Casting Emission Reduction Program

**Prepared by:**
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*US Army Contract DAAE30-02-C-1095*
*FY 2002 Tasks*

# Polyol Urethane / Aluminum

**Technikon # 1256-1212 DK**

**15 May 2001**

*This document was revised for unlimited public distribution*

EPA United States Environmental Protection Agency

CISA

AFS AMERICAN FOUNDRY SOCIETY, INC.

USCAR UNITED STATES COUNCIL FOR AUTOMOTIVE RESEARCH
DAIMLERCHRYSLER Ford Motor Company General Motors

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# Pre-Production Air Emission Test Report

## No-Bake Binder Systems

## Polyether Polyol Urethane / Aluminum

## Emissions Test

## RV100106DK

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

| | | |
|---|---|---|
| Written By: | Scott Forbes | 5/14/01 Date |
| Process Engineering Manager: | Steven Knight | 5/15/01 Date |
| VP Measurement Technologies: | Clifford Glowacki, CIH | 5-15-01 Date |
| VP Operations: | George Crandell | 5-15-01 Date |
| President: | William Walden | 5-15-01 Date |

The data contained in this report were developed to assess the relative metal feeding characteristics of an acoustically stimulated A-356 aluminum casting produced at the Technikon casting facility. You may not obtain the same results in your facility. Data was not collected to assess casting cost, manufacturing methodology, or environmental impact

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# Executive Summary

This report contains the results of emission testing of a Polyether Polyol Urethane / Aluminum No-Bake binder system. All testing was conducted in the CERP Pre-Production foundry, operated by Technikon, LLC.

The Pre-Production Foundry is a simple general purpose manual foundry that was adapted and instrumented to make detailed organic emission measurements, using methods based on EPA protocols for pouring, casting cooling, and shakeout processes on discrete molds. The measurements are conducted under tightly controlled conditions not feasible in a commercial foundry. Evaluating a new product or process in the Technikon Pre-Production Foundry reduces the risk of new material or product introduction for the foundry industry.

The specific objective of this test was to establish relative air emission data for this binder system.

The testing involved the collection of continuous air samples over a seventy-five minute period, including the mold pouring, cooling, shakeout, and post shakeout periods. Process and stack parameters were measured and include: the weights of the casting, mold, binder, Loss on Ignition (LOI) values for the mold prior to the test; metallurgical data; and stack temperature, pressure, volumetric flow rate and moisture content. The process parameters were maintained within prescribed ranges in order to ensure the reproducibility of the tests. Nine molds were poured for this test. Samples were collected and analyzed for over seventy (70) target compounds using procedures based on US EPA Method 18. Continuous monitoring of the Total Gaseous Organic Concentration (TGOC), formerly Total Hydrocarbon Content (THC), of the emissions was conducted according to US EPA Method 25A. Finally, the "condensable" organic material in the emissions was determined using a Technikon developed procedure. The "condensable" represent the "back half" catch from US EPA Method 5.

The mass emission rate of each parameter or target compound was calculated, in pounds per ton of metal, using the Method 25A data or the laboratory analytical results, the measured source data, and the weight of each casting. Results for structural isomers have been grouped and reported as a single entity, for example, ortho-, meta-, and para-xylene are the three (3) structural isomers of dimethyl benzene: Individual isomer results are available in Appendix B of this report. Several "emissions indicators," in addition to the TGOC (THC) as Propane, were also calculated. The HC as Hexane results represent the sum of all organic compounds detected and expressed as Hexane. All of the following sums are sub-groups of this measure. The "Sum of VOCs" is based on the sum of the individual target VOCs measured and includes the HAPs and Polycyclic Organic Material (POMs) listed in the Clean Air Act Amendments of 1990. The "Sum of HAPs" is the sum of the individual target HAPs measured and includes the POMs. Finally, the "Sum of POMs" is the sum of all of the polycyclic organic material measured.

Results for the emission indicators are shown in the following table. All results are measured as pounds emitted per ton of metal.

