Binder Weights, Incoming Sand Temperature, Sand Mixing Time, Core Machine Cycle Time | Sand, and Binder Weights, Incoming Sand Temperature, Sand Mixing Time, Core Machine Cycle Time |
| Source Parameters Measured | Exhaust Duct Temperature, Pressure, and Volumetric Flow Rate | Exhaust Duct Temperature, Pressure, and Volumetric Flow Rate |

## 2.0 Test Methodology

### 2.1 Description of Process and Testing Equipment

Figure 2-1 is a diagram of the core making process and testing equipment.

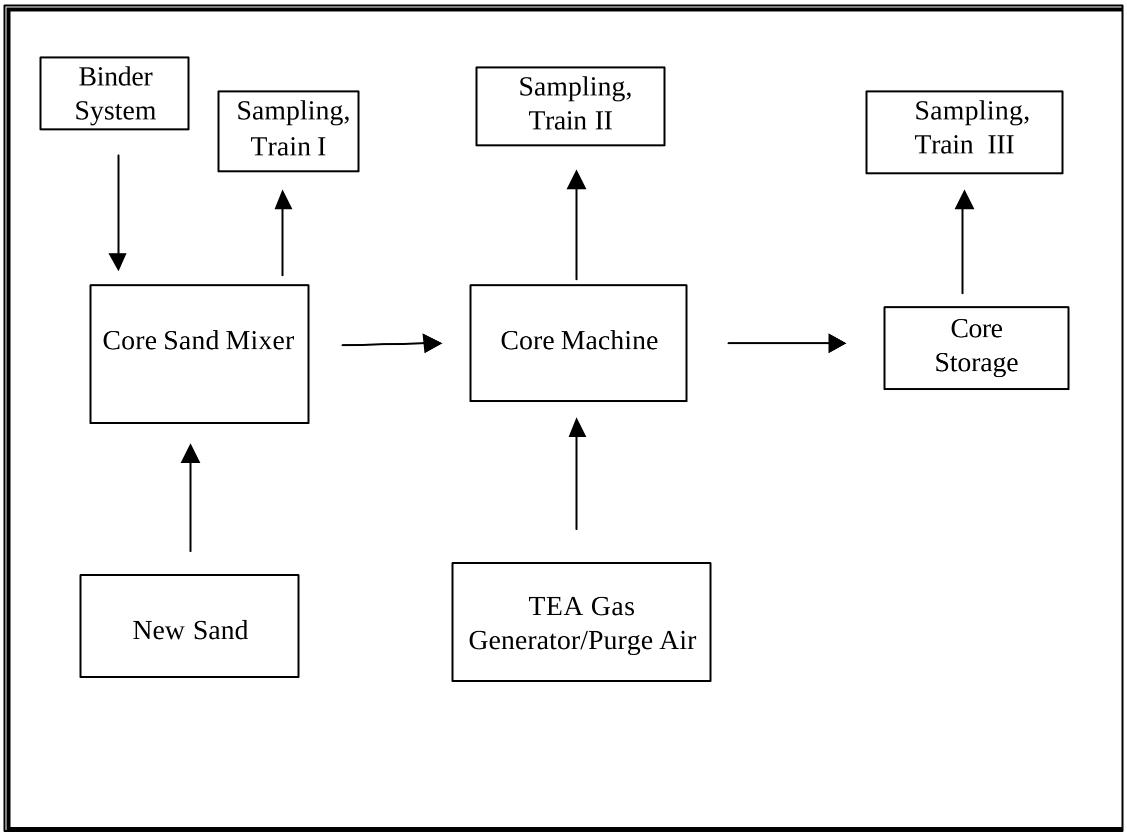



**Figure 2-1 Core Making and Testing Process**

### 2.2 Description of Testing Program

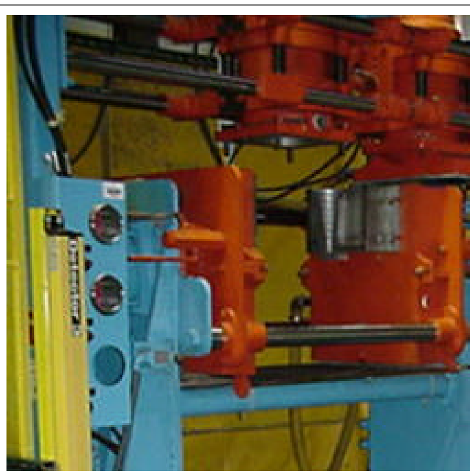
The specific steps used in this sampling program are summarized below:

**Test Plan Review and Approval:** The proposed test plan was reviewed by the Technikon staff and the CERP Steering Committee, and approved.

**Core Preparation**: Step cores were prepared for this test in the Production foundry core room area. The sand and binder were mixed in a Redford-Carver Sand Mixer, and then introduced (blown) into the core tooling of the Redford-Carver core machine. The core-making machine was contained in a permanent total enclosures meeting US EPA Method 204 criteria. A weighed amount of the catalyst, triethylamine (TEA), was heated to 84°F and allowed to expand into the sand in the core box to cure the core. Finally, purge air, heated to 80 F, was blown through the sand mixture in the core box. All these gases are exhausted to a wet gas scrubber charged with sulfuric acid at pH 2 or less. Step cores are fabricated in a single cavity core box. One blow produces one step-core.


*Sand Mixing*

**Individual Sampling Events:** Sampling to determine the mold making emissions consisted of three (3) segments. The mixing emissions were collected from a Redford/Carver 50 pound core sand mixer for seven (7) minutes. The mixed sand was dumped into the Redford Carver sand storage hopper. Air samples were collected during the seven (7) minute mix cycle prior to dumping. During the production of step cores, air sample were also collected to determine the amount of solvents being vented off the core process. The samples were collected during each of the nine (9) thirty (30) minute runs that comprised this portion of the test. The storage segment of the test consisted of placing four (4) cores in the flow-through storage enclosures as soon as they were removed from the core machine. The storage enclosures were sealed and sampling begun. A five (5) hour integrated sample was collected. All of the enclosures used during this test meet or exceed US-EPA Method 204 criteria for Temporary Total Enclosures.


*Core Making*


*Core Storage*

**Process Parameter Measurements:** Table 2-1 lists the process parameters that are monitored during each test. The analytical equipment and methods used are also listed.

**Table 2-1 Process Parameters Measured**

| Parameter | Analytical Equipment and Methods |
|---|---|
| Binder Weight | Mettler PJ8000 Digital Scale (Gravimetric) |
| Core Sand Weight | Simpson IQ-800-3A Digital Scale |

**Air Emissions Analysis**: The specific sampling and analytical methods used in the core sand mixing, making, and core storage tests are based on the USEPA reference methods shown in Table 2-2. The details of the specific testing procedures and their variance from the reference methods, if any, are included in the Technikon Standard Operating Procedures.

**Table 2-2 Sampling and Analytical Methods**

| Measurement Parameter | **Test Method*** |
|---|---|
| Port location | EPA Method 1 |
| Number of traverse points | EPA Method 1 |
| Gas velocity and temperature | EPA Method 2 |
| HC as Hexane Benzene, Naphthalene, Formaldehyde, o-Cresol, Phenol, | EPA Method 18, NIOSH 1500, NIOSH 2002, TO-11 |
| TGOC (THC) as Propane concentration | EPA Method 25A |
| Volatile Matter content | EPA Method 24 |

* These methods were specifically modified to meet the testing objectives of the CERP Program.

**Data Reduction, Tabulation and Preliminary Report Preparation**: The analytical results of the emissions tests provide the mass of each analyte in the sample. For the core-blowing segment of the test, the total mass of the analyte emitted is calculated by multiplying the mass of analyte in the sample times the ratio of the sample volume to the total stack gas volume during the test. The total stack gas volume is calculated from the measured stack gas velocity and duct diameter. The total mass of analyte is then divided by the weight of the binder used to provide emissions data in pounds of analyte per pound of binder.

In the case of the storage segment of this test, the stack-parameters are replaced, by the total volume of gas flowing through the storage enclosure, during each sampling period. The total flow rate through the enclosure was controlled with critical orifices. The total mass of the analyte emitted is then calculated by multiplying the measured mass of analyte in the sample times the ratio of sample volume to total gas volume over the same time period.

**<u>Report Preparation and Review:</u>** The Preliminary Draft Report is reviewed by the Process Team and Emissions Team to ensure its completeness, consistency with the test plan, and adherence to the prescribed QA/QC procedures. Appropriate observations, conclusions and recommendations are added to the report to produce a Draft Report. The Draft Report is reviewed by the Vice President-Measurement Technologies, the Vice President-Operations. Comments are incorporated into a Final Report prior to final signature approval and distribution.

## 2.3 Quality Assurance and Quality Control (QA/QC) Procedures

Detailed QA/QC and data validation procedures for the process parameters, stack measurements, and laboratory analytical procedures are included in the <u>Technikon Standard Operating Procedures</u>. In order to ensure the timely review of critical quality control parameters, the following procedures are followed:

- Immediately following the individual sampling events performed for each test, specific process parameters are reviewed by the Manager - Process Engineering to ensure that the parameters are maintained within the prescribed control ranges. Where data are not within the prescribed ranges, the Manager - Process Engineering and the Vice President-Operations determine whether the individual test samples should be invalidated or flagged for further analysis following review of the laboratory data.

- The source (stack) and sampling parameters, analytical results and corresponding laboratory QA/QC data are reviewed by the Emissions Measurement Team to confirm the validity of the data. The VP-Measurement Technologies reviews and approves the recommendation, if any, that individual sample data should be invalidated. Invalidated data are not used in subsequent calculations.

## 3.0 Test Results

The average emission results, in pounds per pound of binder used, are presented in Table 3-1.

The amount of available VOCs for this binder system was determined using a method based on US EPA Method 24 and found to be 0.33 pounds per pound of binder or 33% of the binder weight. The emission results, as a percentage of the available VOCs, are presented in Table 3-2

Table 3-3 compares the average ER emissions data at 1.75% BOS with similar results from the baseline, EQ.

Table 3-4 contains average test process and source data. The total binder weight and the total core weight were calculated from the total amount of sand and the percent binder used in each section of the test.

Figure 3-1 shows the data from Table 3-1 graphically.

Appendix B contains the detailed emissions and process data.

### Table 3-1 Average Emission Results – Lb/Lb Binder

| Analyte | Mixing | | Making | | Storage | |
|---|---|---|---|---|---|---|
| | 1.20% | 1.75% | 1.20% | 1.75% | 1.20% | 1.75% |
| TGOC as Propane | 0.0054 | 0.0038 | NA | NA | NA | NA |
| **HC as Hexane** | 0.0021 | 0.0014 | 0.0939 | 0.0650 | 0.0272 | 0.0188 |
| Sum of VOCs | 0.0001 | <0.0001 | 0.0009 | 0.0007 | 0.0001 | <0.0001 |
| Sum of HAPs | 0.0001 | <0.0001 | 0.0009 | 0.0007 | 0.0001 | <0.0001 |
| Sum of POMs | ND | ND | 0.0002 | 0.0002 | 0.0001 | <0.0001 |
| **Phenol** | 0.0001 | <0.0001 | 0.0006 | 0.0005 | ND | ND |
| Formaldehyde | ND | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **o-Cresol** | ND | ND | ND | ND | ND | ND |
| **1-Methylnaphthalene** | ND | ND | ND | ND | ND | ND |
| **2-Methylnaphthalene** | ND | ND | ND | ND | ND | ND |
| **Naphthalene** | ND | ND | 0.0002 | 0.0002 | 0.0001 | <0.0001 |

ND: Non Detect; NA: Not Applicable

### Table 3-2 Average Emission Results – % Available Solvent

| Analyte | Mixing | | Making | | Storage | |
|---|---|---|---|---|---|---|
| | 1.20% | 1.75% | 1.20% | 1.75% | 1.20% | 1.75% |
| HC as Hexane | 0.6% | 0.4% | 28.4% | 19.7% | 8.2% | 5.7% |

## Table 3-3 Test EQ/ER Average Emissions Comparison – Lbs/Lb Binder

### Core Mixing

| Compound/Sample | ER | EQ | % Diff |
|---|---|---|---|
| **TGOC as Propane** | 0.0038 | 0.0041 | -7% |
| **HC as Hexane** | 0.0014 | 0.0021 | -33% |
| **Sum of VOCs** | 0.0001 | <0.0001 | -10% |
| **Sum of HAPs** | 0.0001 | <0.0001 | -10% |
| **Sum of POMs** | ND | ND | N |
| **Phenol** | 0.0001 | <0.0001 | 13% |
| **Formaldehyde** | ND | <0.0001 | - |
| **o-Cresol** | ND | ND | - |
| **1-Methylnaphthalene** | ND | ND | - |
| **2-Methylnaphthalene** | ND | ND | - |
| **Naphthalene** | ND | ND | - |

### Core Making

| Compound/Sample | | | |
|---|---|---|---|
| **HC as Hexane** | 0.0650 | 0.0752 | -14% |
| **Sum of VOCs** | 0.0007 | 0.0014 | -50% |
| **Sum of HAPs** | 0.0007 | 0.0014 | -50% |
| **Sum of POMs** | 0.0002 | 0.0010 | -80% |
| **Phenol** | 0.0005 | 0.0003 | 57% |
| **Formaldehyde** | ND | <0.0001 | -100% |
| **o-Cresol** | ND | ND | N |
| **1-Methylnaphthalene** | ND | 0.0003 | -100% |
| **2-Methylnaphthalene** | ND | 0.0004 | -100% |
| **Naphthalene** | 0.0002 | 0.0004 | -50% |

### Core Storage

| Compound/Sample | | | |
|---|---|---|---|
| **HC as Hexane** | 0.0188 | 0.0171 | 10% |
| **Sum of VOCs** | 0.0001 | 0.0008 | -87% |
| **Sum of HAPs** | 0.0001 | 0.0008 | -87% |
| **Sum of POMs** | 0.0001 | 0.0007 | -86% |
| **Phenol** | ND | ND | - |
| **Formaldehyde** | ND | <0.0001 | -85% |
| **o-Cresol** | ND | ND | N |
| **1-Methylnaphthalene** | ND | 0.0002 | -100% |
| **2-Methylnaphthalene** | ND | 0.0003 | -100% |
| **Naphthalene** | 0.0001 | 0.0003 | -66% |

**Table 3-4 Test ER Average Process and Source Data**

| Parameter | Mixing | | Making | | Storage | |
|---|---|---|---|---|---|---|
| **ER Test** | **1.20%** | **1.75%** | **1.20%** | **1.75%** | **1.20%** | **1.75%** |
| **Available Solvent (Lb)** | 0.197 | 0.287 | 0.855 | 1.224 | 0.028 | 0.041 |
| **Calculated Total Binder Weight (Lb)** | 0.597 | 0.870 | 2.59 | 3.71 | 0.085 | 0.124 |
| **Calculated Total Sand Weight (lb)** | 50.3 | 50.3 | 219.6 | 217.1 | 7.19 | 7.24 |
| **Average Binder Percentage (BOS)** | 1.19 | 1.73 | 1.20 | 1.74 | 1.19 | 1.75 |
| **Test Run Duration (min)** | 7 | 7 | 30 | 30 | 300 | 300 |
| **Volumetric Flow Rate (cfm)** | 0.99 | 1.0 | 310 | 310 | 0.33 | 0.34 |
| **Core Machine Cycle Time (min)** | -NA- | -NA- | 1.03 | 1.05 | -NA- | -NA- |
| **Purge Duration (sec)** | -NA- | -NA- | 20 | 20 | -NA- | -NA- |

**Table 3-5 Test EQ Average Process and Source Data**

| Parameter | Mixing | Making | Storage |
|---|---|---|---|
| **EQ Test** | **1.75%** | | |
| **Available Solvent (lb)** | 0.289 | 1.21 | 0.042 |
| **Calculated Total Binder Weight (lb)** | 0.875 | 3.67 | 0.127 |
| **Calculated Total Sand Weight (lb)** | 51.0 | 209.9 | 7.2 |
| **Average Binder Percentage (BOS)** | 1.74 | 1.75 | 1.75 |
| **Test Run Duration (min)** | 7 | 30 | 300 |
| **Volumetric Flow Rate (cfm)** | 1.05 | 320 | 0.33 |
| **Core Machine Cycle Time (min)** | -NA- | 1.2 | -NA- |
| **Purge Duration (sec)** | -NA- | 20 | -NA- |

**Figure 3-1 Average Emission Results 1.20%**

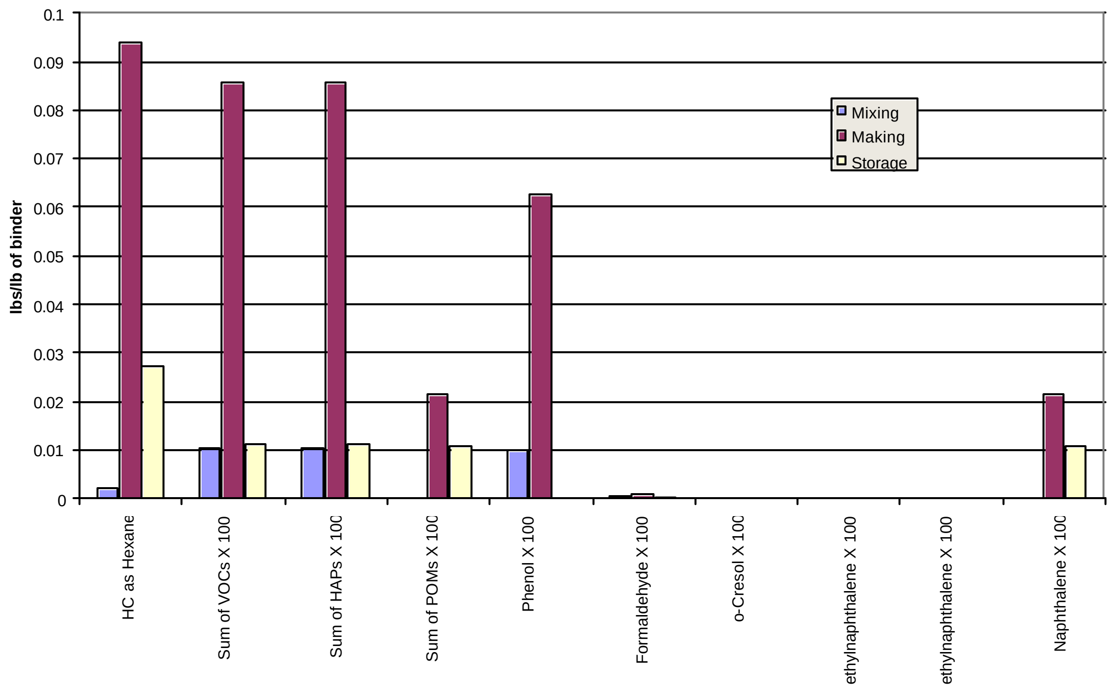
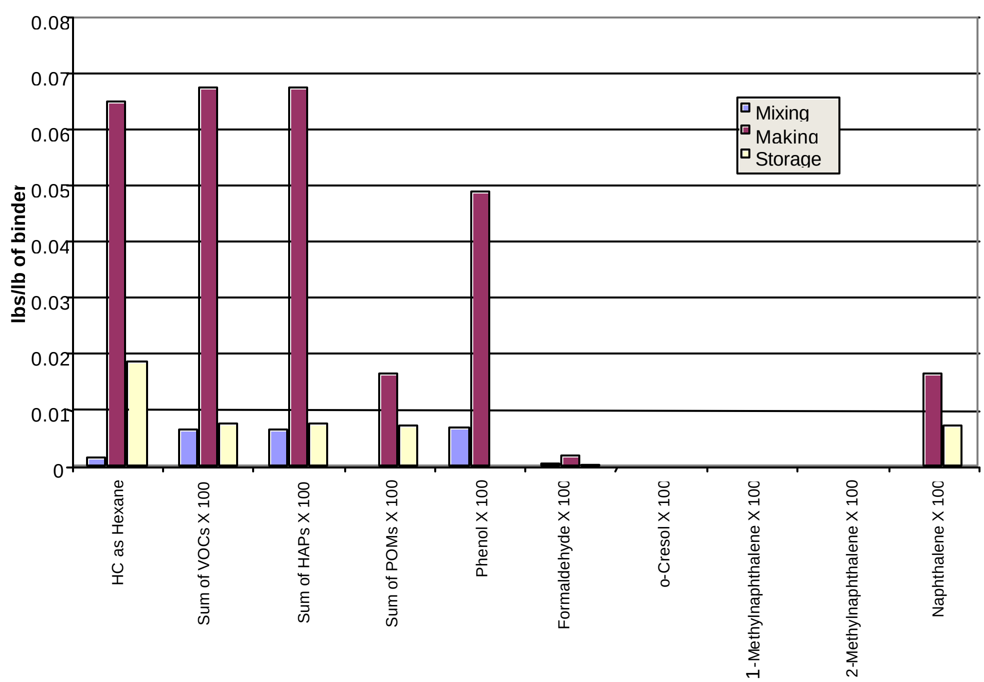
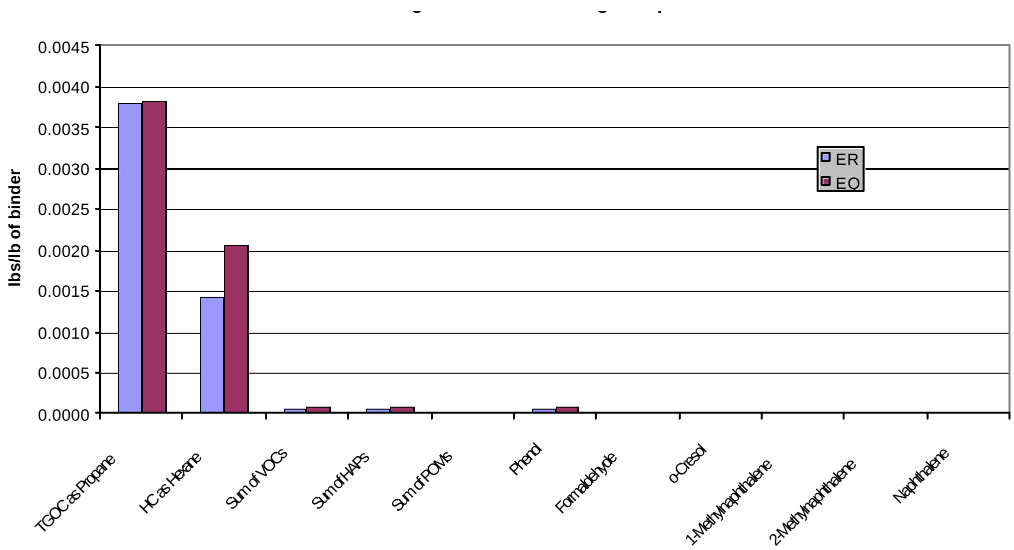