**Table 1-0 Emission Indicator Results**

| TGOC (THC) As Propane | HC as Hexane | Sum of VOCs | Sum of HAPs | Sum of POMs |
|---|---|---|---|---|
| 29.9 | 30.3 | 3.57 | 1.79 | 0.336 |

It must be noted that the reference and product testing performed is not suitable for use as emission factors or for purposes other than evaluating the relative emission reductions associated with the use of alternative materials, equipment, or processes. The emissions measurements are unique to the specific castings produced, materials used, and testing methodology associated with these tests, and should not be used as the basis for estimating emissions from actual commercial foundry applications.

# 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 (US CAR). 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 (US EPA); and the California Air Resources Board (CARB).

## 1.2 CERP Objectives

The primary objective of CERP 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 Clean Air Act Amendment HAP. 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 data collected during the various testing projects are evaluated to determine both the airborne emissions impact of the materials and/or process changes, and their stability and impact upon the quality and economics of casting and core manufacture. The materials, equipment, and processes may need to be further adapted and defined so that they will integrate into current casting facilities smoothly and with minimum capital expenditure.

Normally, Pre-Production testing is conducted first in order to evaluate the air emissions impact of a proposed alternative material, equipment, or process in the most cost effective manner. The Pre-Production Foundry is a simple general purpose manual foundry that was adapted and instrumented to make detailed emission measurements using methods based on EPA protocols for pouring, casting cooling, and shakeout processes on discrete molds under tightly controlled conditions not feasible in a commercial foundry. The Pre-Production Foundry uses a four-cavity, AFS irregular gear mold as its test pattern for No-Bake testing. All No-Bake testing occurs in the Pre-Production Foundry.

The Production Foundry's design as a basic greensand foundry was deliberately chosen so that whatever is tested in this facility will also be convertible to existing mechanized commercial foundries. The type and size of equipment, materials, and processes used emulate an automotive foundry. This facility is used to evaluate materials, equipment, and processes in a continuous

process that is allowed to vary to the limits of commercial experience in a controlled manner. The Production Foundry provides simultaneous detailed individual emission measurements using methods based on US EPA protocols of the melting, pouring, sand preparation, mold making, and core making processes. It is instrumented so that the data on all activities of the metal casting process can be simultaneously and continuously collected, in order to completely evaluate the economic impact of the prospective emission reducing strategy. The Production Foundry's test casting is a single cavity Ford Motor Company I-4 engine block. Castings are randomly selected to evaluate the impact of the material, equipment, or process on casting quality. Alternative materials, equipment, and processes that demonstrate significant air emission reduction potential, preserve casting quality parameters, and that are economically viable based on the Pre-Production testing, may be further evaluated in the Production Foundry.

It must be noted that the results from the reference and product testing performed are not suitable for use as emission factors or for other purposes other than evaluating the relative emission reductions associated with the use of alternative materials, equipment, or manufacturing processes. The emissions measurements are unique to the specific castings produced, materials used, and testing methodology associated with these tests. These measurements should not be used as the basis for estimating emissions from actual commercial foundry applications.

### 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 the performance of an alternative material, equipment, or process in the Pre-Production Foundry. 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 Appendices B and C of this report. Section 4 of this report contains a discussion of the results and recommendations for additional testing, if any.

The raw data for this test series are included in a data binder that is maintained at the Technikon facility. There are several support documents that provide details regarding the testing and analytical procedures used. Appendix F contains a listing of these support documents.

### 1.4 Preliminary Testing

The foundation for the specific test protocols and airborne emission measurements have been determined from testing performed to:

- Establish the required number of samples needed to statistically support the evaluation of emission reduction potentials of the alternative materials, equipment, and processes that may be evaluated;

- Provide a series of standardized emissions from standard mold packages.

It has been determined that nine replicate tests will provide a statistically significant sample for the purposes of evaluating the emission reductions from alternative materials, equipment, and

processes. The results of the testing conducted in support of this conclusion is included in a report entitled Evaluation of the Required Number of Replicate Tests to Provide Statistically Significant Air Emission Reduction Comparisons for the CERP Pre-Production Foundry Test Program.

## 1.5 Specific Test Plan and Objectives

This report contains the results of testing performed to provide reference or baseline data on the VOC and HAP emissions from a Phenolic Urethane No-Bake binder system. Table 1-1 provides a summary of the test plan. The details of the approved test plan are included in Appendix A.

**Table 1-1 Test Plan Summary**

| | **Test Plan** |
|---|---|
| Type of Product tested | No-Bake Polyether Polyol Urethane |
| Test Plan Number | RV100106DK |
| Binder System | Delta HA TECHNISET® 20-015/23-133 |
| Metal Poured | Aluminum |
| Casting Type | Four-cavity AFS Irregular Gear Mold |
| Number of molds poured | 9 |
| Test Dates | 01-02-01 > 01-04-01 |
| Emissions Measured | 70 organic HAPs and VOCs |
| Process Parameters Measured | Total Casting, Mold, and Binder Weights; Metallurgical data, % LOI; Stack Temperature, Moisture Content, Pressure, and Volumetric Flow Rate |

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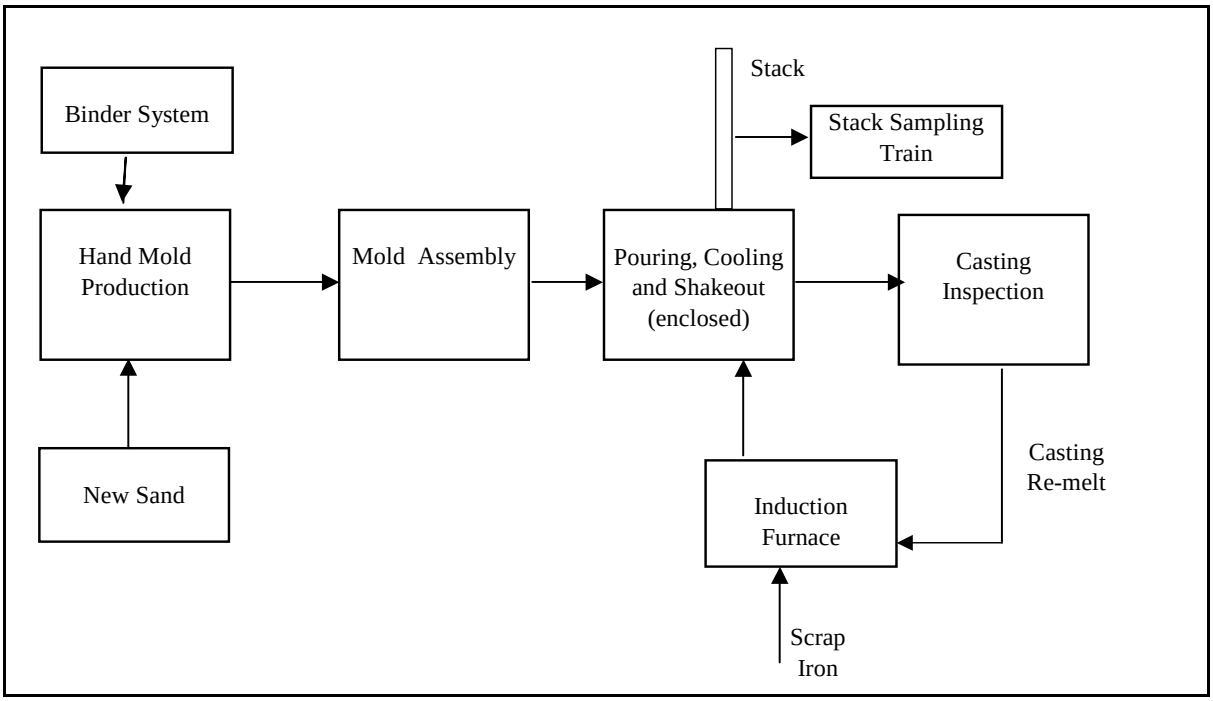
# 2.0 Test Methodology

## 2.1 Description of Process and Testing Equipment

Figure 2-1 is a diagram of the Pre-Production Foundry process equipment.

**Figure 2-1 Pre-Production Foundry Layout Diagram**




## 2.2 Description of Testing Program

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

1. **Test Plan Review and Approval:** The proposed test plan was reviewed by the Technikon staff and CTC Program Manager, and approved.