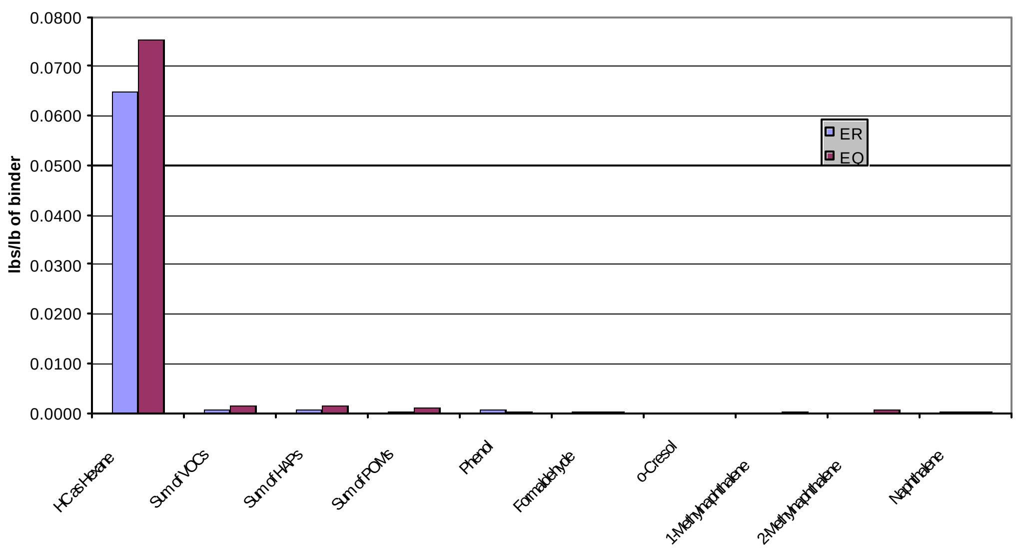

**Figure 3-2 Average Emission Results 1.75%**



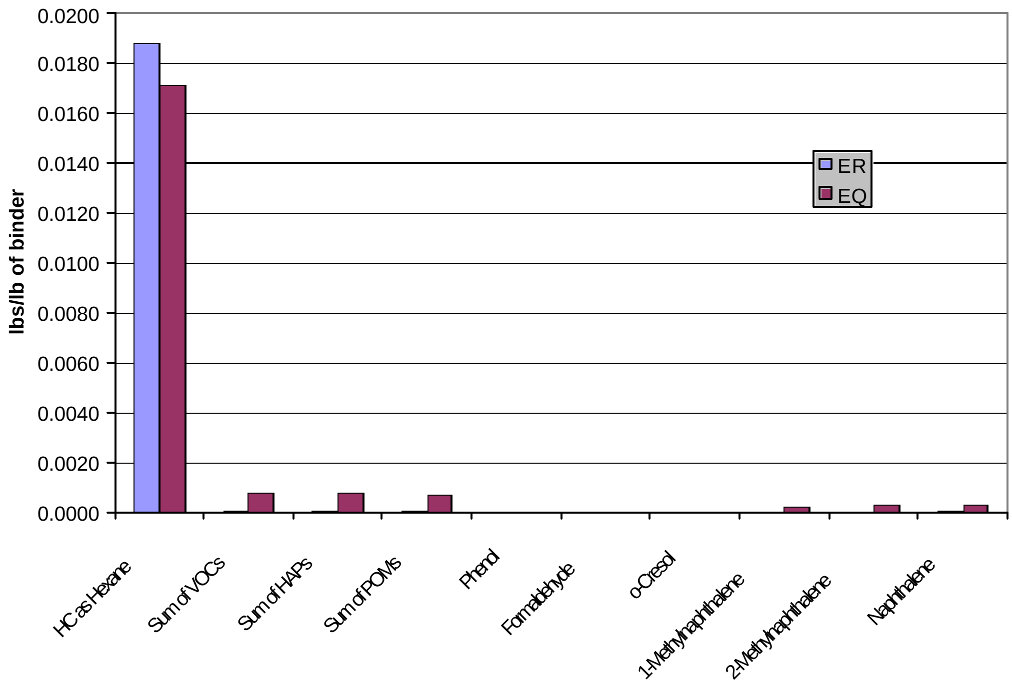
## Figure 3-3 Core Mixing Comparison




## Figure 3-4 Core Making Comparison



# Figure 3-5 Core Storage Comparison



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# 4.0 Discussion of Results

Volatile organic compound (VOC), hazardous air pollutant (HAP), and polycyclic organic material (POM) emissions were measured during core production activities associated with the use of a phenolic urethane binder system in the Technikon research and development core room. All test measurements associated with the core-production process were conducted within enclosures meeting the criteria for a temporary total enclosure according to US EPA Method 204. Results are expressed as pounds of emissions produced per pound of binder chemical and as percent of available solvent. Tables 3-1, and 3-2, summarize the results in lbs/lb of binder and % available solvent. The overall results for emissions during core sand/binder mixing, making, and storage in tests EQ and ER indicated that the largest proportion (75% – 80%) of emissions are generated by core making itself (gas/purge fugitives). Core storage releases the second largest proportion of total emissions generated (18% – 22%) while mixing accounted for the smallest release of VOCs (1.5% – 2.5%). Table 3-3 presents the overall results for this test series (ER) compared to the results for the baseline test series (EQ). The results for test series ER were somewhat surprising in that generally lower emissions were observed for the 1.75% binder as compared to the 1.2% binder. Although, the process air temperature remained close to 80 degrees Fahrenheit throughout the entire ER test series, ambient temperature was about 18 degrees Fahrenheit lower during the testing of the higher binder level. Future testing will be designed in order to further investigate the effect ambient/process stream temperature on VOC emission dynamics during the core production process.

**Mixing**

HAP emissions generated by mixing activities at both the 1.2% and 1.75% binder levels mainly consisted of relatively minor amounts of phenol and formaldehyde. The results presented in Table 3-1 (measured as HC as hexane) showed that mixing contributed the least proportion to total emissions which were measured during the mixing, making, and storage test segments (1.7% and 1.6% at the 1.2% and 1.75% binder levels respectively). These results also agree well with the 2.2% proportionate emissions measured during the mixing test for baseline test EQ.

**Making (Gas/Purge and Fugitives)**

Table 3-3 also shows that core making was the largest contributor to the overall emissions during the 3 test segments. For example, the HC as hexane results for core making activities (gas purge and fugitive emissions) contributed 76.3% of the total emissions measured during the three test segments for both the 1.2% and 1.75% binder levels. Again, the proportion of emissions captured during the ER test core making agrees well with the baseline results of 79.7% for test EQ.

**Storage**

Following core making itself, emissions from the storage of freshly made test step cores were found to contribute the next largest proportion of VOCs to the total found during these three test segments. The results for core storage showed that the proportion of emissions due to core storage was 22.1% for both the 1.2% and 1.75% binder levels and compares well to the 18.1% measured during the EQ baseline test.

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# Appendix A  Approved Test and Sample Plans

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# TECHNIKON TEST PLAN

- **CONTRACT NUMBER:** 1409 **TASK NUMBER:** 1.1.1
- **WORK ORDER NUMBER**: 1166 **Series**: ER
- **SAMPLE EVENTS:** 6 mix, 6 make, 6 store @ each 1.2% & 1.75%
- **SITE:** ___**PRE-PRODUCTION (243)** _X__ **FOUNDRY (238)**
- **TEST TYPE:** Core mixing, core making, core storage vendor product.
- **METAL TYPE**: None
- **MOLD TYPE:** None
- **NUMBER OF TESTS:** 12 core sand mixing, 12 core making, 12-core storage, and 2 core test dogbones.
- **CORE TYPE:** AFS Step Core, Ashland Isocure ® 389FC/689F Phenolic urethane binder at 1.2% and 1.75% total resin, 55% Part I, 45% part II, TEA gas catalyzed.
- **TEST DATE:** **START:** 16 SEP 2002
  **FINISHED:** 1 OCT 2002

**TEST OBJECTIVES:**

1. Measure selective HAP and VOC emissions from Core sand mixing, Gas & Purge and Fugitive Core Making, and Core Storage of AFS step cores made with 1.20% & 1.75% Ashland binder.
2. Measure 2-hour core dogbone strength at 1.2% and 1.75% total resin content.

**VARIABLES**:

1. **Core Sand Mixing:** The uncoated sand shall be Wexford W450 Lakesand. It shall be preheated or cooled to maintain a temperature of 89 +/- 2 degrees Fahrenheit. The binder shall be 1.75 +/- 0.0175% and 1.2 +/- 0.012 % Ashland 389FC/689F mixed Part I/Part II in the ratio of 55/45. The sand will be coated in the Redford/Carver 50 pound core sand mixer for 7 minutes. One minute shall be used to dispense the sand and the two binder components and one additional minute shall be used strictly for discharging the muller. Each core sand mixing test shall be one seven (7) minute 50 pound cycle within the muller only and monitored continuously by TGOC and adsorption tube sampling. Prior to the first mixing test five (5) batches shall be run to normalize the background within the muller. Sampling media will be changed after each one-cycle test during which time mixing will continue in order to maintain the background concentration. A total of six (6) mixing tests shall be run at each of 2 resin levels.

2. **Core Making:** The Redford/Carver core machine will operate on a nominal one (1) minute door-to-door cycle. The environmental enclosure shall be supplied with air controlled to 82 +/- 5 degrees Fahrenheit. TEA will be fed to the core machine at a nominal 5 grams

per cycle. The purge pressure shall be 20+/-2 psi. The core-make test will begin after the core machine has run sufficient time, at rate, to have the background emission concentration stabilize. Each core-make test will be 30 core cycles, about one half hour long, with continuous TGOC and adsorption tube sampling. Sample media will be changed after each 30-cycle test. The core machine will run continuously during media change and testing to maintain the background concentration. The gas & purge and fugitive emissions will be collected to a common sampling stack.

3. **Core Storage:** The store test will consist of weighed cores sequentially sampled, four (4) in a group, from the core machine and placed in individual sampling domes. The domes are in a temperature-controlled room at 82+/- 5 degrees Fahrenheit and sampled continuously with TGOC and adsorption tubes for 5 hours.

**BRIEF OVERVIEW:** Core making is not a single process but rather a series of steps each with its own process collectable and fugitive emissions. This test will look at selected HAP & VOC emissions from combined process collectable and fugitive emission streams during each of the core sand mixing, core making, and core storage steps.

**SPECIAL CONDITIONS:** The sand mixer will have a removable lid that allows air to infiltrate radially from the perimeter. Materials will be charged though a closeable door in the lid. Samples will be extracted from the center of the headspace below the lid. The core machine with step core tooling shall be housed in a double walled emission enclosure. The area between the walls shall be flushed with temperature-controlled air at 80+/-5 degrees Fahrenheit. This air shall be the ambient make up air for the core process within the enclosure. The core box and core machine shall be tightly plumbed to extract gasses passed through the core box into a common sampling stack with the fugitive gasses. The sampling environment will be maintained at 75-85$^{o}$F. Core storage will be individual cores tested under individual glass domes in groups of four (4) cores for a period of five hours. The environment will be totally captured. One dome will be monitored by TGOC.

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| | |
|---|---|
| **Process Engineering Manager (Technikon)** | **Date** |
| **V.P. Measurement Technology (Technikon)** | **Date** |
| **V.P. Operations (Technikon)** | **Date** |
| **CERP Representative** | **Date** |

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# Series ER

# Core Sand Mixing, Curing, and Storage
## Ashland Isocure® 389FC/689F

**A.** The Experiment:

1. Evaluate the emissions from Ashland Isocure ® 389FC/689F part I and part II Phenolic Urethane binder system at 1.2% and 1.75% total binder.

**B.** Mixing Test: Twelve discreet seven (7) minute batches run as 4 sets of three (3) runs per day. Runs 1 thru 6 shall be at 1.2% total binder and runs 7 thru 12 shall be at 1.75%.

1. The test shall be conducted in the 50-pound Carver core sand mixer fitted with the capture hood with make-up air ventilation.
   a. The emission sample shall be taken from the air space above the mixing sand.
2. Mixing
   a. Turn on the Kloster sand heater/cooler. Adjust the set point so that sand is delivered to the mixer in the temperature range of 87-92°F.
   b. Attach the emission sampling equipment to the 50-pound Carver core sand mixer.
   c. Pre-measure 1.2% or 1.75% (BOS) of Ashland Isocure ® binder based on a 50-pound batch.
      1) Part I (389FC) is 55% of the total binder and is 149.8 grams @ 1.2% or 218.5 grams @ 1.75%.
      2) Part II (689F) is 45% of the total binder and is 122.6 grams @ 1.2% or 178.8 grams @ 1.75%.

      **Note:** Pre-wet the dispensing cup and tare the wet cup.
   d. Pre-Weigh 50 pounds of Wexford W450 Lake Sand, heated to 87-92°F in the Kloster sand heater/cooler, in the Simpson Technologies weight system.
   e. Place the capture hood on top of the mixer. Start the mixer.
   f. Start the timer. Start monitoring with the TGOC only. Monitor with the TGOC continuously until the end of the test.
   g. Use the TGOC data during the background-stabilizing period to confirm the required media flow rates. If a change is required restart the test.
   h. Make five (5) emission background-generating batches.
   i. The procedure for this and the contiguously run test batches shall be as follows: Add the 50-pounds of raw sand, about 20-25 seconds, followed by the binder part I dispensed over 20 seconds, followed by binder part II dispensed over 20 seconds. All materials should be in the mixer within 50-70 seconds from start of the batch. Mix each batch until a total of 6 minutes have elapsed, then discharge the batch into the core machine hopper until a total of 7 minutes has elapsed from the start of the batch. Close the trap door to the core machine hopper after each batch. Be prepared to recharge the mixer for the next batch immediately at the end of each 7-minute period.

**j.** During the mixing period the next set of components must be weighed and made ready. Having two or three material sets weighed and protected from evaporation at all times makes the process go smoothly.

**k.** At the end of fifth batch (35 minutes)

**1)** Close the discharge door.
**2)** Open the sample train to the mixer.
**3)** The emission sample size will be one (1) batch. Collect the air sample until the door is closed at the end of the batch cycle.
**4)** During the next batch the media will be changed.
**5)** The next batch will be an emission sample again.
**6)** Continue alternating until three (3) emission tests for mixing are complete.

**l.** Repeat steps B.2.i-j for as many cycles as is necessary to complete the five (5) background batches, the three (3) emission test batches, and two (2) media changing periods, a total of 10 batches. Continue batches uninterrupted during media changes between tests.

**m.** Repeat steps B.2.i-j for as many cycles as is necessary to support the Core Making test.

**n.** Repeat the above for each day the Mixing test is run.

**3.** Switch the TGOC over to the Core Making apparatus at the conclusion of the daily Mix test.

**C.** Core making test: Twelve (12) discreet tests in four daily sets of three (3) tests each having thirty (30), approximately one (1) minute, core cycles. Runs 1 thru 6 shall be at 1.2% total binder and runs 7 thru 12 shall be at 1.75%.

**1.** Turn on the core storage room temperature control system 24 hours ahead of expected use time. Set control so that the core machine sees 80 +/- 3$^{o}$F.
**2.** Turn on the G/F core machine master start.
**3.** Turn on and adjust the Luber TEA gas generator.

**a.** Make sure there is enough TEA in the Luber TEA storage tank.
**b.** Set the MAX WORKING PRESSURE to 45 psi.
**c.** Set the gassing time (T1) to 0.75 seconds
**d.** Adjust the TEA flow rate to .019 pounds/second.
**Note:** This will give a minimum input of 4 grams per cycle.
**e.** Leave the Timer TR1 at 0.3 seconds, the proportional valve voltage at 7.5 volts and timer at 3 seconds, the low purge pressure at 10 psi and high purge pressure at 45 psi.
**Note:** This should yield a working pressure of about 7 psi.
**f.** Connect the TEA weighing container to the Luber supply line.

**1)** Dispense about 250 grams of TEA into the weigh container. The scale has a 300-gram capacity.
**2)** Close valve on Luber TEA storage tank.
**3)** Refill about every 50 blows.