*No-Bake Mold Preparation*

2. **Mold, and Metal Preparation:** The molds are prepared to a standard composition by the Technikon production team. Relevant process data are collected during mold preparation. Aluminum is melted in a 250 lb. Ajax induction furnace. The amount of metal melted is determined from the poured weight of the casting and the number of molds to be poured. The metal composition is prescribed by a metal composition worksheet. The weight of metal poured into each mold is recorded on the process data summary sheet.

3. **Individual Sampling Events:** Replicate tests are performed on several mold packages. The mold packages are each placed into an enclosed test stand. Aluminum is poured through an opening in the top of the enclosure. The opening is closed as soon as pouring is completed. Continuous air samples are collected during the forty-five minute pouring and cooling process, during the fifteen minute shakeout of the mold, and for an additional fifteen minute period following shakeout. The total sampling time is seventy-five minutes.

*Pouring of Molds Through Opening in Collection Hood*

The weight of each mold and the weight of binder used to prepare that mold are recorded on the Process Data Summary Sheet. In addition, the pouring temperature, number of cavities poured, the %LOI of the mold before pouring are also recorded on the Process Data Summary Sheet.

*Castings after Shake Out*

The unheated emission hood is ventilated at approximately 700 SCFM through a 12-inch diameter heated duct. Emissions samples are drawn from sampling ports located to ensure conformance with EPA Method 1. The tip of the probe is located in the centroid of the duct.

4. **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.

*Volatiles and Condensables Sampling*

**Table 2-1 Process Parameters Measured**

| Parameter | Analytical Equipment and Methods |
|---|---|
| Mold Weight | Acme 4260 Crane Scale (Gravimetric) |
| Casting Weight | Westweigh PP2847 Platform Scale (Gravimetric) |
| Binder Weight | Mettler PJ8000 Digital Scale (Gravimetric) |
| Sand Resin Tensile Strength | Dietert 405 Universal Strength Machine |
| Tensile Test Bar Weight | Mettler PJ 4000 Digital Scale (Gravimetric) |
| LOI, % | Denver Instruments XE-100 Analytical Scale (AFS procedure 321-87-S) |
| **Metallurgical Parameters** | |
| Pouring Temperature | Electro-Nite DT 260 (T/C immersion pyrometer) |
| Carbon/Silicon, and Fusion Temperature | Electro-Nite Datacast 2000 (Thermal Arrest) |
| Alloy Weights | OHAUS MP-2 |
| Carbon/Silicon | Baird Foundry Mate Optical Emission Spectrometer |

5. **Air Emissions Analysis:** The specific sampling and analytical methods used in the Pre-Production Foundry 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 are included in the CERP Emissions Testing and Analytical Testing 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 |
| Gas density and molecular weight | EPA Method 3a |
| Gas moisture | EPA Method 4, gravimetric |
| HAPs concentration | EPA Method 18, TO11, NIOSH 2002* |
| VOCs analysis | EPA Method 18, 25A, TO11, NIOSH 2002* |
| Condensables | Technikon method ** |

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

**The Technikon condensables method is intended to provide a measure of the EPA Method 5 "back-half" determination.

6. **Data Reduction, Tabulation and Preliminary Report Preparation:** The analytical results of the emissions tests provide the mass of each analyte in the sample. The total mass of the analyte emitted is calculated by multiplying the mass of analyte in the sample times the ratio of total stack gas volume to sample volume. The total stack gas volume is calculated from the measured stack gas velocity and duct diameter, and corrected to dry standard conditions using the measured stack pressures, temperatures, gas molecular weight and moisture content. The total mass of analyte is then divided by the weight of the casting poured to provide emissions data in pounds of analyte per ton of metal.

The results of each of the sampling events are included in Appendix B of this report. The results of each test are also averaged and are shown in Table 3.1.

7. **Report Preparation and Review:** 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, and the Technikon President. Comments are incorporated into a draft 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 Technikon Standard Operating Procedures. 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 ton of metal poured, are presented in Table 3-1 for tests reported in this document. This table includes the individual organic HAP compounds that comprise at least 95% of the total HAPs measured, along with the corresponding sum of VOCs, sum of HAPs, and sum of POMs. The table also includes the TGOM (THC) as Propane and HC as Hexane. Figures 3-1, 3-2, and 3-3 present the five emissions indicators, and selected individual HAP and VOC emissions data from Tables 3-1 in graphical form. Appendix B contains the detailed data including the results for all analytes measured. Table 3-2 includes the averages of the key process and source parameters and the data target ranges. All emission results are presented without blank or background correction. Detailed process and source data are presented in Appendix C.

Method 25A charts for the tests are included in Appendix D of this report. The charts are presented to show the VOC profile of emissions for each pour.

The Validation Log included in Appendix E of this report presents the results of the data validation process.

## Table 3-1 Summary of Test Plan DK Average Results

| COMPOUND / SAMPLE NUMBER | AVERAGE |
|---|---|
| **TGOM (THC) as Propane** | 29.9 |
| **HC as Hexane** | 30.3 |
| **Sum of VOCs** | 3.57 |
| **Sum of HAPs** | 1.79 |
| **Sum of POMs** | 0.336 |
| **Individual Organic HAPs** | |
| **o,m,p-Cresol** | 0.889 |
| **Phenol** | 0.310 |
| **Naphthalene** | 0.262 |
| **Acetaldehyde** | 0.091 |
| **Aniline** | 0.077 |
| **Other VOCs** | |
| **Dimethylphenols** | 0.774 |
| **Trimethylphenols** | 0.500 |
| **Indan** | 0.286 |
| **Trimethylbenzenes** | 0.146 |
| **Other Analytes** | |
| **Carbon Monoxide** | 1.84 |
| **Methane** | N/A |
| **Carbon Dioxide** | 114 |
| **Condensables** | 2.26 |
| **Acetone** | 0.062 |

**All "Other Analytes" are not included in the sum of HAPs or VOCs.**
**N/A: Not Applicable**

**Table 3-2 Summary of Test Plan DK Process and Stack Parameters**

| Average Process and Stack Parameters | Average of DK | Target Range |
|---|---|---|
| Casting Metal Weight: casting & sprue, lbs. | 51 | 50 - 54 |
| Pouring Temperature, °F | 1251 | 1240 - 1260 |
| No-Bake Mold Weight, lbs. | 331 | 325 - 335 |
| % Resin (part I) + co-reactant (part II) BOS | 1.1 | 1.1 |
| Ratio Resin (part 1) to co-reactant (part II) | 50 / 50 | 50 / 50 |
| True % Resin & co-reactant (part I + part II) | 1.09 | 1.07 - 1.11 |
| No Bake Mold LOI, % @ 1400°F | 1.37 | 1.0 - 1.9 |
| Dog Bone Tensile Strength 2 hrs, psi | 63 | 30 - 80 |
| Dog Bone Tensile Strength 24 hrs at 90% RH, psi | 23 | 15 - 30 |
| | | |
| Average Stack Temperature, °F | 79 | 80 ± 10 |
| Total Moisture Content, % | 0.82 | 0-2.5 |
| Average Stack Velocity, ft./sec. | 15.76 | 16 ± 2 |
| Avg. Stack Pressure, in. Hg | 30.22 | 29.92 ± 1 |
| Stack Flow Rate, scfm | 730 | 700 ± 50 |