**Caution: Verify that the TEA weigh container is secure on the weigh scale. If the bottle falls to the floor a TEA spill can occur.**

   - **g.** Conduct 5 gassing purge cycles within ½ hour of testing to stabilize the Luber generator.
     - **1)** Vent this material to the scrubber.
     - **2)** Record the TEA weight dispensed.
   - **h.** Record the ambient temperature, the inlet pressure, Max working pressure, working pressure, TEA flow rate, gassing timer value, & purge timer value.
4. Attach the emission sample train to the gas-purge-fugitive sample pipe.
5. Begin monitoring with the TGOC.
6. Prepare the core sand in the Carver mixer according to section B.2.i-j except without the emission sampling equipment attached to the mixer.
7. Prepare the core machine emission enclosure.
8. Verify that the temperature controlled core test room is set to deliver air at 80-85$^{o}$F to the core enclosure.
9. Set up the Redford/Carver core machine with the step core box.
10. Verify that the air temperature in the gas-purge-fugitive exhaust tube is 80-85 degrees Fahrenheit.
11. Set the Redford/Carver core machine to gas for 0.75 seconds with zero (0) second delay after gassing and twenty (20) second purge. Total cycle time to be about one (1) minute. Set the cycle counter to zero (0).
12. Start and calibrate the Luber TEA vaporizer to dispense about 4 grams of TEA per machine cycle.
13. Mix core sand per section B.2.i-j as required, in fifty (50) pound batches to assure continuity of production.
14. Cycle the core machine for 10-15 cycles or until fugitives emissions are stable based on the TGOC and good core manufacture is achieved. Note: if release agent is required wipe release agent on to core box do not spray.
15. Make cores continuously as above. Any stoppage will impact the fugitive's emission level.
16. Record the number and weight of each core throughout the test.
17. When everybody is ready, start the emission-sampling clock and open the sample train. Sample continuously for 30 core cycles, approximately thirty (30) minutes then close the sample train at the start of the 31$^{st}$ core cycle.
18. Do not stop making core.
19. Set up the sample train again and repeat the test for another thirty-core test. A total of twelve (12) 30-core tests are to be performed in groups of three (3) per day.
20. Empty and clean the core machine and core sand mixer.

**D.** Core storage tests.

1. Prepare the 4 individual core storage emission enclosures.
2. Set up a TGOC to monitor one enclosure and the sample train to monitor the other three enclosures and calibrate them.
3. Mix sand by the method of section B.2.i-j.
4. Make core by the method of Section C.
5. Number and weigh each core and record same.

6. When good core are being made sample four (4) cores whose weight is at least 7.10 pounds, and differ by no more than 0.05 pounds for the storage test. Place these cores in the core storage emission enclosures.
7. Close the enclosure bonnet, start the test clock, open to the TGOC or the sample train.
8. Record the date, start time for each core as well as the core weight and core number as it appears on the Core Make Log.
9. Continue sampling train and TGOC for 5 hours then close the sample train. Separate longer tests may be conducted by this procedure at the discretion of the emission team.
10. Repeat this procedure to obtain twelve (12) discrete tests in groups of three (3) plus the TGOC monitoring each day.

**E.** Dog Bone Test cores

1. Make 12 Dogbone test cores from a single batch of sand each day of testing.
2. Two hours after making the dogbones tensile test them in the Universal 405 Test machine. Perform a scratch hardness test on each dogbone on the flat side of one of the broken ends.
3. Record, for each dogbone the date & time of the sand batch and dogbone manufacture, the total binder content, the time of testing, the core weight, scratch hardness, and tensile strength.

Steven Knight
Mgr. Process Engineering

# CORE MIXING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/23/02 | | | | | | | | | | | 1.2% Binder |
| EVENT 1 | | | | | | | | | | | |
| THC | ER-10101 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | ER-10102 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| NIOSH 1500 | ER-10103 | | | 1 | | | | | 20 | 2 | 400/200 mg Charcoal (Orbo 32) |
| NIOSH 1500 | ER-10104 | | | | 1 | | | | 0 | | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | ER-10105 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| NIOSH 2002 | ER-10106 | | | 1 | | | | | 1000 | 9 | 400/200 mg Silica Gel (Orbo 53) |
| NIOSH 2002 | ER-10107 | | | | 1 | | | | 0 | | 400/200 mg Silica Gel (Orbo 53) |
| TO11 | ER-10108 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| TO11 | ER-10109 | | | | 1 | | | | 0 | | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | |
| | THC | | | | | | | | 1800 | 12 | THC |
| | Excess | | | | | | | | 22000 | 13 | Excess |

## CORE MIXING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/23/02 | | | | | | | | | | | 1.2% Binder |
| EVENT 2 | | | | | | | | | | | |
| THC | ER-10201 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | ER-10202 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | ER-10203 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| TO11 | ER-10204 | | 1 | | | | | | 1000 | 9 | (DNPH cartridge sep-pak) |
| TO11 | ER-10205 | | | 1 | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | THC | | | | | | | | 1800 | 12 | THC |
| | Excess | | | | | | | | 22000 | 13 | Excess |

# CORE MIXING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/23/02 | | | | | | | | | | | 1.2% Binder |
| EVENT 3 | | | | | | | | | | | |
| THC | ER-10301 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | ER-10302 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | ER-10303 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | ER-10304 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| TO11 | ER-10305 | | | | | 1 | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | THC | | | | | | | | 1800 | 12 | THC |
| | Excess | | | | | | | | 22000 | 13 | Excess |

## CORE MIXING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/24/02 | | | | | | | | | | | 1.2% Binder |
| EVENT 4 | | | | | | | | | | | |
| THC | ER-10401 | X | | | | | | | | | |
| NIOSH 1500 | ER-10402 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | ER-10403 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | ER-10404 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | THC | | | | | | | | 1800 | 12 | THC |
| | Excess | | | | | | | | 22000 | 13 | Excess |

# CORE MIXING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/24/02 | | | | | | | | | | | 1.2% Binder |
| EVENT 5 | | | | | | | | | | | |
| THC | ER-10501 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | ER-10502 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | ER-10503 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | ER-10504 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | THC | | | | | | | | 1800 | 12 | THC |
| | Excess | | | | | | | | 22000 | 13 | Excess |

# CORE MIXING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/24/02 | | | | | | | | | | | 1.2% Binder |
| EVENT 6 | | | | | | | | | | | |
| THC | ER-10601 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | ER-10602 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | ER-10603 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | ER-10604 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | THC | | | | | | | | 1800 | 12 | THC |
| | Excess | | | | | | | | 22000 | 13 | Excess |

## CORE MIXING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/27/02 | | | | | | | | | | | 1.75% Binder |
| EVENT 7 | | | | | | | | | | | |
| THC | ER-10701 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | ER-10702 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| NIOSH 1500 | ER-10703 | | | 1 | | | | | 20 | 2 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | ER-10704 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| NIOSH 2002 | ER-10705 | | | 1 | | | | | 1000 | 9 | 400/200 mg Silica Gel (Orbo 53) |
| TO11 | ER-10706 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | |
| | THC | | | | | | | | 1800 | 12 | THC |
| | Excess | | | | | | | | 22000 | 13 | Excess |

# CORE MIXING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/27/02 | | | | | | | | | | | 1.75% Binder |
| EVENT 8 | | | | | | | | | | | |
| THC | ER-10801 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | ER-10802 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | ER-10803 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| TO11 | ER-10804 | | 1 | | | | | | 1000 | 9 | (DNPH cartridge sep-pak) |
| TO11 | ER-10805 | | | 1 | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | THC | | | | | | | | 1800 | 12 | THC |
| | Excess | | | | | | | | 22000 | 13 | Excess |

## CORE MIXING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/27/02 | | | | | | | | | | | 1.75% Binder |
| EVENT 9 | | | | | | | | | | | |
| THC | ER-10901 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | ER-10902 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | ER-10903 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | ER-10904 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| TO11 | ER-10905 | | | | | 1 | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | THC | | | | | | | | 1800 | 12 | THC |
| | Excess | | | | | | | | 22000 | 13 | Excess |

# CORE MIXING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/24/02 | | | | | | | | | | | 1.75% Binder |
| EVENT 10 | | | | | | | | | | | |
| THC | ER-11001 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | ER-11002 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | ER-11003 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | ER-11004 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | THC | | | | | | | | 1800 | 12 | THC |
| | Excess | | | | | | | | 22000 | 13 | Excess |

# CORE MIXING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/24/02 | | | | | | | | | | | 1.75% Binder |
| EVENT 11 | | | | | | | | | | | |
| THC | ER-11101 | X | | | | | | | | | |
| NIOSH 1500 | ER-11102 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | ER-11103 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | ER-11104 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | THC | | | | | | | | 1800 | 12 | THC |
| | Excess | | | | | | | | 22000 | 13 | Excess |

# CORE MIXING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/24/02 | | | | | | | | | | | 1.75% Binder |
| EVENT 12 | | | | | | | | | | | |
| THC | ER-11201 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | ER-11202 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | ER-11203 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | ER-11204 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | THC | | | | | | | | 1800 | 12 | THC |
| | Excess | | | | | | | | 22000 | 13 | Excess |

## CORE MAKING ER - SERIES
## SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/25/02 | | | | | | | | | | | 1.2% Binder |
| EVENT 1 | | | | | | | | | | | |
| THC | ER-20101 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | 20 | 1 | Excess |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 20 | 3 | Excess |
| | Excess | | | | | | | | 80 | 4 | Excess |
| NIOSH 1500 | ER-20102 | | 1 | | | | | | 500 | 5 | 100/50 mg Char-coal (SKC 226-01) |
| NIOSH 1500 | ER-20103 | | | 1 | | | | | 500 | 6 | 100/50 mg Char-coal (SKC 226-01) |
| | Excess | | | | | | | | 900 | 7 | Excess |
| | Excess | | | | | | | | 900 | 8 | Excess |
| NIOSH 2002 | ER-20104 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| NIOSH 2002 | ER-20105 | | | 1 | | | | | 1000 | 10 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | ER-20106 | | 1 | | | | | | 1000 | 11 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 500 | 12 | Excess |
| | Excess | | | | | | | | 5000 | 13 | Excess |
| | | | | | | | | | | | |

## CORE MAKING ER - SERIES
## SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/25/02 | | | | | | | | | | | 1.2% Binder |
| EVENT 2 | | | | | | | | | | | |
| THC | ER-20201 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | 20 | 1 | Excess |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 20 | 3 | Excess |
| | Excess | | | | | | | | 80 | 4 | Excess |
| NIOSH 1500 | ER-20202 | | 1 | | | | | | 500 | 5 | 100/50 mg Char-coal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| | Excess | | | | | | | | 900 | 8 | Excess |
| NIOSH 2002 | ER-20203 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | ER-20204 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| TO11 | ER-20205 | | | 1 | | | | | 1000 | 11 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 500 | 12 | Excess |
| | Excess | | | | | | | | 5000 | 13 | Excess |
| | | | | | | | | | | | |

## CORE MAKING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/25/02 | | | | | | | | | | | 1.2% Binder |
| EVENT3 | | | | | | | | | | | |
| THC | ER-20301 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | 20 | 1 | Excess |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 20 | 3 | Excess |
| | Excess | | | | | | | | 80 | 4 | Excess |
| NIOSH 1500 | ER-20302 | | 1 | | | | | | 500 | 5 | 100/50 mg Char-coal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| | Excess | | | | | | | | 900 | 8 | Excess |
| NIOSH 2002 | ER-20303 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | ER-20304 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| TO11 | ER-20305 | | | | | 1 | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 500 | 12 | Excess |
| | Excess | | | | | | | | 5000 | 13 | Excess |

## CORE MAKING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/25/02 | | | | | | | | | | | |
| EVENT 4 | | | | | | | | | | | 1.2% Binder |
| THC | ER-20401 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | 20 | 1 | Excess |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 20 | 3 | Excess |
| | Excess | | | | | | | | 80 | 4 | Excess |
| NIOSH 1500 | ER-20402 | | 1 | | | | | | 500 | 5 | 100/50 mg Char-coal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| | Excess | | | | | | | | 900 | 8 | Excess |
| NIOSH 2002 | ER-20403 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | ER-20404 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 500 | 12 | Excess |
| | Excess | | | | | | | | 5000 | 13 | Excess |

## CORE MAKING ER - SERIES
## SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/25/02 | | | | | | | | | | | |
| EVENT 5 | | | | | | | | | | | 1.2% Binder |
| THC | ER-20501 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | 20 | 1 | Excess |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 20 | 3 | Excess |
| | Excess | | | | | | | | 80 | 4 | Excess |
| NIOSH 1500 | ER-20502 | | 1 | | | | | | 500 | 5 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| | Excess | | | | | | | | 900 | 8 | Excess |
| NIOSH 2002 | ER-20503 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | ER-20504 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 500 | 12 | Excess |
| | Excess | | | | | | | | 5000 | 13 | Excess |

## CORE MAKING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/25/02 | | | | | | | | | | | 1.2% Binder |
| EVENT 6 | | | | | | | | | | | |
| THC | ER-20601 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | 20 | 1 | Excess |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 20 | 3 | Excess |
| | Excess | | | | | | | | 80 | 4 | Excess |
| NIOSH 1500 | ER-20602 | | 1 | | | | | | 500 | 5 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| | Excess | | | | | | | | 900 | 8 | Excess |
| NIOSH 2002 | ER-20603 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | ER-20604 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 500 | 12 | Excess |
| | Excess | | | | | | | | 5000 | 13 | Excess |

## CORE MAKING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/26/02 | | | | | | | | | | | 1.75% Binder |
| EVENT 7 | | | | | | | | | | | |
| THC | ER-20701 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | 20 | 1 | Excess |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 20 | 3 | Excess |
| | Excess | | | | | | | | 80 | 4 | Excess |
| NIOSH 1500 | ER-20702 | | 1 | | | | | | 500 | 5 | 100/50 mg Char-coal (SKC 226-01) |
| NIOSH 1500 | ER-20703 | | | 1 | | | | | 500 | 6 | 100/50 mg Char-coal (SKC 226-01) |
| | Excess | | | | | | | | 900 | 7 | Excess |
| | Excess | | | | | | | | 900 | 8 | Excess |
| NIOSH 2002 | ER-20704 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| NIOSH 2002 | ER-20705 | | | 1 | | | | | 1000 | 10 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | ER-20706 | | 1 | | | | | | 1000 | 11 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 500 | 12 | Excess |
| | Excess | | | | | | | | 5000 | 13 | Excess |

## CORE MAKING ER - SERIES
## SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/26/02 | | | | | | | | | | | 1.75% Binder |
| EVENT 8 | | | | | | | | | | | |
| THC | ER-20801 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | 20 | 1 | Excess |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 20 | 3 | Excess |
| | Excess | | | | | | | | 80 | 4 | Excess |
| NIOSH 1500 | ER-20802 | | 1 | | | | | | 500 | 5 | 100/50 mg Char-coal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| | Excess | | | | | | | | 900 | 8 | Excess |
| NIOSH 2002 | ER-20803 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | ER-20804 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| TO11 | ER-20805 | | | 1 | | | | | 1000 | 11 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 500 | 12 | Excess |
| | Excess | | | | | | | | 5000 | 13 | Excess |

# CORE MAKING ER - SERIES
# SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/26/02 | | | | | | | | | | | 1.75% Binder |
| EVENT 9 | | | | | | | | | | | |
| THC | ER-20901 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | 20 | 1 | Excess |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 20 | 3 | Excess |
| | Excess | | | | | | | | 80 | 4 | Excess |
| NIOSH 1500 | ER-20902 | | 1 | | | | | | 500 | 5 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| | Excess | | | | | | | | 900 | 8 | Excess |
| NIOSH 2002 | ER-20903 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | ER-20904 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| TO11 | ER-20905 | | | | | 1 | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 500 | 12 | Excess |
| | Excess | | | | | | | | 5000 | 13 | Excess |

## CORE MAKING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/26/02 | | | | | | | | | | | 1.75% Binder |
| EVENT 10 | | | | | | | | | | | |
| THC | ER-21001 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | | 1 | Excess |
| | Excess | | | | | | | | | 2 | Excess |
| | Excess | | | | | | | | | 3 | Excess |
| | Excess | | | | | | | | | 4 | Excess |
| NIOSH 1500 | ER-21002 | | 1 | | | | | | 500 | 5 | 100/50 mg Char-coal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | | 7 | Excess |
| | Excess | | | | | | | | | 8 | Excess |
| NIOSH 2002 | ER-21003 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | ER-21004 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | | 12 | Excess |
| | Excess | | | | | | | | | 13 | Excess |

## CORE MAKING ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/26/02 | | | | | | | | | | | 1.75% Binder |
| EVENT 11 | | | | | | | | | | | |
| THC | ER-21101 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | 20 | 1 | Excess |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 20 | 3 | Excess |
| | Excess | | | | | | | | 80 | 4 | Excess |
| NIOSH 1500 | ER-21102 | | 1 | | | | | | 500 | 5 | 100/50 mg Char-coal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| | Excess | | | | | | | | 900 | 8 | Excess |
| NIOSH 2002 | ER-21103 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | ER-21104 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 500 | 12 | Excess |
| | Excess | | | | | | | | 5000 | 13 | Excess |

## CORE MAKING ER - SERIES
## SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/26/02 | | | | | | | | | | | 1.75% Binder |
| EVENT 12 | | | | | | | | | | | |
| THC | ER-21201 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | 20 | 1 | Excess |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 20 | 3 | Excess |
| | Excess | | | | | | | | 80 | 4 | Excess |
| NIOSH 1500 | ER-21202 | | 1 | | | | | | 500 | 5 | 100/50 mg Char-coal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| | Excess | | | | | | | | 900 | 8 | Excess |
| NIOSH 2002 | ER-21203 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | ER-21204 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 500 | 12 | Excess |
| | Excess | | | | | | | | 5000 | 13 | Excess |

## CORE STORAGE ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/23/02 | | | | | | | | | | | 5-Hr. Test-Core 1 (D1) |
| EVENT 1 | | | | | | | | | | | 1.2% Binder |
| NIOSH 1500 | ER-30101 | | 1 | | | | | | 25 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| NIOSH 1500 | ER-30102 | | | 1 | | | | | 25 | 2 | 100/50 mg Charcoal (SKC 226-01) |
| NIOSH 2002 | ER-30103 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| NIOSH 2002 | ER-30104 | | | 1 | | | | | 30 | 4 | 150/75 mg Silica Gel (SKC 226-10) |
| TO-11 | ER-30105 | | 1 | | | | | | 200 | 5 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

## CORE STORAGE ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/23/02 | | | | | | | | | | | 5 Hour Test-Core 2 (D2) |
| EVENT 2 | | | | | | | | | | | 1.2% Binder |
| NIOSH 1500 | ER-30201 | | 1 | | | | | | 30 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| NIOSH 2002 | ER-3202 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| TO-11 | ER-3203 | | 1 | | | | | | 200 | 4 | (DPNH cartridge sep-pak) |
| TO-11 | ER-3204 | | | 1 | | | | | 200 | 5 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

# CORE STORAGE ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/23/02 | | | | | | | | | | | 5 Hour Test-Core 3 (D3) |
| EVENT 3 | | | | | | | | | | | 1.2% Binder |
| NIOSH 1500 | ER-30301 | | 1 | | | | | | 30 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 30 | 2 | Excess |
| NIOSH 2002 | ER-30302 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| TO-11 | ER-30303 | | 1 | | | | | | 200 | 4 | (DPNH cartridge sep-pak) |
| TO-11 | ER-30304 | | | | | 1 | | | 200 | 4 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 200 | 5 | Excess |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

## CORE STORAGE ER - SERIES
## SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/24/02 | | | | | | | | | | | 5 Hour Test-Core 4 (D1) |
| EVENT 4 | | | | | | | | | | | 1.2% Binder |
| NIOSH 1500 | ER-30401 | | 1 | | | | | | 25 | 1 | 100/50 mg Char-coal (SKC 226-01) |
| | Excess | | | | | | | | 25 | 2 | Excess |
| NIOSH 2002 | ER-30402 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| | Excess | | | | | | | | 30 | 4 | Excess |
| TO-11 | ER-30403 | | 1 | | | | | | 200 | 5 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | Variable | 6 | No Critical Ori-fice |
| | | | | | | | | | | | |

# CORE STORAGE ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/24/02 | | | | | | | | | | | 5 Hour Test-Core 5 (D2) |
| EVENT 5 | | | | | | | | | | | 1.2% Binder |
| NIOSH 1500 | ER-30501 | | 1 | | | | | | 30 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| NIOSH 2002 | ER-30502 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| TO-11 | ER-30503 | | 1 | | | | | | 200 | 4 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 200 | 5 | Excess |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

## CORE STORAGE ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/24/02 | | | | | | | | | | | 5 Hour Test-Core 6 (D3) |
| EVENT 6 | | | | | | | | | | | 1.2% Binder |
| NIOSH 1500 | ER-30601 | | 1 | | | | | | 30 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 30 | 2 | Excess |
| NIOSH 2002 | ER-30602 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| TO-11 | ER-30603 | | 1 | | | | | | 200 | 4 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 200 | 5 | Excess |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

# CORE STORAGE ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/26/02 | | | | | | | | | | | 5 Hour Test-Core 7 (D1) |
| EVENT 7 | | | | | | | | | | | 1.75% Binder |
| NIOSH 1500 | ER-30701 | | 1 | | | | | | 25 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| NIOSH 1500 | ER-30702 | | | 1 | | | | | 25 | 2 | Excess |
| NIOSH 2002 | ER-30703 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| NIOSH 2002 | ER-30704 | | | 1 | | | | | 30 | 4 | Excess |
| TO-11 | ER-30705 | | 1 | | | | | | 200 | 5 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

# CORE STORAGE ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/26/02 | | | | | | | | | | | 5 Hour Test-Core 8 (D2) |
| EVENT 8 | | | | | | | | | | | 1.75% Binder |
| NIOSH 1500 | ER-30801 | | 1 | | | | | | 30 | 1 | 100/50 mg Char-coal (SKC 226-01) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| NIOSH 2002 | ER-30802 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| TO-11 | ER-30803 | | 1 | | | | | | 200 | 4 | (DPNH cartridge sep-pak) |
| TO-11 | ER-30804 | | | 1 | | | | | 200 | 5 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | Variable | 6 | No Critical Ori-fice |
| | | | | | | | | | | | |

## CORE STORAGE ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/26/02 | | | | | | | | | | | 5 Hour Test-Core 9 (D3) |
| EVENT 9 | | | | | | | | | | | 1.75% Binder |
| NIOSH 1500 | ER-30901 | | 1 | | | | | | 30 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 30 | 2 | Excess |
| NIOSH 2002 | ER-30902 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| TO-11 | ER-30903 | | 1 | | | | | | 200 | 4 | (DPNH cartridge sep-pak) |
| TO-11 | ER-30904 | | | | | 1 | | | 200 | 4 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 200 | 5 | Excess |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

## CORE STORAGE ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/27/02 | | | | | | | | | | | 5 Hour Test-Core 10 (D1) |
| EVENT 10 | | | | | | | | | | | 1.75% Binder |
| NIOSH 1500 | ER-31001 | | 1 | | | | | | 25 | 1 | 100/50 mg Char-coal (SKC 226-01) |
| | Excess | | | | | | | | 25 | 2 | Excess |
| NIOSH 2002 | ER-31002 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| | Excess | | | | | | | | 30 | 4 | Excess |
| TO-11 | ER-31003 | | 1 | | | | | | 200 | 5 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | Variable | 6 | No Critical Ori-fice |
| | | | | | | | | | | | |

## CORE STORAGE ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/27/02 | | | | | | | | | | | 5 Hour Test-Core 11 (D2) |
| EVENT 11 | | | | | | | | | | | 1.75% Binder |
| NIOSH 1500 | ER-31101 | | 1 | | | | | | 30 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| NIOSH 2002 | ER-31102 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| TO-11 | ER-31103 | | 1 | | | | | | 200 | 4 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 200 | 5 | Excess |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

## CORE STORAGE ER - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/27/02 | | | | | | | | | | | 5 Hour Test-Core 12 (D3) |
| EVENT 12 | | | | | | | | | | | 1.75% Binder |
| NIOSH 1500 | ER-31201 | | 1 | | | | | | 30 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 30 | 2 | Excess |
| NIOSH 2002 | ER-31202 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| TO-11 | ER-31203 | | 1 | | | | | | 200 | 4 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 200 | 5 | Excess |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

# TECHNIKON TEST PLAN

> **CONTRACT NUMBER:** 1409 **TASK NUMBER:** 1.2.3
> **WORK ORDER NUMBER:** 1165 **Series:** EQ
> **SAMPLE EVENTS:** EQ001-009 mix, EQ021-029 make, EQ031-039 store
> **SITE:** ___**PRE-PRODUCTION (243)** _X__ **FOUNDRY (238)**
> **TEST TYPE:** Capability, Core mixing, core making, core storage baseline 2002
> **METAL TYPE**: None
> **MOLD TYPE:** None
> **NUMBER OF MOLDS:** None
> **CORE TYPE:** AFS Step Core, Ashland Isocure ® LF305/52-904GR Phenolic urethane binder, TEA catalyzed
> **TEST DATE:** **START**: 19 Aug 2002
> **FINISHED:** 13 Sep 2002

## TEST OBJECTIVES:

1. Develop facility and methods to make a core mix, make, and store baseline having significantly reduced process variability and improved independent sample capture methods.
2. Measure selective HAP and VOC emissions from Core sand mixing, Gas & Purge and Fugitive Core Making, and Core Storage of AFS step cores made with 1.75% Ashland binder to make a 2002 Core baseline.

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## VARIABLES:

1. **Core Sand Mixing:** The uncoated sand shall be Wexford W450 Lakesand. It shall be preheated or cooled to maintain a temperature of 85 +/- 5 degrees Fahrenheit. The binder shall be 1.75 +/- .0175% Ashland 305/52-904 mixed Part I/Part II in the ratio of 55/45. The sand will be coated in the Redford/Carver 50 pound core sand mixer for 7 minutes. One minute shall be used to dispense the sand and the two binder components and one additional minute shall be used strictly for discharging the muller. Each core sand mixing test shall be one seven (7) minute 50-pound cycle within the muller only monitored continuously by TGOC and adsorption tube sampling. Prior to the first test five (5) batches shall be run to the storage hopper to normalize the background. Sampling media will be changed after each one-cycle test during which time mixing will continue in order to maintain the background concentration. A total of nine (9) mixing tests shall be run.

2. **Core Making**: The Redford/Carver core machine will operate on a nominal one (1) minute door-to-door cycle. The environmental enclosure shall be supplied with air controlled to 82 +/- 5 degrees Fahrenheit. TEA will be fed to the core machine at a nominal 5 grams per cy-

cle. The purge pressure shall be 20+/-2 psi. The core-make test will begin after the core machine has run sufficient time, at rate, to have the background emission concentration stabilize. Each core-make test will be 30 core cycles, about one half hour long, with continuous TGOC and adsorption tube sampling. Sample media will be changed after each 30-cycle test. The core machine will run continuously during media change and testing to maintain the background concentration. The gas & purge and fugitive emissions will be collected to a common sampling stack.

3. **Core Storage:** The store test will consist of weighed cores sampled four (4) at a time, from the core machine and placed in individual sampling domes. The domes are in a temperature-controlled room at 82+/- 5 degrees Fahrenheit and sampled continuously with TGOC and adsorption tubes for 5 hours.

**BRIEF OVERVIEW:** Core making is not a single process but rather a series of steps each with its own process collectable and fugitive emissions. This test will look at selected HAP & VOC emissions from combined process collectable and fugitive emission streams during each of the core sand mixing, core making, and core storage steps.

**SPECIAL CONDITIONS**: The sand mixer will have a removable lid that allows air to infiltrate radially from the perimeter. Materials will be charged though a closeable door in the lid. Samples will be extracted from the center of the headspace below the lid. The core machine with step core tooling shall be housed in a double walled emission enclosure. The area between the walls shall be flushed with temperature-controlled air at 80+/-5 degrees Fahrenheit. This air shall be the ambient make up air for the core process within the enclosure. The core box and core machine shall be tightly plumbed to extract gasses passed through the core box into a common sampling stack with the fugitive gasses. The sampling environment will be maintained at 75-85 degrees F.

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| | |
|---|---|
| **Process Engineering Manager**<br>(Technikon) | **Date** |
| **V.P. Measurement Technology**<br>(Technikon) | **Date** |
| **V.P. Operations**<br>(Technikon) | **Date** |
| **CERP Representative** | **Date** |

## Series EQ (Baseline)

# Core Sand Mixing, Curing, and Storage

**A.** The Experiment:

**1.** Design and develop improved capability to evaluate the standard emissions from the mixing, making, and storage of gas catalyzed cold reacting core sand mixtures.

**2.** Evaluate the emissions from Ashland Isocure ® LF305/52-904 part I and part II binder system to form a mixing, making, storage baseline for Iron-Phenolic Urethane binder systems.

**B.** Capability Study:

**1.** Mixing:

**a.** Design and manufacture a capture hood for the Carver 50 pound capacity core sand mixer consisting of:

**1)** An annular air makeup port which allows air to enter the mixer radially in such a way as to not significantly affect the emission evaporation from the sand surface.

**2)** The ventilation rate shall be sufficient to prevent escape of the emissions except to the emission-sampling stream.

**3)** An emission sampling port centered on the capture hood.

**4)** A discharge pipe connected to a sampling train and pump via a heated line to the THC analyzer.

**2.** Core Making:

**a.** Design and manufacture a total emission enclosure to capture and sample aggregate emissions from both the core box gas-purge cycles and fugitives from the enclosure.

**1)** A gassing head capable of independently delivering a catalyzing gas and purge air from the external Luber gas generator to the common fugitives collection pipe. The flow rate in the sampling pipe at the sampling location must be virtually independent of the whether the gas-purge cycle is active.

**3.** Storage:

**a.** Design and manufacture a set of four-storage emission sampling chambers.

**1)** Each chamber shall have independent air flow controls.

**2)** The sum of the chamber flows shall not exceed 50 liters/minute.

**3)** One chamber shall be connected to the THC analyzer.

**4)** Three chambers shall be connected to a sampling train via independent sampling media.

**4.** Conduct a set of preliminary tests to verify that the design criteria are met.

**a.** Conduct a "mixedness" test to verify that the mixer will create a homogeneous mixture within the prescribed mixing time.

**b.** Conduct a THC mixing calibration run according to the mixing schedule described below in order to determine the required media flow rates.

**c.** Conduct a THC core making calibration at 60 core /hour in order to determine the required media flow rates.

- **d.** Conduct a THC core storage calibration run using core made per the core make procedure in order to determine the required media flow rates.
- **e.** Record the ambient air temperature, pressure, and moisture content; scavenging air velocity; all machine parameters; all core weights; and all events.

**C.** Mixing Test:

1. Nine discrete seven (7) minute batches run contiguously.
2. The test shall be conducted in the 50-pound Carver core sand mixer fitted with the capture hood with make-up air ventilation.
   - **a.** The emission sample shall be taken from the air space above the mixing sand.
3. Mixing
   - **a.** Turn on the Kloster sand heater/cooler. Adjust the set point so that sand is delivered to the mixer in the temperature range of 80-90°F.
   - **b.** Attach the emission sampling equipment to the 50-pound Carver core sand mixer.
   - **c.** Pre-measure 1.75% (BOS) Ashland Isocure ® binder based on a 50-pound batch.
     - **1)** Part I (LF305) is 55% of the total resin and is 218.3 grams.
     - **2)** Part II (52-904) is 45% of the total resin and is 178.6 grams

     **Note**: Pre-wet the dispensing cup and tare the wet cup.
   - **d.** Pre-Weigh 50-pounds of Wexford W450 Lake Sand, heated to 80-90°F in the Kloster sand heater/cooler, in the Simpson Technologies weight system.
   - **e.** Place the capture hood on top of the mixer. Start the mixer.
   - **f.** Start the timer. Start monitoring with the THC only. Monitor with the THC continuously until the end of the test.
   - **g.** Make five (5) emission background-generating batches.
   - **h.** The procedure for this and the contiguously run test batches shall be as follows: Add the 50 pounds of raw sand, about 20-25 seconds, followed by the binder part I dispensed over 20 seconds, followed by binder part II dispensed over 20 seconds. All materials should be in the mixer within 50-70 seconds from start of the batch. Mix each batch until a total of 6 minutes have elapsed, then discharge the batch until a total of 7 minutes has elapsed from the start of the batch. Be prepared to recharge the mixer for the next batch immediately at the end of each 7-minute period.
   - **i.** During this activity the next set of components must be weighed and made ready. Having two or three material sets weighed and protected at all times makes the process go smoothly.
   - **j.** At the end of fifth batch (35 minutes)
     - **1)** Close the discharge door.
     - **2)** Open the sample train to the mixer.
     - **3)** The emission sample size will be one (1) batch.
     - **4)** During the next batch the media will be changed.
     - **5)** The next batch will be an emission sample again.
     - **6)** Continue alternating until nine (9) emission tests are complete.
   - **k.** Repeat steps C.2.g-h for as many cycles as is necessary to complete the five (5) background batches, the nine (9) emission test batches, and nine (9) media changing periods, a total of 23 batches. Continue batches uninterrupted during media changes between tests.

**D.** Core Making test: Nine (9) tests each having thirty (30) approximately one (1) minute core cycles.

**1.** Turn on the core storage room temperature control system 24 hours ahead of expected use time. Set control so that the core machine sees 80°F.

**2.** Turn on and adjust the Luber TEA gas generator.

**a.** Make sure there is enough TEA in the Luber TEA storage tank.

**b.** Set the MAX WORKING PRESSURE to 45 psi.

**c.** Set the gassing time (T1) to 0.75 seconds

**d.** Adjust the TEA flow rate to .019 pounds/second.
**Note:** This will give an amine input of 5.1 grams per cycle.

**e.** Leave the Timer TR1 at 0.3 seconds, the proportional valve voltage at 7.5 volts and timer at 3 seconds, the low purge pressure at 10 psi and high purge pressure at 45 psi.
**Note:** This should yield a working pressure of about 7 psi.

**f.** Connect the TEA weighing container to the Luber supply line.

**1)** Dispense about 250 grams of TEA into the weigh container. The scale has a 300-gram capacity.

**2)** Isolate the Luber TEA storage tank.

**g.** Conduct 5 gassing purge cycles within ½ hour of testing to stabilize the Luber generator.

**1)** Vent this material to the scrubber.

**2)** Record the TEA weight dispensed.

**h.** Record the ambient temperature, the inlet pressure, Max working pressure, working pressure, TEA flow rate, gassing timer value, & purge timer value.

**3.** Attach the emission sample train to the gas-purge-fugitive sample pipe.

**4.** Begin monitoring with the THC.

**5.** Prepare the core sand in the Carver mixer according to section C.2.g-h except without the emission sampling equipment attached to the mixer.

**6.** Prepare the core machine emission enclosure.

**7.** Verify that the temperature controlled core test room is set to deliver air at 75-85°F to the core enclosure.

**8.** Set up the Redford/Carver core machine with the step core corebox.

**9.** Verify that the air temperature in the gas-purge-fugitive exhaust tube is 75-85 degrees Fahrenheit.

**10.** Set the Redford/Carver core machine to gas for 0.75 seconds with zero (0) second delay after gassing and twenty (20) second purge. Total cycle time to be one (1) minute. Set the cycle counter to zero (0).

**11.** Start and calibrate the Luber TEA vaporizer to dispense 5.0-5.2 grams of TEA per machine cycle.

**12.** Mix core sand per section C.2.g-h. as required in fifty (50) pound batches to assure continuity of production.

**13.** Cycle the core machine for 10-15 cycles or until fugitives emissions are stable based on the THC and good core manufacture is achieved. Note: if release agent is required brush release agent on to core box do not spray.

**14.** Make cores continuously as above. Any stoppage will impact the fugitive's emission level.

**15.** Record the number and weight of each core throughout the test.

16. When everybody is ready, start the emission-sampling clock and open the sample train. Sample continuously for 30 core cycles, approximately thirty (30) minutes then close the sample train.
17. Do not stop making core.
18. Set up the sample train again and repeat the test for another thirty-core test. A total of nine (9) half-hour tests are to be performed.
19. Empty and clean the core machine and core sand mixer.

**E.** Core storage tests.

1. Prepare the 4 individual core storage emission enclosures.
2. Set up a THC to monitor one enclosure and the sample train to monitor the other three enclosures and calibrate them.
3. Mix sand by the method of section C.2.g-h.
4. Make core by the method of Section D.
5. Number, weigh, and record each core.
6. When good core are being made, sample four (4) cores whose weight is 7.30, 7.35, or 7.40 pounds for the storage test. Place these cores in the core storage emission enclosures.
7. Close the enclosure bonnet, start the test clock, open to the THC or the sample train.
8. Record the start time for each core as well as the core weight
9. Continue sampling train for 5 hours then close the sample train. Separate longer tests may be conducted by this procedure at the discretion of the emission team.
10. Continue the THC monitoring for 24 hours.
11. Repeat this procedure to obtain nine (9) discrete tests plus the THC monitoring.