***LOI includes approximately 0.3-0.5% from sand carbonate decomposition**

**Figure 3-1 Emission Indicators from Test Series DK**

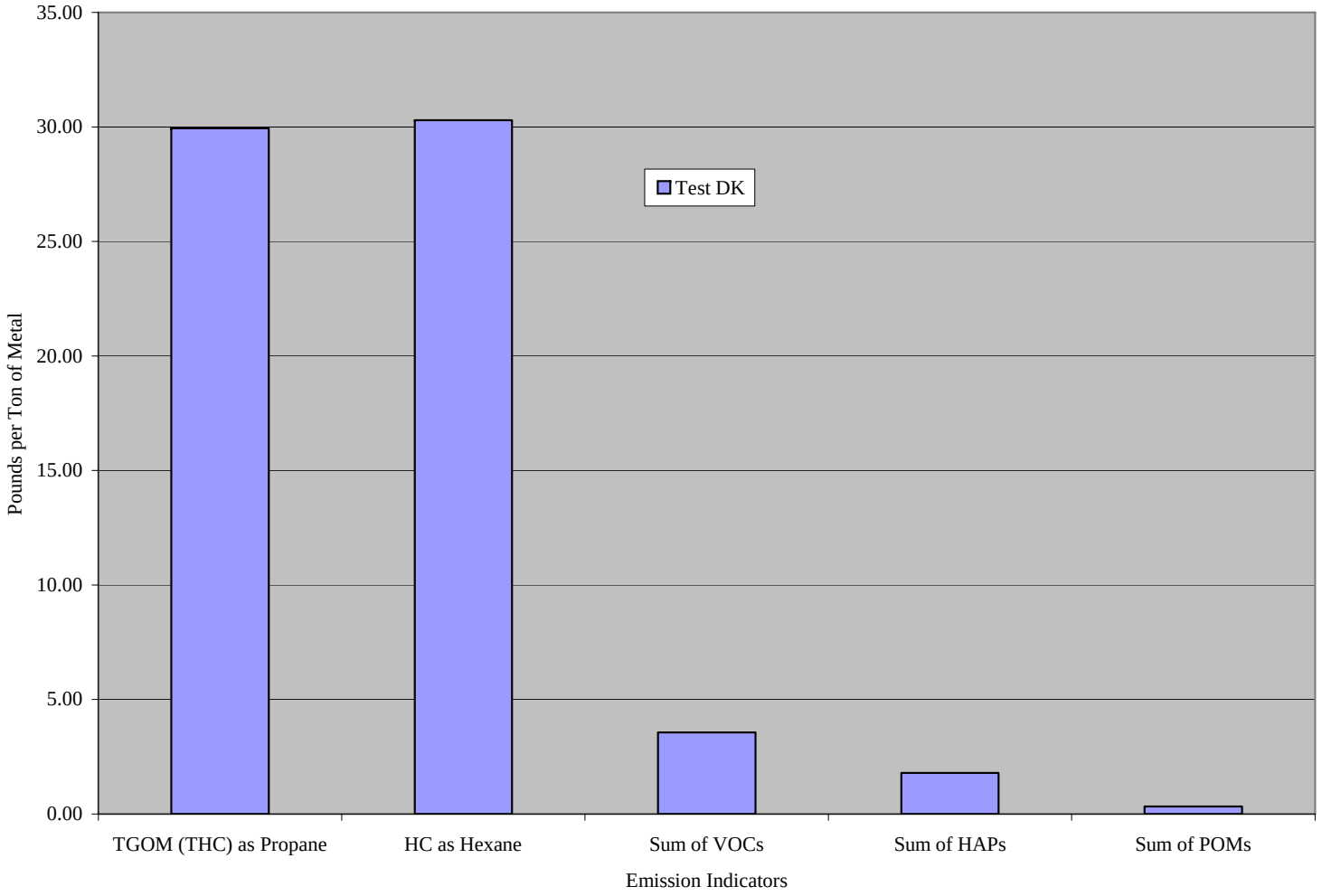