Steven Knight
Mgr. Process Engineering

## CORE MIXING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/9/02 | | | | | | | | | | | |
| EVENT 1 | | | | | | | | | | | |
| THC | EQ-00101 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | EQ-00102 | | 1 | | | | | | 20 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| NIOSH 1500 | EQ-00103 | | | 1 | | | | | 20 | 2 | 400/200 mg Charcoal (Orbo 32) |
| NIOSH 1500 | EQ-00104 | | | | 1 | | | | | | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | EQ-00105 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| NIOSH 2002 | EQ-00106 | | | 1 | | | | | 1000 | 9 | 400/200 mg Silica Gel (Orbo 53) |
| NIOSH 2002 | EQ-00107 | | | | 1 | | | | | | 400/200 mg Silica Gel (Orbo 53) |
| TO11 | EQ-00108 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| TO11 | EQ-00109 | | | | 1 | | | | 1000 | 11 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 200 | 12 | Excess |
| | Excess | | | | | | | | 22000 | 13 | Excess |

## CORE MIXING EQ - SERIES
## SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/9/02 | | | | | | | | | | | |
| EVENT 2 | | | | | | | | | | | |
| THC | EQ-00201 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | EQ-00202 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | EQ-00203 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| TO11 | EQ-00204 | | 1 | | | | | | 1000 | 9 | (DNPH cartridge sep-pak) |
| TO11 | EQ-00205 | | | 1 | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 200 | 12 | Excess |
| | Excess | | | | | | | | 22000 | 13 | Excess |

## CORE MIXING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/9/02 | | | | | | | | | | | |
| EVENT 3 | | | | | | | | | | | |
| THC | EQ-00301 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | EQ-00302 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | EQ-00303 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | EQ-00304 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| TO11 | EQ-00305 | | | | | 1 | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 200 | 12 | Excess |
| | Excess | | | | | | | | 22000 | 13 | Excess |

## CORE MIXING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/9/02 | | | | | | | | | | | |
| EVENT 4 | | | | | | | | | | | |
| THC | EQ-00401 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | EQ-00402 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | EQ-00403 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | EQ-00404 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 200 | 12 | Excess |
| | Excess | | | | | | | | 22000 | 13 | Excess |

## CORE MIXING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/9/02 | | | | | | | | | | | |
| EVENT 5 | | | | | | | | | | | |
| THC | EQ-00501 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | EQ-00502 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | EQ-00503 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | EQ-00504 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 200 | 12 | Excess |
| | Excess | | | | | | | | 22000 | 13 | Excess |

## CORE MIXING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/9/02 | | | | | | | | | | | |
| EVENT 6 | | | | | | | | | | | |
| THC | EQ-00601 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | EQ-00602 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | EQ-00603 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | EQ-00604 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 200 | 12 | Excess |
| | Excess | | | | | | | | 22000 | 13 | Excess |

## CORE MIXING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/9/02 | | | | | | | | | | | |
| EVENT 7 | | | | | | | | | | | |
| THC | EQ-00701 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | EQ-00702 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | EQ-00703 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | EQ-00704 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 200 | 12 | Excess |
| | Excess | | | | | | | | 22000 | 13 | Excess |

**CORE MIXING EQ - SERIES**
**SAMPLE PLAN**

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/9/02 | | | | | | | | | | | |
| EVENT 8 | | | | | | | | | | | |
| THC | EQ-00801 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | EQ-00802 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | EQ-00803 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | EQ-00804 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 200 | 12 | Excess |
| | Excess | | | | | | | | 22000 | 13 | Excess |

# CORE MIXING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/9/02 | | | | | | | | | | | |
| EVENT 9 | | | | | | | | | | | |
| THC | EQ-00901 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | EQ-00902 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | EQ-00903 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | EQ-00904 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 200 | 12 | Excess |
| | Excess | | | | | | | | 22000 | 13 | Excess |

## CORE MIXING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/9/02 | | | | | | | | | | | |
| EVENT 10 | | | | | | | | | | | |
| THC | EQ-01001 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | EQ-01002 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | EQ-01003 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | EQ-01004 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 200 | 12 | Excess |
| | Excess | | | | | | | | 22000 | 13 | Excess |

## CORE MIXING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/9/02 | | | | | | | | | | | |
| EVENT 11 | | | | | | | | | | | |
| THC | EQ-01101 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | EQ-01102 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | EQ-01103 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | EQ-01104 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 200 | 12 | Excess |
| | Excess | | | | | | | | 22000 | 13 | Excess |

# CORE MIXING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/9/02 | | | | | | | | | | | |
| EVENT 12 | | | | | | | | | | | |
| THC | EQ-01201 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | EQ-01202 | | 1 | | | | | | 20 | 1 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | EQ-01203 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| | Excess | | | | | | | | 1000 | 9 | Excess |
| TO11 | EQ-01204 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | 200 | 12 | Excess |
| | Excess | | | | | | | | 22000 | 13 | Excess |

# CORE MIXING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/9/02 | | | | | | | | | | | |
| EVENT 13 | | | | | | | | | | | |
| THC | EQ-01301 | X | | | | | | | | | TOTAL |
| NIOSH 1500 | EQ-01302 | | 1 | | | | | | 20 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| NIOSH 1500 | EQ-01303 | | | 1 | | | | | 20 | 2 | 400/200 mg Charcoal (Orbo 32) |
| | Excess | | | | | | | | 45 | 3 | Excess |
| | Excess | | | | | | | | 35 | 4 | Excess |
| | Excess | | | | | | | | 60 | 5 | Excess |
| | Excess | | | | | | | | 750 | 6 | Excess |
| | Excess | | | | | | | | 900 | 7 | Excess |
| NIOSH 2002 | EQ-01305 | | 1 | | | | | | 1000 | 8 | 400/200 mg Silica Gel (Orbo 53) |
| NIOSH 2002 | EQ-01306 | | | 1 | | | | | 1000 | 9 | 400/200 mg Silica Gel (Orbo 53) |
| TO11 | EQ-01308 | | 1 | | | | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| TO11 | EQ-01309 | | | | | 1 | | | 1000 | 10 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | |
| | Excess | | | | | | | | 200 | 12 | Excess |
| | Excess | | | | | | | | 22000 | 13 | Excess |

## CORE MAKING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/11/02 | | | | | | | | | | | |
| EVENT | | | | | | | | | | | |
| THC | EQ-02101 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | | 1 | Excess |
| | Excess | | | | | | | | | 2 | Excess |
| | Excess | | | | | | | | | 3 | Excess |
| | Excess | | | | | | | | | 4 | Excess |
| NIOSH 1500 | EQ-02102 | | 1 | | | | | | 500 | 5 | 100/50 mg Charcoal (SKC 226-01) |
| NIOSH 1500 | EQ-02103 | | | 1 | | | | | 500 | 6 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | | 7 | Excess |
| | Excess | | | | | | | | | 8 | Excess |
| NIOSH 2002 | EQ-02104 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| NIOSH 2002 | EQ-02105 | | | 1 | | | | | 1000 | 10 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | EQ-02106 | | 1 | | | | | | 1000 | 11 | (DNPH cartridge sep-pak) |
| | Excess | | | | | | | | | 12 | Excess |
| | Excess | | | | | | | | | 13 | Excess |
| | | | | | | | | | | | |

# CORE MAKING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/11/02 | | | | | | | | | | | |
| EVENT | | | | | | | | | | | |
| THC | EQ-02201 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | | 1 | Excess |
| | Excess | | | | | | | | | 2 | Excess |
| | Excess | | | | | | | | | 3 | Excess |
| | Excess | | | | | | | | | 4 | Excess |
| NIOSH 1500 | EQ-02202 | | 1 | | | | | | 500 | 5 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | | 7 | Excess |
| | Excess | | | | | | | | | 8 | Excess |
| NIOSH 2002 | EQ-02203 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | EQ-02204 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| | EQ-02205 | | | 1 | | | | | 1000 | 11 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | | 12 | Excess |
| | Excess | | | | | | | | | 13 | Excess |
| | | | | | | | | | | | |

## CORE MAKING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/11/02 | | | | | | | | | | | |
| EVENT | | | | | | | | | | | |
| THC | EQ-02301 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | | 1 | Excess |
| | Excess | | | | | | | | | 2 | Excess |
| | Excess | | | | | | | | | 3 | Excess |
| | Excess | | | | | | | | | 4 | Excess |
| NIOSH 1500 | EQ-02302 | | 1 | | | | | | 500 | 5 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | | 7 | Excess |
| | Excess | | | | | | | | | 8 | Excess |
| NIOSH 2002 | EQ-02303 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | EQ-02304 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| TO11 | EQ-02305 | | | | | 1 | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | | 12 | Excess |
| | Excess | | | | | | | | | 13 | |

## CORE MAKING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/11/02 | | | | | | | | | | | |
| EVENT | | | | | | | | | | | |
| THC | EQ-02401 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | | 1 | Excess |
| | Excess | | | | | | | | | 2 | Excess |
| | Excess | | | | | | | | | 3 | Excess |
| | Excess | | | | | | | | | 4 | Excess |
| NIOSH 1500 | EQ-02402 | | 1 | | | | | | 500 | 5 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | | 7 | Excess |
| | Excess | | | | | | | | | 8 | Excess |
| NIOSH 2002 | EQ-02403 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | EQ-02404 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | | 12 | Excess |
| | Excess | | | | | | | | | 13 | Excess |

## CORE MAKING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/11/02 | | | | | | | | | | | |
| EVENT | | | | | | | | | | | |
| THC | EQ-02501 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | | 1 | Excess |
| | Excess | | | | | | | | | 2 | Excess |
| | Excess | | | | | | | | | 3 | Excess |
| | Excess | | | | | | | | | 4 | Excess |
| NIOSH 1500 | EQ-02502 | | 1 | | | | | | 500 | 5 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | | 7 | Excess |
| | Excess | | | | | | | | | 8 | Excess |
| NIOSH 2002 | EQ-02503 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | EQ-02504 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | | 12 | Excess |
| | Excess | | | | | | | | | 13 | Excess |

## CORE MAKING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/11/02 | | | | | | | | | | | |
| EVENT | | | | | | | | | | | |
| THC | EQ-02601 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | | 1 | Excess |
| | Excess | | | | | | | | | 2 | Excess |
| | Excess | | | | | | | | | 3 | Excess |
| | Excess | | | | | | | | | 4 | Excess |
| NIOSH 1500 | EQ-02602 | | 1 | | | | | | 500 | 5 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | | 7 | Excess |
| | Excess | | | | | | | | | 8 | Excess |
| NIOSH 2002 | EQ-02603 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | EQ-02604 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | | 12 | Excess |
| | Excess | | | | | | | | | 13 | Excess |

## CORE MAKING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/11/02 | | | | | | | | | | | |
| EVENT | | | | | | | | | | | |
| THC | EQ-02701 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | | 1 | Excess |
| | Excess | | | | | | | | | 2 | Excess |
| | Excess | | | | | | | | | 3 | Excess |
| | Excess | | | | | | | | | 4 | Excess |
| NIOSH 1500 | EQ-02702 | | 1 | | | | | | 500 | 5 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | | 7 | Excess |
| | Excess | | | | | | | | | 8 | Excess |
| NIOSH 2002 | EQ-02703 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | EQ-02704 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | | 12 | Excess |
| | Excess | | | | | | | | | 13 | Excess |

# CORE MAKING EQ - SERIES
# SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/11/02 | | | | | | | | | | | |
| EVENT | | | | | | | | | | | |
| THC | EQ-02801 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | | 1 | Excess |
| | Excess | | | | | | | | | 2 | Excess |
| | Excess | | | | | | | | | 3 | Excess |
| | Excess | | | | | | | | | 4 | Excess |
| NIOSH 1500 | EQ-02802 | | 1 | | | | | | 500 | 5 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | | 7 | Excess |
| | Excess | | | | | | | | | 8 | Excess |
| NIOSH 2002 | EQ-02803 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | EQ-02804 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | | 12 | Excess |
| | Excess | | | | | | | | | 13 | Excess |

## CORE MAKING EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/11/02 | | | | | | | | | | | 30 Minute Test |
| EVENT | | | | | | | | | | | |
| THC | EQ-02901 | X | | | | | | | | | TOTAL |
| | Excess | | | | | | | | | 1 | Excess |
| | Excess | | | | | | | | | 2 | Excess |
| | Excess | | | | | | | | | 3 | Excess |
| | Excess | | | | | | | | | 4 | Excess |
| NIOSH 1500 | EQ-02902 | | 1 | | | | | | 500 | 5 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 500 | 6 | Excess |
| | Excess | | | | | | | | | 7 | Excess |
| | Excess | | | | | | | | | 8 | Excess |
| NIOSH 2002 | EQ-02903 | | 1 | | | | | | 1000 | 9 | 150/75 mg Silica Gel (SKC 226-10) |
| TO11 | EQ-02904 | | 1 | | | | | | 1000 | 10 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 1000 | 11 | Excess |
| | Excess | | | | | | | | | 12 | Excess |
| | Excess | | | | | | | | | 13 | Excess |

# CORE STORAGE EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/10/02 | | | | | | | | | | | 5-Hr. Test-Core 1 |
| EVENT | | | | | | | | | | | |
| NIOSH 1500 | EQ-03101 | | 1 | | | | | | 25 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| NIOSH 1500 | EQ-03102 | | | 1 | | | | | 25 | 2 | 100/50 mg Charcoal (SKC 226-01) |
| NIOSH 2002 | EQ-03103 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| NIOSH 2002 | EQ-03104 | | | 1 | | | | | 30 | 4 | 150/75 mg Silica Gel (SKC 226-10) |
| TO-11 | EQ-03105 | | 1 | | | | | | 200 | 5 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

# CORE STORAGE EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/10/02 | | | | | | | | | | | 5 Hour Test-Core 2 |
| EVENT | | | | | | | | | | | |
| NIOSH 1500 | EQ-03201 | | 1 | | | | | | 30 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| NIOSH 2002 | EQ-3202 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| TO-11 | EQ-3203 | | 1 | | | | | | 200 | 4 | (DPNH cartridge sep-pak) |
| TO-11 | EQ-3204 | | | 1 | | | | | 200 | 5 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

# CORE STORAGE EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/10/02 | | | | | | | | | | | 5 Hour Test-Core 3 |
| EVENT | | | | | | | | | | | |
| NIOSH 1500 | EQ-03301 | | 1 | | | | | | 30 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 30 | 2 | Excess |
| NIOSH 2002 | EQ-03302 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| TO-11 | EQ-03303 | | 1 | | | | | | 200 | 4 | (DPNH cartridge sep-pak) |
| TO-11 | EQ-03304 | | | | | 1 | | | 200 | 4 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 200 | 5 | Excess |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

# CORE STORAGE EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/11/02 | | | | | | | | | | | 5 Hour Test-Core 4 |
| EVENT | | | | | | | | | | | |
| NIOSH 1500 | EQ-03401 | | 1 | | | | | | 25 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 25 | 2 | Excess |
| NIOSH 2002 | EQ-03402 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| | Excess | | | | | | | | 30 | 4 | Excess |
| TO-11 | EQ-03403 | | 1 | | | | | | 200 | 5 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

# CORE STORAGE EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/11/02 | | | | | | | | | | | 5 Hour Test-Core 5 |
| EVENT | | | | | | | | | | | |
| NIOSH 1500 | EQ-03501 | | 1 | | | | | | 30 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| NIOSH 2002 | EQ-03502 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| TO-11 | EQ-03503 | | 1 | | | | | | 200 | 4 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 200 | 5 | Excess |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

# CORE STORAGE EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/11/02 | | | | | | | | | | | 5 Hour Test-Core 6 |
| EVENT | | | | | | | | | | | |
| NIOSH 1500 | EQ-03601 | | 1 | | | | | | 30 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 30 | 2 | Excess |
| NIOSH 2002 | EQ-03602 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| TO-11 | EQ-03603 | | 1 | | | | | | 200 | 4 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 200 | 5 | Excess |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

# CORE STORAGE EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/11/02 | | | | | | | | | | | 5 Hour Test-Core 7 |
| EVENT | | | | | | | | | | | |
| NIOSH 1500 | EQ-03701 | | 1 | | | | | | 25 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 25 | 2 | Excess |
| NIOSH 2002 | EQ-03702 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| | Excess | | | | | | | | 30 | 4 | Excess |
| TO-11 | EQ-03703 | | 1 | | | | | | 200 | 5 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

# CORE STORAGE EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/11/02 | | | | | | | | | | | 5 Hour Test-Core 8 |
| EVENT | | | | | | | | | | | |
| NIOSH 1500 | EQ-03801 | | 1 | | | | | | 30 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 20 | 2 | Excess |
| NIOSH 2002 | EQ-03802 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| TO-11 | EQ-03803 | | 1 | | | | | | 200 | 4 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 200 | 5 | Excess |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

# CORE STORAGE EQ - SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/11/02 | | | | | | | | | | | 5 Hour Test-Core 9 |
| EVENT | | | | | | | | | | | |
| NIOSH 1500 | EQ-03901 | | 1 | | | | | | 30 | 1 | 100/50 mg Charcoal (SKC 226-01) |
| | Excess | | | | | | | | 30 | 2 | Excess |
| NIOSH 2002 | EQ-03902 | | 1 | | | | | | 60 | 3 | 150/75 mg Silica Gel (SKC 226-10) |
| TO-11 | EQ-03903 | | 1 | | | | | | 200 | 4 | (DPNH cartridge sep-pak) |
| | Excess | | | | | | | | 200 | 5 | Excess |
| | Excess | | | | | | | | Variable | 6 | No Critical Orifice |
| | | | | | | | | | | | |

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# Appendix B  Detailed Test and Process Data

# Individual Mixing Test Results – Lb/Lb Binder

## Core Mixing

| Compound/Sample Number | ER001 | ER002 | ER003 | ER004 | ER005 | ER006 | ER007 | ER008 | ER009 | ER010 | ER011 | ER012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TGOC as Propane | 5.20E-03 | 5.50E-03 | 5.50E-03 | 5.50E-03 | 5.40E-03 | 5.50E-03 | 3.20E-03 | 3.30E-03 | 3.60E-03 | 4.20E-03 | 4.20E-03 | 4.30E-03 |
| HC as Hexane | 2.18E-03 | 1.58E-03 | 2.34E-03 | I | I | 2.34E-03 | 1.76E-03 | 1.65E-03 | 9.38E-04 | 1.38E-03 | 1.32E-03 | 1.54E-03 |
| Sum of VOCs | 9.76E-05 | 1.03E-04 | 1.06E-04 | 1.05E-04 | 1.05E-04 | 1.07E-04 | 5.46E-05 | 5.89E-05 | 6.38E-05 | 7.79E-05 | 8.11E-05 | I |
| Sum of HAPs | 9.76E-05 | 1.03E-04 | 1.06E-04 | 1.05E-04 | 1.05E-04 | 1.07E-04 | 5.46E-05 | 5.89E-05 | 6.38E-05 | 7.79E-05 | 8.11E-05 | I |
| Sum of POMs | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | Individual Organic HAPs and VOCs | | | | | | | | | | | |
| Phenol | 9.29E-05 | 9.80E-05 | 9.83E-05 | 1.00E-04 | 1.00E-04 | 1.02E-04 | 4.78E-05 | 5.17E-05 | 5.51E-05 | 7.35E-05 | 7.72E-05 | 1.21E.04 |
| Formaldehyde | 4.71E-06 | 5.39E-06 | 7.92E-06 | 4.40E-06 | 5.11E-06 | 5.18E-06 | 6.78E-06 | 7.16E-06 | 8.78E-06 | 4.38E-06 | 3.93E-06 | I |
| o-Cresol | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 1-Methylnaphthalene | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 2-Methylnaphthalene | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Naphthalene | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |

# Individual Gas/Purge and Fugitive Test Results – Lb/Lb Binder

## Core Mixing

| Compound/Sample Number | ER001 | ER002 | ER003 | ER004 | ER005 | ER006 | ER007 | ER008 | ER009 | ER010 | ER011 | ER012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HC as Hexane | 9.42E-02 | 9.15E-02 | 9.55E-02 | 9.62E-02 | 9.11E-02 | 9.47E-02 | 6.35E-02 | 5.39E-02 | 7.71E-02 | 6.21E-02 | 6.57E-02 | 6.23E-02 |
| Sum of VOCs | 8.13E-04 | 8.02E-04 | 9.27E-04 | 9.03E-04 | 8.19E-04 | 8.72E-04 | I | 6.85E-04 | 6.99E-04 | 6.62E-04 | 6.74E-02 | 6.56E-04 |
| Sum of HAPs | 8.13E-04 | 8.02E-04 | 9.27E-04 | 9.03E-04 | 8.19E-04 | 8.72E-04 | I | 6.85E-04 | 6.99E-04 | 6.62E-04 | 6.74E-04 | 6.56E-04 |
| Sum of POMs | 2.15E-04 | 1.99E-04 | 2.27E-04 | 2.35E-04 | 1.89E-04 | 2.30E-04 | 1.71E-04 | 1.52E-04 | 1.79E-04 | 1.68E-04 | 1.75E-04 | 1.42E-04 |
| | **Individual Organic HAPs and VOCs** | | | | | | | | | | | |
| Phenol | 5.84E-04 | 5.90E-04 | 6.94E-04 | 6.58E-04 | 6.18E-04 | 6.28E-04 | 4.72E-04 | 5.09E-04 | 5.00E-04 | 4.75E-04 | 4.80E-04 | 4.95E-04 |
| Formaldehyde | 1.42E-05 | 1.30E-05 | 5.83E-06 | 1.06E-05 | 1.21E-05 | 1.33E-05 | I | 2.32E-05 | 1.97E-05 | 1.88E-05 | 1.88E-05 | 1.89E-05 |
| o-Cresol | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 1-Methylnaphthalene | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 2-Methylnaphthalene | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Naphthalene | 2.15E-04 | 1.99E-04 | 2.27E-04 | 2.35E-04 | 1.89E-04 | 2.30E-04 | 1.71E-04 | 1.52E-04 | 1.79E-04 | 1.68E-04 | 1.75E-04 | 1.42E-04 |

# Individual Storage Test Results – Lb/Lb Binder

## Core Storage

| Compound/Sample Number | ER001 | ER002 | ER003 | ER004 | ER005 | ER006 | ER007 | ER008 | ER009 | ER010 | ER011 | ER012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HC as Hexane | 2.74E-02 | 2.62E-02 | 2.89E-02 | 2.63E-02 | 2.67E-02 | 2.66E-02 | 1.83E-02 | 1.42E-02 | 1.88E-02 | 1.93E-02 | 1.98E-02 | 2.24E-02 |
| Sum of VOCs | 1.03E-04 | 9.21E-05 | 1.31E-04 | 1.13E-04 | 1.19E-04 | 1.09E-04 | 8.15E-05 | I | 6.71E-05 | 9.65E-05 | 6.29E-05 | I |
| Sum of HAPs | 1.03E-04 | 9.21E-05 | 1.31E-04 | 1.13E-04 | 1.19E-04 | 1.09E-04 | 8.15E-05 | I | 6.71E-05 | 9.65E-05 | 6.29E-05 | I |
| Sum of POMs | 1.01E-04 | 8.97E-05 | 1.29E-04 | 1.11E-04 | 1.18E-04 | 1.06E-04 | 7.92E-05 | I | 6.41E-05 | 9.42E-05 | 6.10E-05 | 7.10E-05 |
| | **Individual Organic HAPs and VOCs** | | | | | | | | | | | |
| Phenol | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | I |
| Formaldehyde | 2.35E-06 | 2.40E-06 | 2.58E-06 | 2.06E-06 | 1.94E-06 | 2.50E-06 | 2.24E-06 | 2.36E-06 | 2.93E-06 | 2.29E-06 | 1.87E-06 | 2.02E-06 |
| o-Cresol | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 1-Methylnaphthalene | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 2-Methylnaphthalene | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Naphthalene | 1.01E-04 | 8.97E-05 | 1.29E-04 | 1.11E-04 | 1.18E-04 | 1.06E-04 | 7.92E-05 | I | 6.41E-05 | 9.42E-05 | 6.10E-05 | 7.10E-05 |

# Individual Detection Levels – Lb/Lb Binder

## Core Mixing

| Compound/Sample Number | ER001 | ER002 | ER003 | ER004 | ER005 | ER006 | ER007 | ER008 | ER009 | ER010 | ER011 | ER012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phenol | 5.91E-07 | 5.91E-07 | 5.92E-07 | 5.62E-07 | 5.62E-07 | 5.61E-07 | 4.14E-07 | 4.13E-07 | 4.14E-07 | 3.86E-07 | 3.86E-07 | 3.86E-07 |
| Formaldehyde | 7.38E-08 | 7.38E-08 | 7.39E-08 | 7.03E-08 | 7.03E-08 | 7.02E-08 | 5.17E-08 | 5.16E-08 | 5.17E-08 | 4.83E-08 | 4.83E-08 | 4.83E-08 |
| o-Cresol | 1.25E-06 | 1.25E-06 | 1.26E-06 | 1.19E-06 | 1.19E-06 | 1.19E-06 | 8.80E-07 | 8.78E-07 | 8.80E-07 | 8.21E-07 | 8.21E-07 | 8.21E-07 |
| 1-Methylnaphthalene | 9.44E-05 | 9.44E-05 | 9.46E-05 | 8.99E-05 | 8.99E-05 | 8.97E-05 | 6.62E-05 | 6.60E-05 | 6.62E-05 | 6.18E-05 | 6.18E-05 | 6.18E-05 |
| 2-Methylnaphthalene | 9.44E-05 | 9.44E-05 | 9.46E-05 | 8.99E-05 | 8.99E-05 | 8.97E-05 | 6.62E-05 | 6.60E-05 | 6.62E-05 | 6.18E-05 | 6.18E-05 | 6.18E-05 |
| Naphthalene | 9.44E-05 | 9.44E-05 | 9.46E-05 | 8.99E-05 | 8.99E-05 | 8.97E-05 | 6.62E-05 | 6.60E-05 | 6.62E-05 | 6.18E-05 | 6.18E-05 | 6.18E-05 |
| **Core Making** | | | | | | | | | | | | |
| Phenol | 4.50E-05 | 4.41E-05 | 4.49E-05 | 4.51E-05 | 4.40E-05 | 4.44E-05 | 3.15E-05 | 3.29E-05 | 3.15E-05 | 3.42E-05 | 3.16E-05 | 3.20E-05 |
| Formaldehyde | 6.74E-06 | 6.62E-06 | 6.73E-06 | 6.76E-06 | 6.61E-06 | 6.66E-06 | 4.72E-06 | 4.93E-06 | 4.72E-06 | 5.12E-06 | 4.69E-06 | 4.80E-06 |
| o-Cresol | 4.50E-05 | 4.41E-05 | 4.49E-05 | 4.51E-05 | 4.40E-05 | 4.44E-05 | 3.15E-05 | 3.29E-05 | 3.15E-05 | 3.42E-05 | 3.13E-05 | 3.20E-05 |
| 1-Methylnaphthalene | 1.57E-04 | 1.54E-04 | 1.57E-04 | 1.58E-04 | 1.54E-04 | 1.55E-04 | 1.10E-04 | 1.15E-04 | 1.10E-04 | 1.20E-04 | 1.09E-04 | 1.12E-04 |
| 2-Methylnaphthalene | 1.57E-04 | 1.54E-04 | 1.57E-04 | 1.58E-04 | 1.54E-04 | 1.55E-04 | 1.10E-04 | 1.15E-04 | 1.10E-04 | 1.20E-04 | 1.09E-04 | 1.12E-04 |
| Naphthalene | 1.57E-04 | 1.54E-04 | 1.57E-04 | 1.58E-04 | 1.54E-04 | 1.55E-04 | 1.10E-04 | 1.15E-04 | 1.10E-04 | 1.20E-04 | 1.09E-04 | 1.12E-04 |
| **Core Storage** | | | | | | | | | | | | |
| Phenol | 2.14E-05 | 2.18E-05 | 2.21E-05 | 2.21E-05 | 2.16r-05 | 2.21E-05 | 1.56E-05 | 1.54E-05 | 1.54E-05 | 1.60E-05 | 1.60E-05 | 1.55E-05 |
| Formaldehyde | 7.14E-07 | 7.27E-07 | 7.36E-07 | 7.36E-07 | 7.19E-07 | 7.36E-07 | 5.20E-07 | 5.14E-07 | 5.14E-07 | 5.33E-07 | 5.33E-07 | 5.18E-07 |
| o-Cresol | 2.85E-05 | 2.91E-05 | 2.94E-05 | 2.94E-05 | 2.87E-05 | 2.94E-05 | 2.08E-05 | 2.05E-05 | 2.05E-05 | 2.13E-05 | 2.13E-05 | 2.07E-05 |
| 1-Methylnaphthalene | 8.56E-05 | 8.73E-05 | 8.83E-05 | 8.83E-05 | 8.62E-05 | 8.83E-05 | 6.24E-05 | 6.16E-05 | 6.16E-05 | 6.40E-05 | 6.40E-05 | 6.21E-05 |
| 2-Methylnaphthalene | 8.56E-05 | 8.73E-05 | 8.83E-05 | 8.83E-05 | 8.62E-05 | 8.83E-05 | 6.24E-05 | 6.16E-05 | 6.16E-05 | 6.40E-05 | 6.40E-05 | 6.21E-05 |
| Naphthalene | 8.56E-05 | 8.73E-05 | 8.83E-05 | 8.83E-05 | 8.62E-05 | 8.83E-05 | 6.24E-05 | 6.16E-05 | 6.16E-05 | 6.40E-05 | 6.40E-05 | 6.21E-05 |

# Individual Core Mixing Test Results – Lb/Lb Binder

| Compound/Sample Number | EQ004 | EQ005 | EQ006 | EQ007 | EQ008 | EQ009 | EQ010 | EQ011 | EQ012 | Average | STDEV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Test Dates** | 9/9/2002 | 9/9/2002 | 9/9/2002 | 9/9/2002 | 9/9/2002 | 9/9/2002 | 9/9/2002 | 9/9/2002 | 9/9/2002 | | |
| **TGOC as Propane** | 4.20E-03 | 4.00E-03 | 4.00E-03 | 4.00E-03 | 4.10E-03 | 4.00E-03 | 4.00E-03 | 4.00E-03 | 4.10E-03 | 4.04E-03 | 7.26E-05 |
| **HC as Hexane** | 2.23E-03 | 1.43E-03 | 1.79E-03 | 2.05E-03 | 2.10E-03 | 2.17E-03 | 1.99E-03 | 2.43E-03 | 2.31E-03 | 2.06E-03 | 2.98E-04 |
| **Sum of VOCs** | 9.33E-05 | 8.88E-05 | 9.15E-05 | 8.97E-05 | 8.52E-05 | 8.97E-05 | 8.90E-05 | 8.88E-05 | 9.95E-05 | 9.06E-05 | 3.97E-06 |
| **Sum of HAPs** | 9.33E-05 | 8.88E-05 | 9.15E-05 | 8.97E-05 | 8.52E-05 | 8.97E-05 | 8.90E-05 | 8.88E-05 | 9.95E-05 | 9.06E-05 | 3.97E-06 |
| **Sum of POMs** | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| | **Individual Organic HAPs and VOCs** | | | | | | | | | | |
| **Phenol** | 8.98E-05 | 8.54E-05 | 8.81E-05 | 8.63E-05 | 8.18E-05 | 8.63E-05 | 8.55E-05 | 8.53E-05 | 9.61E-05 | 8.72E-05 | 3.98E-06 |
| **Formaldehyde** | 3.50E-06 | 3.42E-06 | 3.37E-06 | 3.41E-06 | 3.42E-06 | 3.48E-06 | 3.49E-06 | 3.53E-06 | 3.42E-06 | 3.45E-06 | 5.47E-08 |
| **o-Cresol** | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| **1-Methylnaphthalene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| **2-Methylnaphthalene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |
| **Naphthalene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |

ND: Non Detect; NA: Not Applicable
Formaldehyde results reported as a minimum.

## Individual Gas/Purge and Fugitive Test EQ Results – Lb/Lb Binder

| Compound/Sample Number | EQ021 | EQ022 | EQ023 | EQ024 | EQ025 | EQ026 | EQ027 | EQ028 | EQ029 | Average | STDEV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Test Dates** | **9/11/02** | **9/11/02** | **9/11/02** | **9/11/02** | **9/11/02** | **9/12/02** | **9/12/02** | **9/12/02** | **9/12/02** | | |
| **HC as Hexane** | 7.29E-02 | 7.70E-02 | 7.83E-02 | 8.51E-02 | 7.96E-02 | 6.93E-02 | 7.29E-02 | 7.04E-02 | 7.15E-02 | 7.52E-02 | 5.14E-03 |
| **Sum of VOCs** | 1.14E-03 | 1.70E-03 | 1.58E-03 | 1.68E-03 | 1.40E-03 | 1.22E-03 | 1.32E-03 | 1.38E-03 | 1.49E-03 | 1.43E-03 | 1.96E-04 |
| **Sum of HAPs** | 1.14E-03 | 1.70E-03 | 1.58E-03 | 1.68E-03 | 1.40E-03 | 1.22E-03 | 1.32E-03 | 1.38E-03 | 1.49E-03 | 1.43E-03 | 1.96E-04 |
| **Sum of POMs** | 7.58E-04 | 1.27E-03 | 1.21E-03 | 1.27E-03 | 1.07E-03 | 8.32E-04 | 9.07E-04 | 9.73E-04 | 1.10E-03 | 1.04E-03 | 1.88E-04 |
| | **Individual Organic HAPs and VOCs** | | | | | | | | | | |
| **2-Methylnaphthalene** | 3.04E-04 | 5.49E-04 | 5.08E-04 | 5.47E-04 | 4.52E-04 | 3.47E-04 | 3.69E-04 | 4.08E-04 | 4.58E-04 | 4.38E-04 | 8.77E-05 |
| **Naphthalene** | 2.77E-04 | 4.47E-04 | 3.96E-04 | 4.00E-04 | 3.44E-04 | 2.80E-04 | 3.16E-04 | 3.21E-04 | 3.66E-04 | 3.50E-04 | 5.77E-05 |
| **Phenol** | 2.98E-04 | 3.41E-04 | 2.92E-04 | 3.30E-04 | 2.98E-04 | 3.07E-04 | 3.15E-04 | 3.15E-04 | 2.97E-04 | 3.10E-04 | 1.67E-05 |
| **1-Methylnaphthalene** | 1.77E-04 | 2.77E-04 | 3.04E-04 | 3.23E-04 | 2.70E-04 | 2.06E-04 | 2.22E-04 | 2.45E-04 | 2.77E-04 | 2.55E-04 | 4.73E-05 |
| **Formaldehyde** | 8.02E-05 | 9.05E-05 | 8.03E-05 | 7.81E-05 | 3.39E-05 | 8.35E-05 | 9.37E-05 | 8.95E-05 | 9.15E-05 | 8.01E-05 | 1.83E-05 |
| **o-Cresol** | ND | ND | ND | ND | ND | ND | ND | ND | ND | NA | NA |

ND: Non Detect; NA: Not Applicable

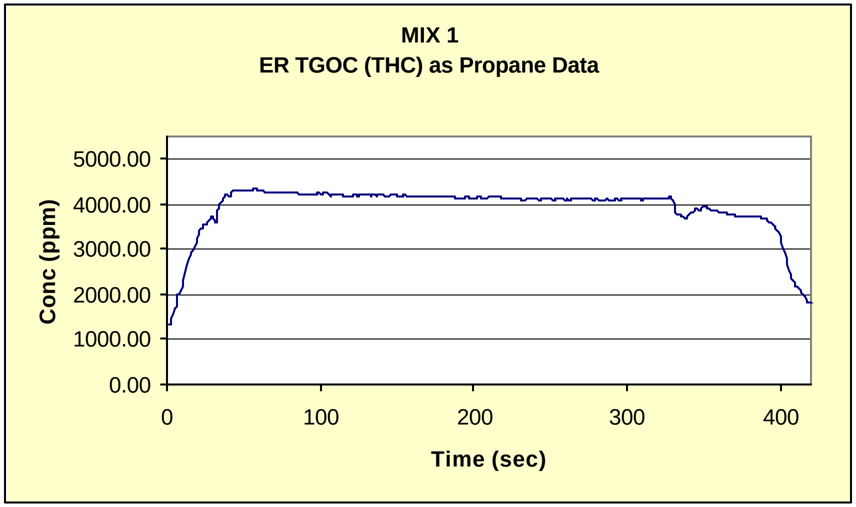
## Test EQ and ER Quantitation Limits - Lb/Lb Binder

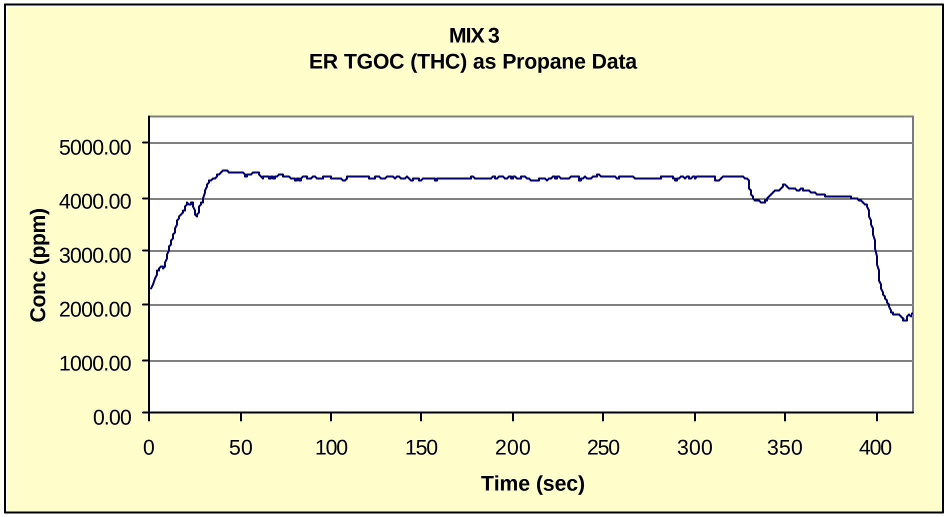
| Core Mixing | |
|---|---|
| 1.75% | |
| HC as hexane | 1.34E-04 |
| 1-methylnaphthalene | 6.69E-05 |
| 2-methylnaphthalene | 6.69E-05 |
| naphthalene | 6.69E-05 |
| o,m,p-cresol | 5.24E-07 |
| formaldehyde | 3.62E-08 |
| phenol | 4.37E-07 |

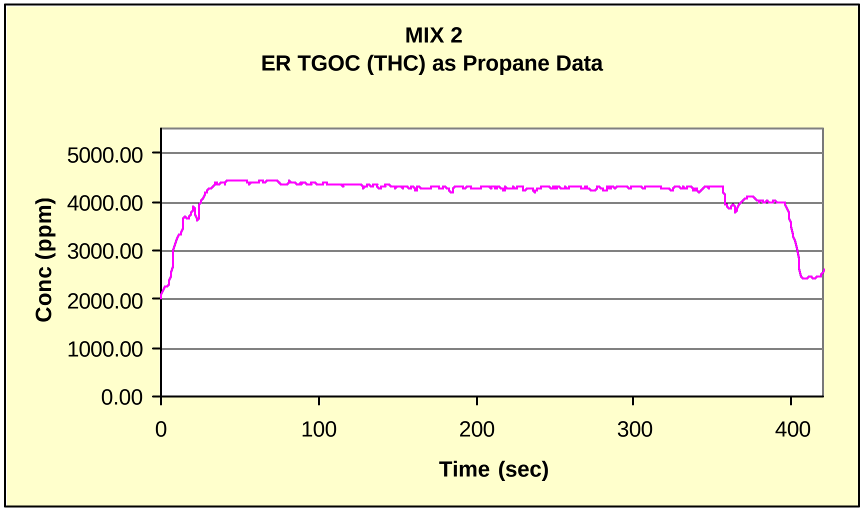
| Core Making | |
|---|---|
| 1.75% | |
| HC as hexane | 4.36E-04 |
| 1-methylnaphthalene | 2.18E-04 |
| 2-methylnaphthalene | 2.18E-04 |
| naphthalene | 2.18E-04 |
| o,m,p-cresol | 3.19E-05 |
| formaldehyde | 1.85E-06 |
| phenol | 2.66E-05 |

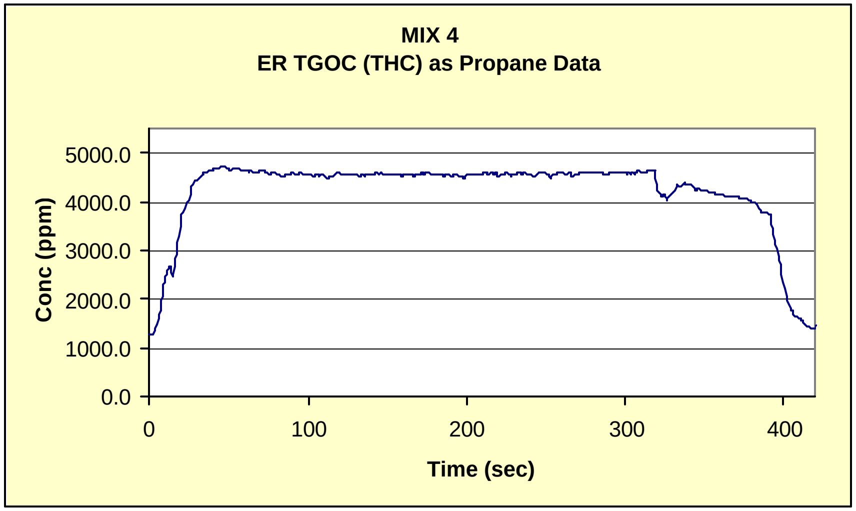
| Core Storage | |
|---|---|
| 1.75% | |
| HC as hexane | 2.63E-04 |
| 1-methylnaphthalene | 1.31E-04 |
| 2-methylnaphthalene | 1.31E-04 |
| naphthalene | 1.31E-04 |
| o,m,p-cresol | 1.61E-05 |
| formaldehyde | 2.64E-07 |
| phenol | 1.34E-05 |