**Figure 3-2 Selected HAP Emissions from Test Series DK**

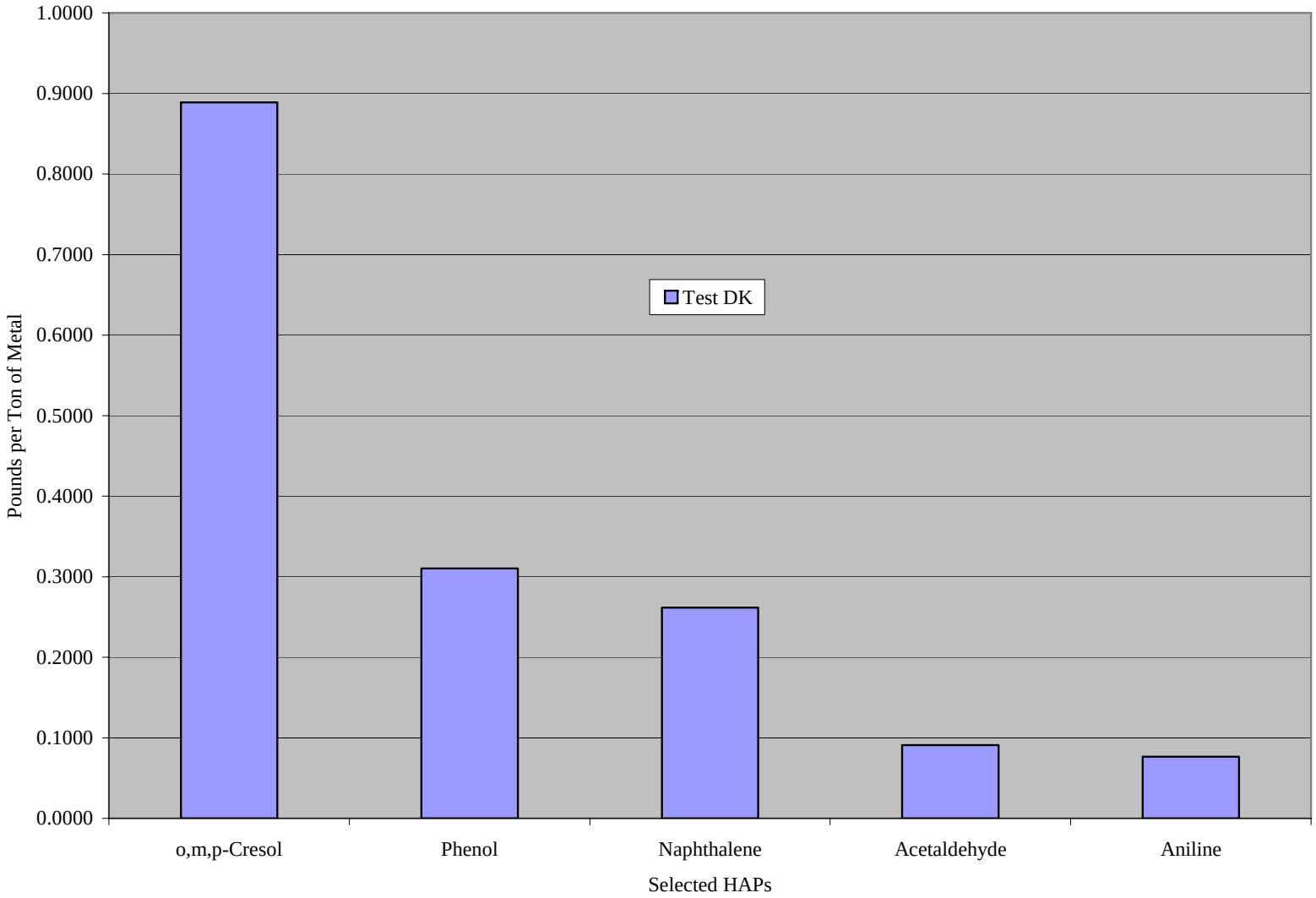
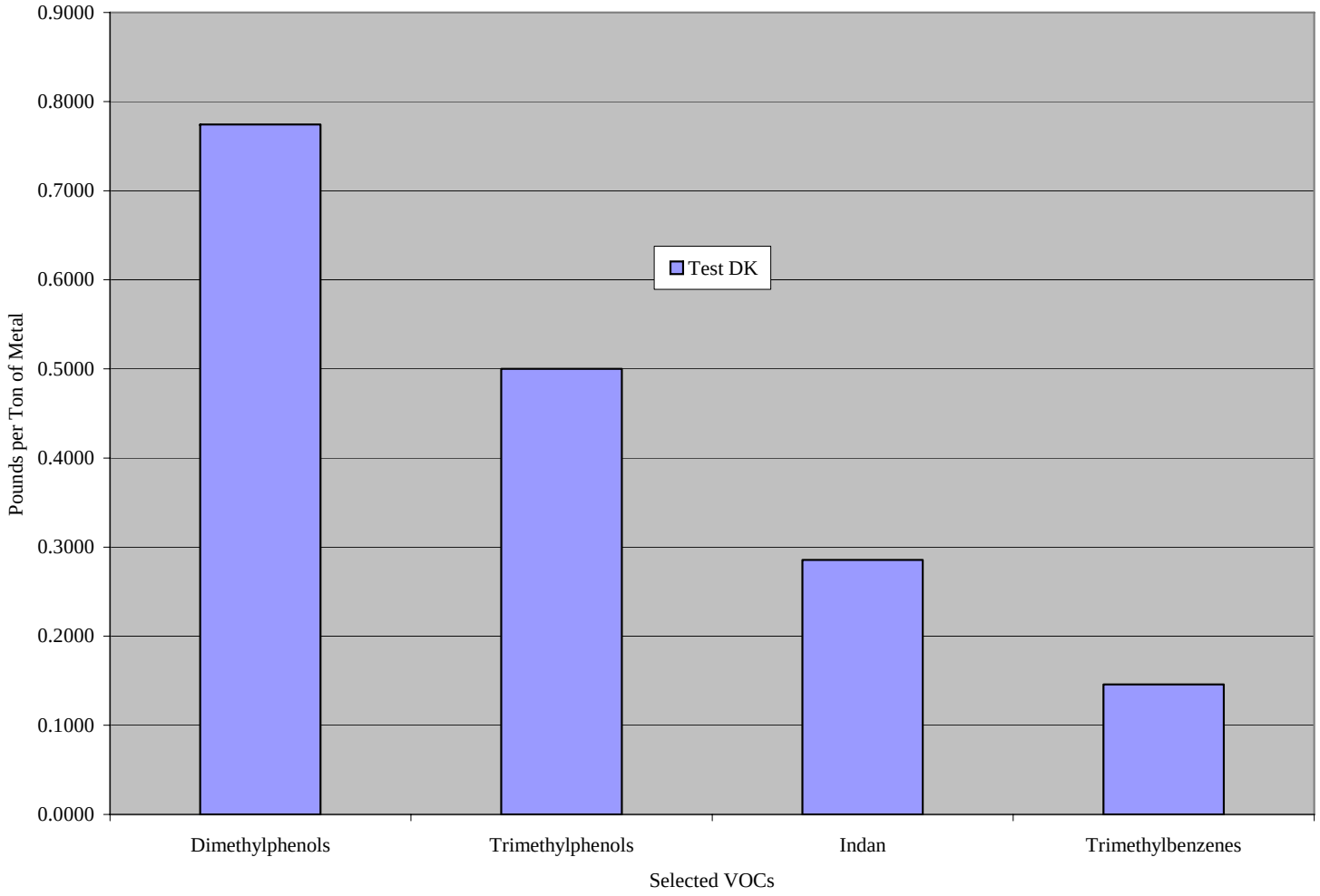