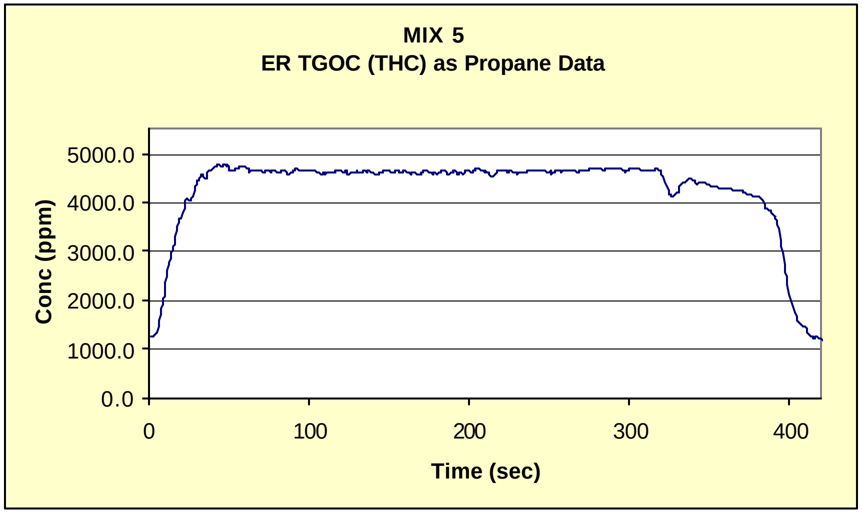
# Appendix C  Method 25A Charts

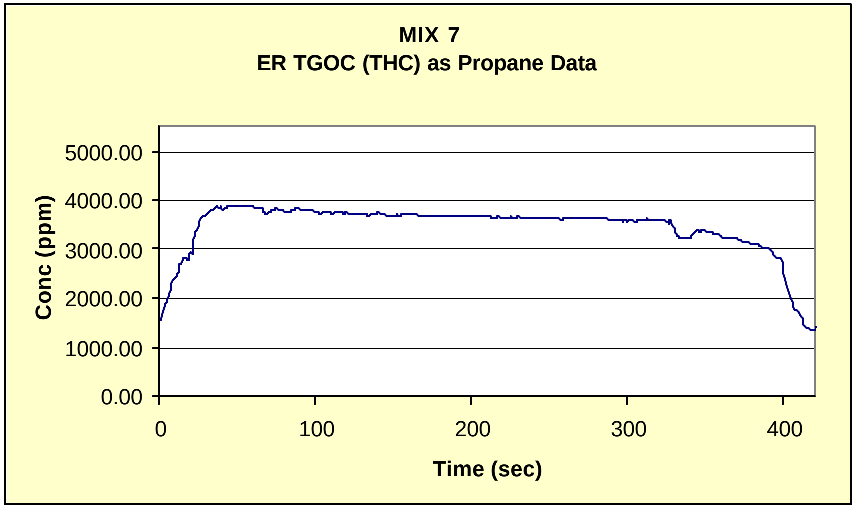

MIX 1
ER TGOC (THC) as Propane Data
Conc (ppm)
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
0
100
200
300
400
Time (sec)

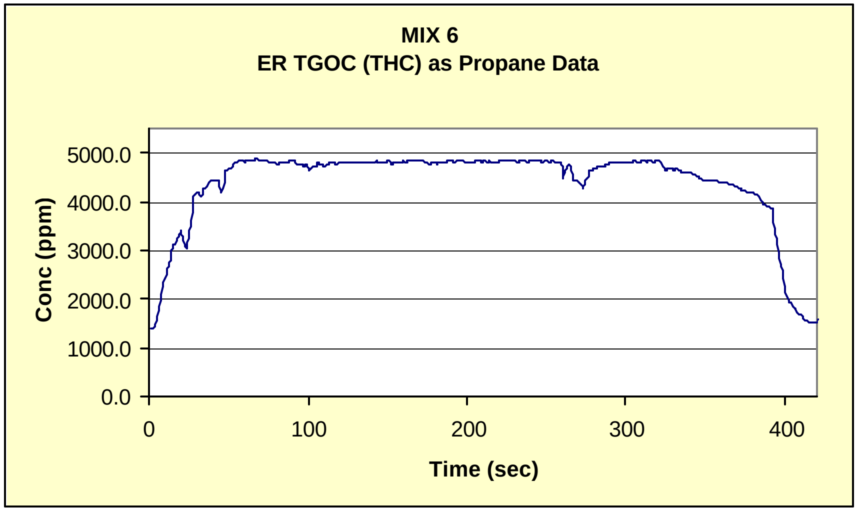

MIX 3
ER TGOC (THC) as Propane Data
Conc (ppm)
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
0
50
100
150
200
250
300
350
400
Time (sec)

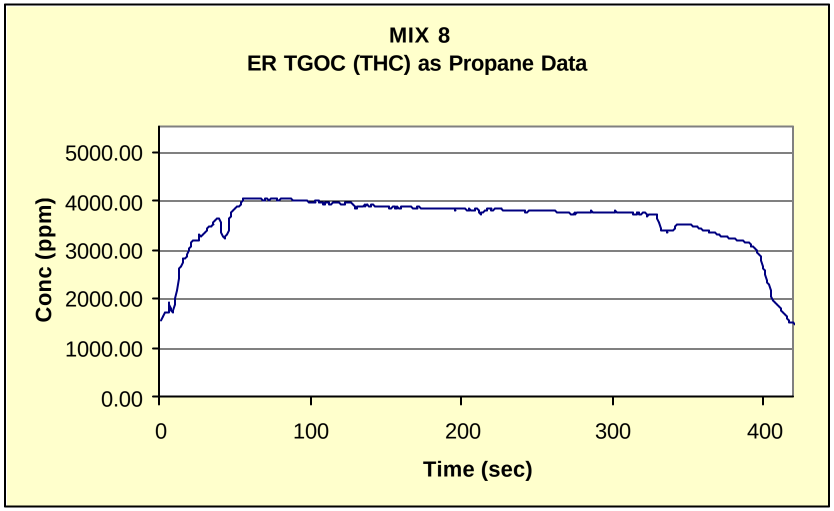

MIX 2
ER TGOC (THC) as Propane Data
Conc (ppm)
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
0
100
200
300
400
Time (sec)

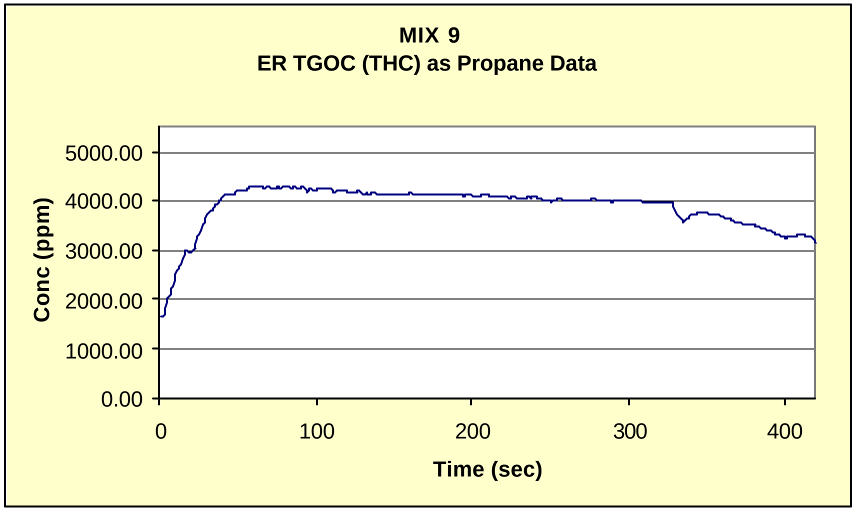

MIX 4
ER TGOC (THC) as Propane Data
Conc (ppm)
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0
100
200
300
400
Time (sec)

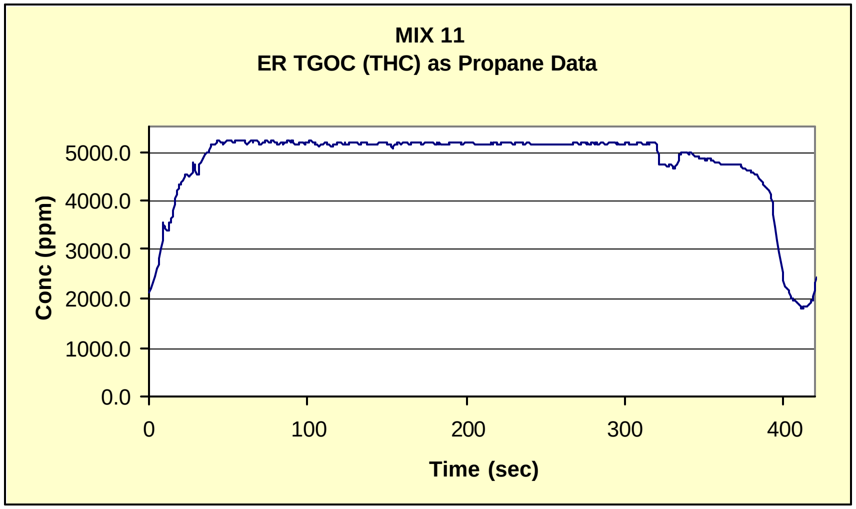

MIX 5
ER TGOC (THC) as Propane Data
Conc (ppm)
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0
100
200
300
400
Time (sec)

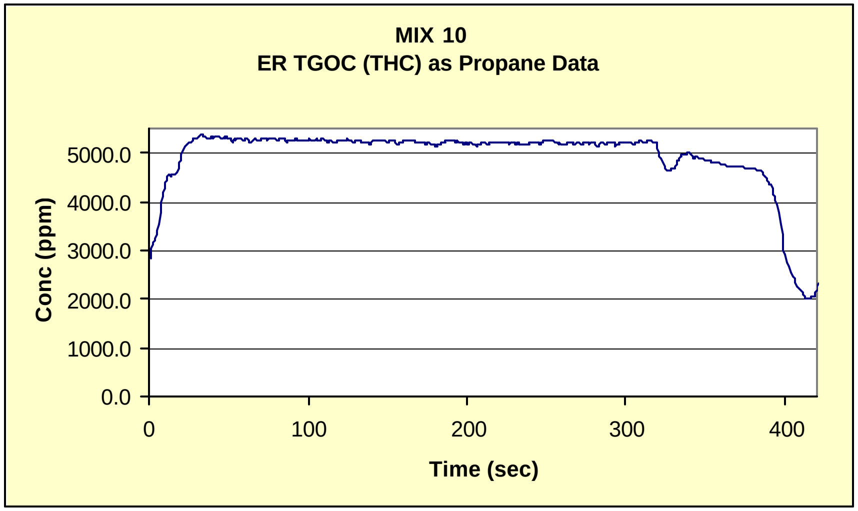

MIX 7
ER TGOC (THC) as Propane Data
Conc (ppm)
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
0
100
200
300
400
Time (sec)

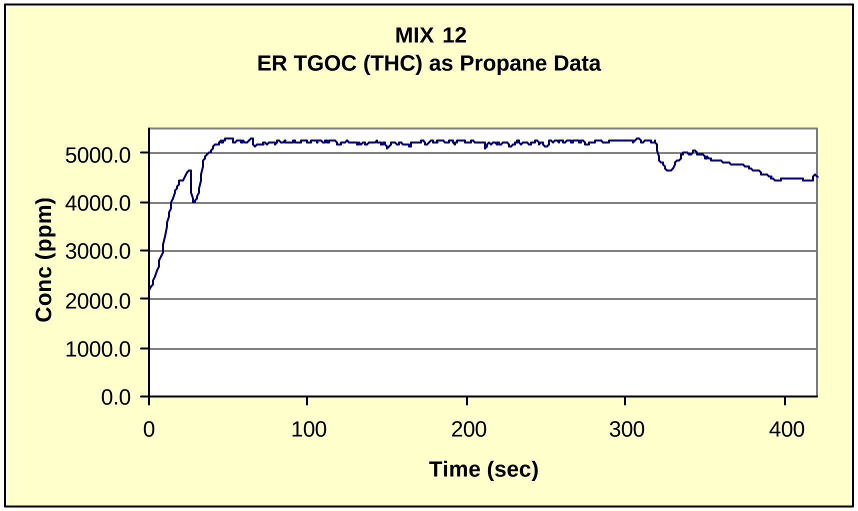

MIX 6
ER TGOC (THC) as Propane Data
Conc (ppm)
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0
100
200
300
400
Time (sec)

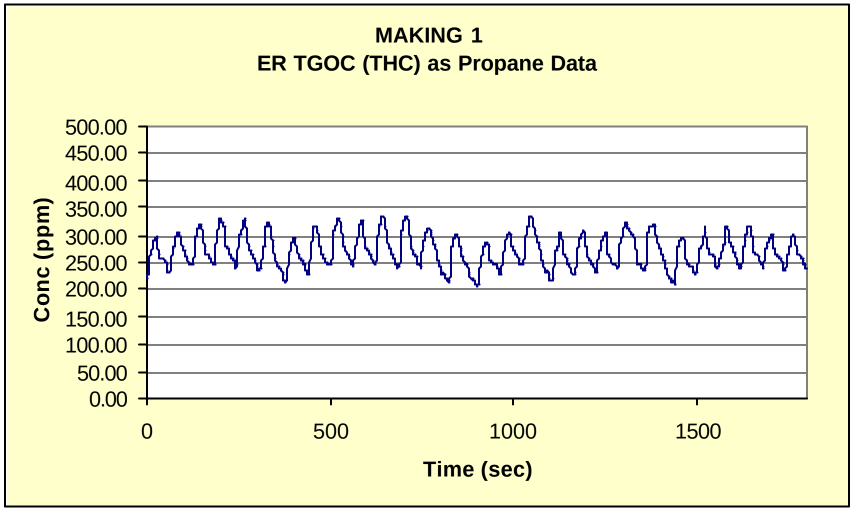

MIX 8
ER TGOC (THC) as Propane Data
Conc (ppm)
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
0
100
200
300
400
Time (sec)

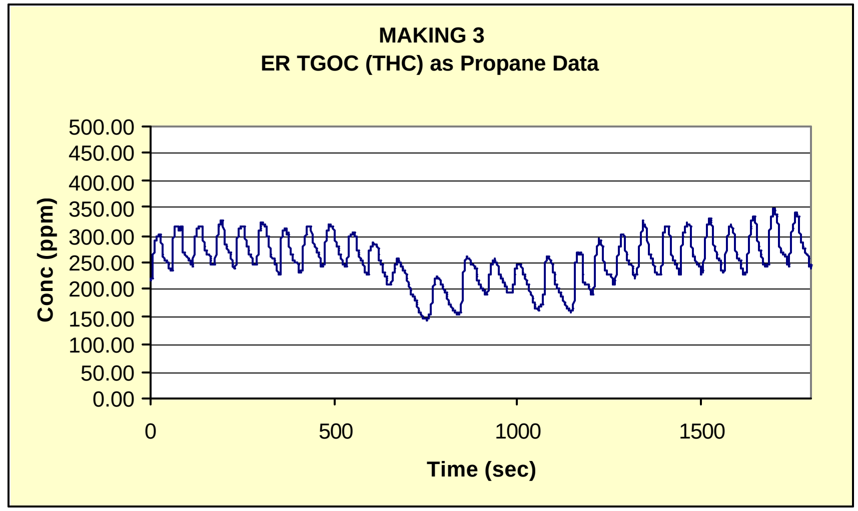

MIX 9
ER TGOC (THC) as Propane Data
Conc (ppm)
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
0
100
200
300
400
Time (sec)

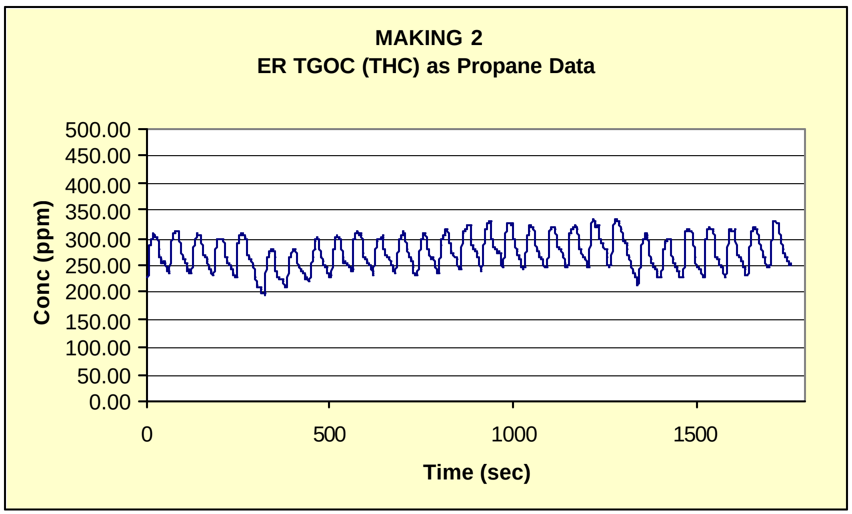

MIX 11
ER TGOC (THC) as Propane Data
Conc (ppm)
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0
100
200
300
400
Time (sec)

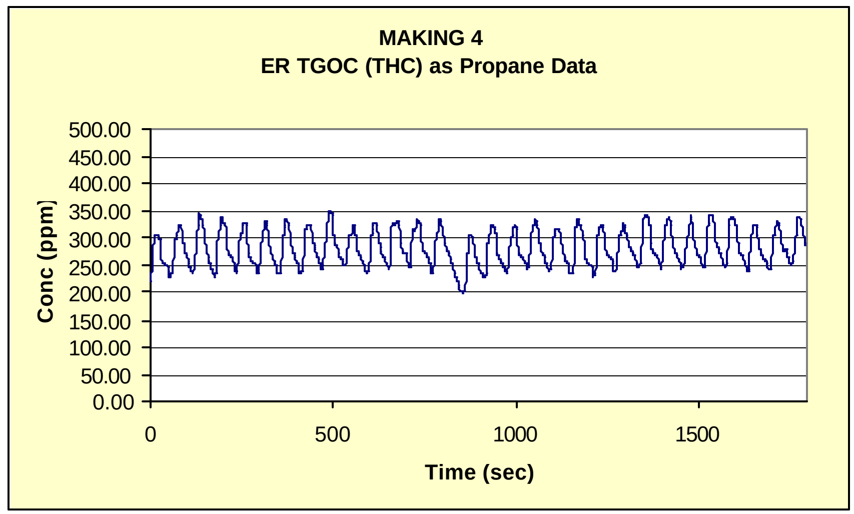

MIX 10
ER TGOC (THC) as Propane Data
Conc (ppm)
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0
100
200
300
400
Time (sec)

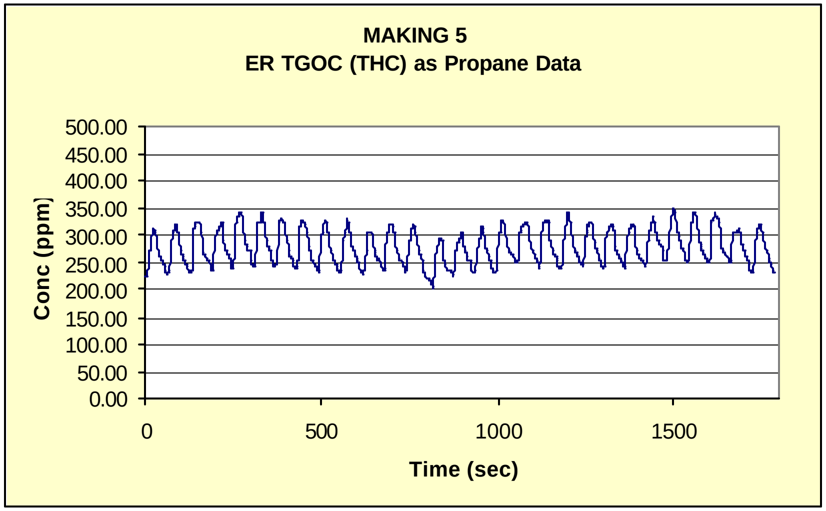

MIX 12
ER TGOC (THC) as Propane Data
Conc (ppm)
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0
100
200
300
400
Time (sec)

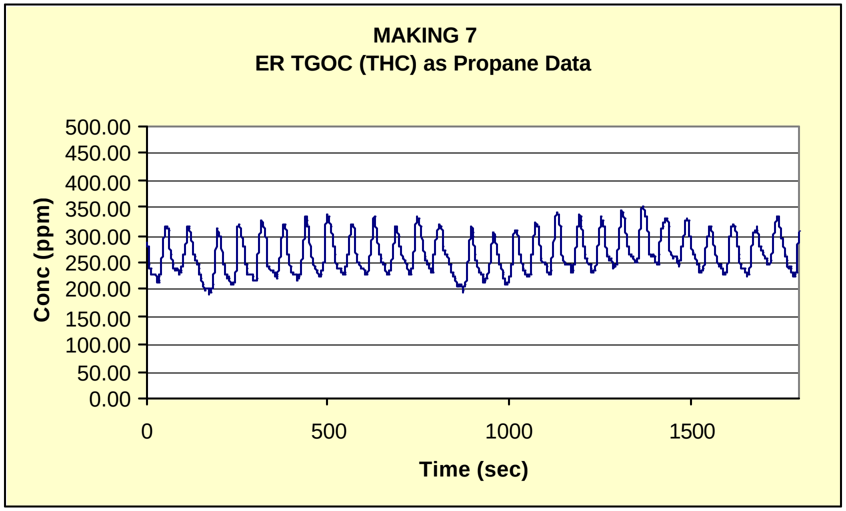

MAKING 1
ER TGOC (THC) as Propane Data
Conc (ppm)
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
500
1000
1500
Time (sec)

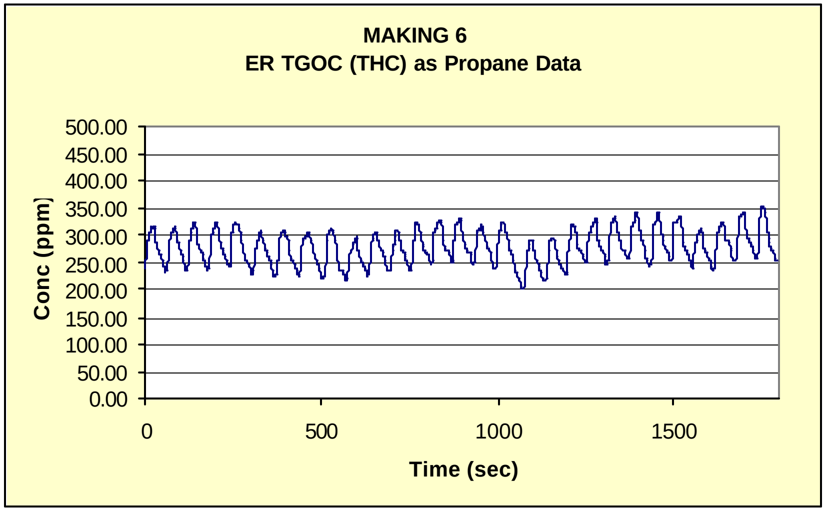

MAKING 3
ER TGOC (THC) as Propane Data
Conc (ppm)
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
500
1000
1500
Time (sec)

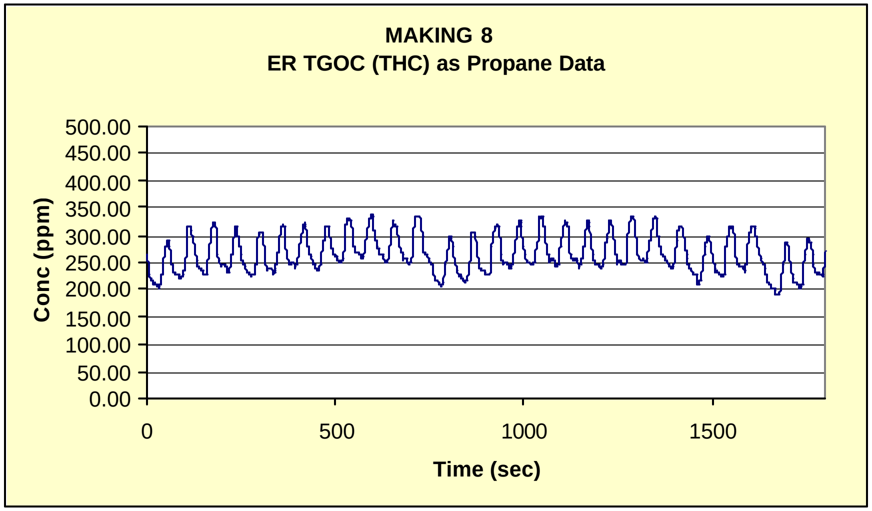

MAKING 2
ER TGOC (THC) as Propane Data
Conc (ppm)
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
500
1000
1500
Time (sec)

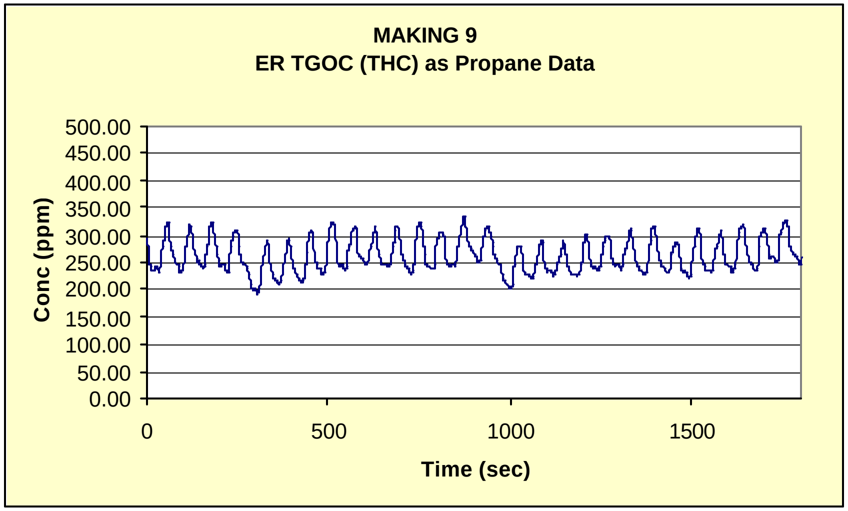

MAKING 4
ER TGOC (THC) as Propane Data
Conc (ppm)
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
500
1000
1500
Time (sec)

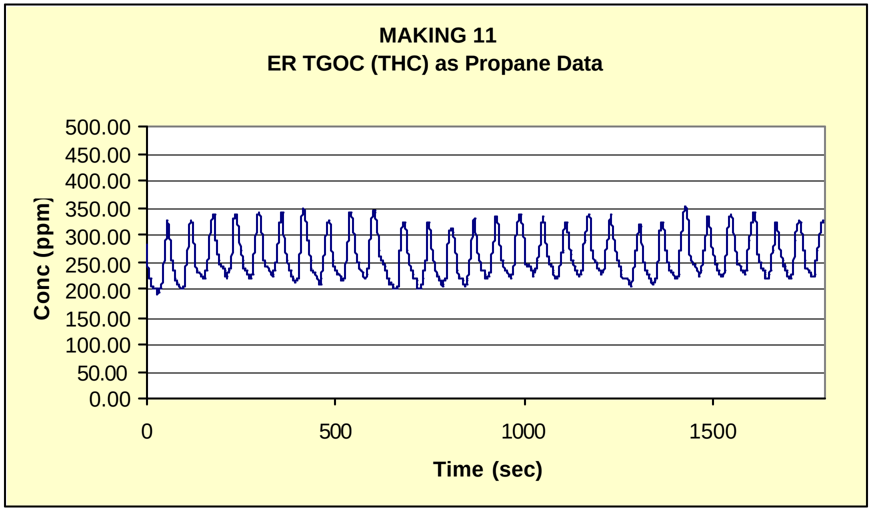

MAKING 5
ER TGOC (THC) as Propane Data
Conc (ppm)
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
500
1000
1500
Time (sec)

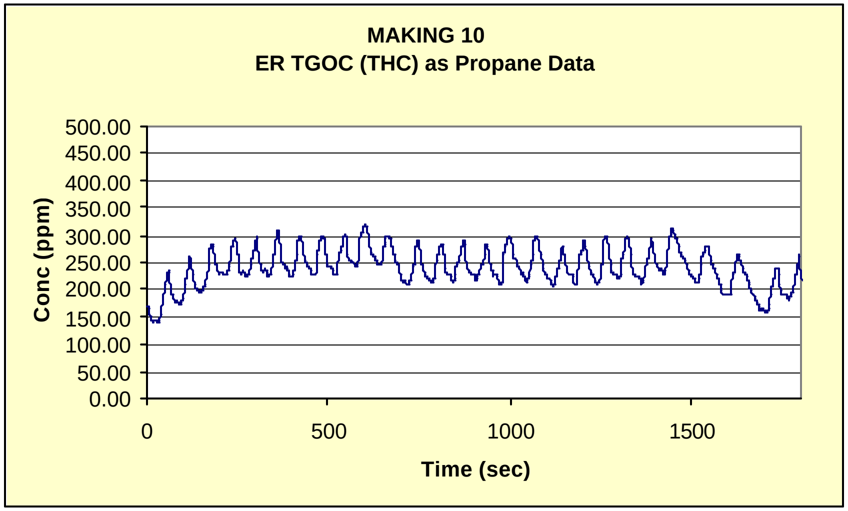

MAKING 7
ER TGOC (THC) as Propane Data
Conc (ppm)
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
500
1000
1500
Time (sec)

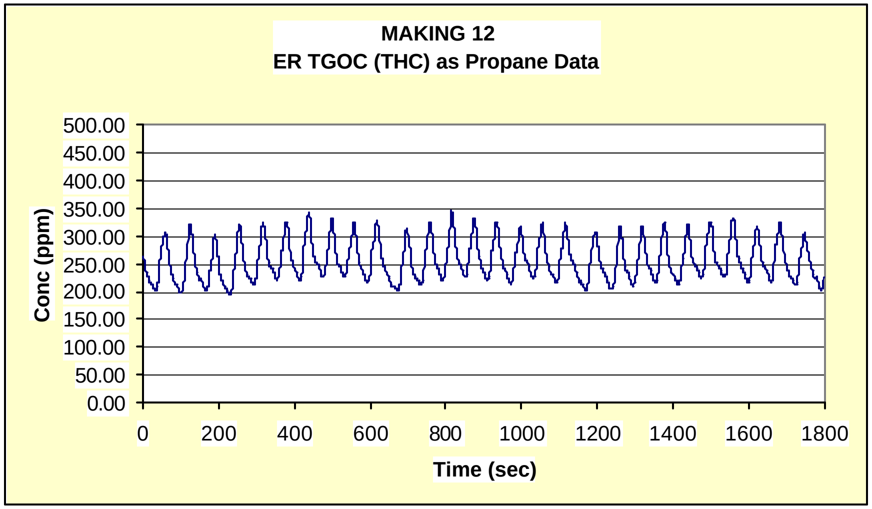

MAKING 6
ER TGOC (THC) as Propane Data
Conc (ppm)
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
500
1000
1500
Time (sec)

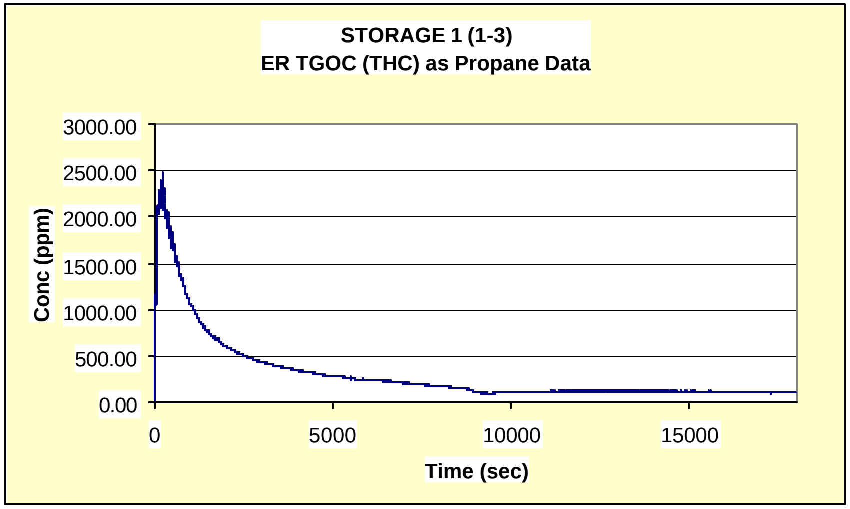

MAKING 8
ER TGOC (THC) as Propane Data
Conc (ppm)
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
500
1000
1500
Time (sec)

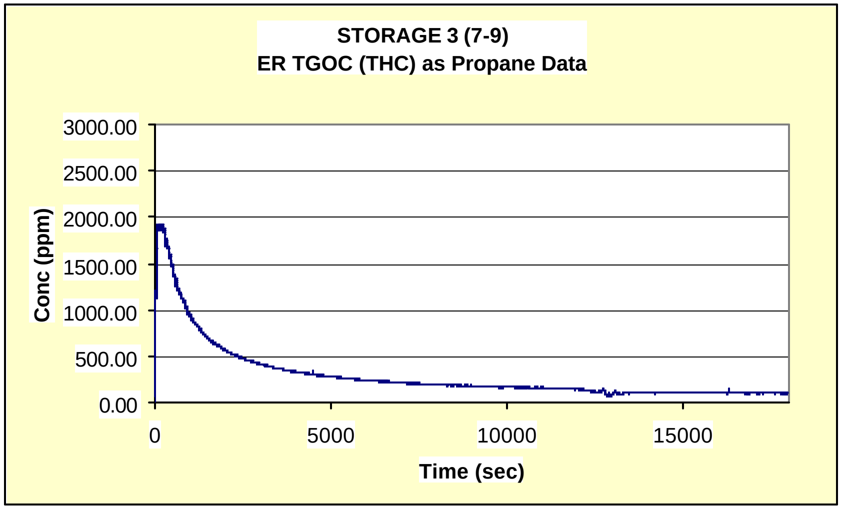

MAKING 9
ER TGOC (THC) as Propane Data
Conc (ppm)
Time (sec)

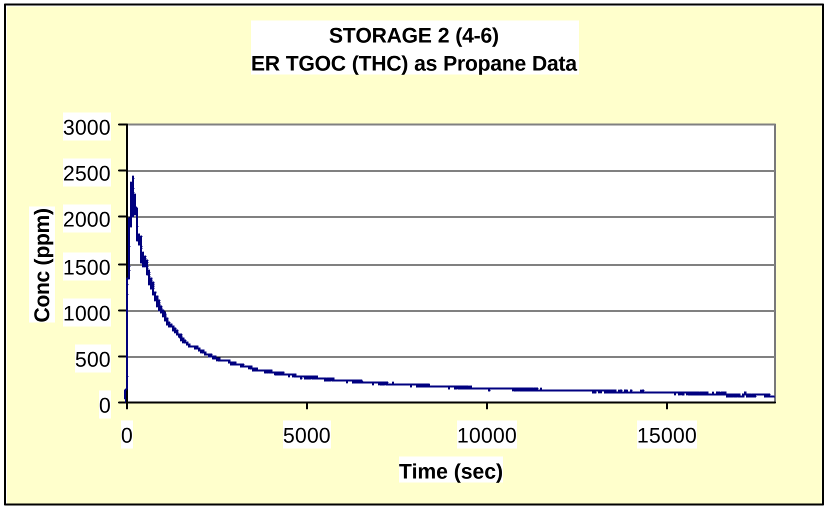

MAKING 11
ER TGOC (THC) as Propane Data
Conc (ppm)
Time (sec)

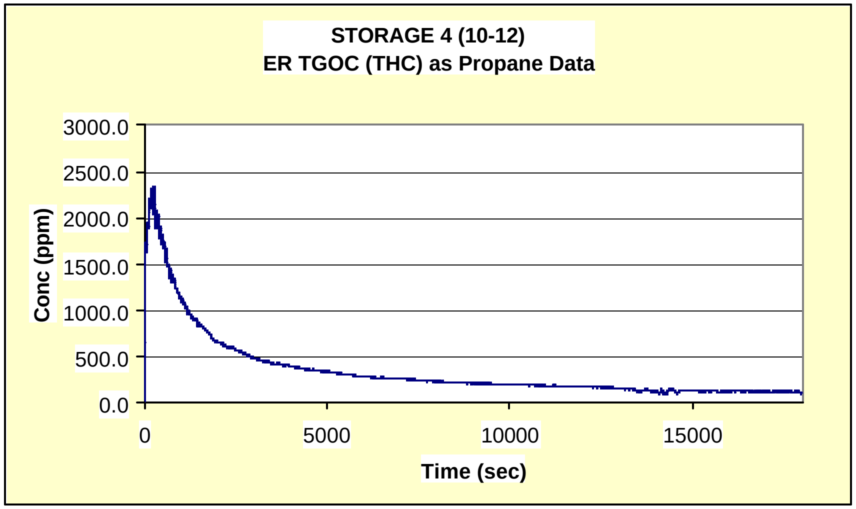

MAKING 10
ER TGOC (THC) as Propane Data
Conc (ppm)
Time (sec)


MAKING 12
ER TGOC (THC) as Propane Data
Conc (ppm)
Time (sec)


STORAGE 1 (1-3)
ER TGOC (THC) as Propane Data
Conc (ppm)
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
0
5000
10000
15000
Time (sec)


STORAGE 3 (7-9)
ER TGOC (THC) as Propane Data
Conc (ppm)
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
0
5000
10000
15000
Time (sec)


STORAGE 2 (4-6)
ER TGOC (THC) as Propane Data
Conc (ppm)
3000
2500
2000
1500
1000
500
0
0
5000
10000
15000
Time (sec)


STORAGE 4 (10-12)
ER TGOC (THC) as Propane Data
Conc (ppm)
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
0
5000
10000
15000
Time (sec)

# Appendix D Glossary

*THIS PAGE INTENTIONALLY BLANK*

| | |
|---|---|
| ND | Non Detect |
| NA | Not Applicable |
| HC as Hexane | Calculated by the summation of all area between elution of Hexane through the elution of Hexadecane. The quantity of HC is performed against a five-point calibration curve of Hexane by dividing the total area count from C6 through C16 to the area of Hexane from the initial calibration curve. |
| BOS | Based on Sand |
| Binder | Part 1 plus Part II |