**Figure 3-3 Selected VOC Emissions from Test Series DK**



## 4.0 Discussion of Results

Nine (9) of the measured compounds comprise greater than 95% of the mass of all VOCs measured in the Polyether Polyol Urethane Aluminum No-Bake test series. Of these VOCs, five (5) of the compounds, o,m,p-cresol, phenol, naphthalene, acetaldehyde, and aniline are HAPs, and one of them, naphthalene, is also a POM. Two methods were employed to measure undifferentiated hydrocarbon emissions, TGOM (THC) as propane, performed in accordance with EPA Method 25A, and HC as hexane. Both methods yielded similar values, expressed as pounds per ton of metal poured. This is true even though distinct differences in methodologies are present that would not necessarily be expected to produce equivalent results. EPA Method 25A, TGOM (as propane), is weighted to the detection of more volatile hydrocarbon species, beginning at C1 (methane), with results calibrated against a three-carbon alkane (propane). HC as hexane is weighted to detection of relatively less volatile compounds. This method detects hydrocarbon compounds in the alkane range between C6 and C16, with results calibrated against a six-carbon alkane (hexane).

Phenolic compounds predominate the speciated emissions profile, both as VOCs and HAPs followed by aromatic hydrocarbons.

Observation of measured process parameters indicates that the test was run within an acceptable range.

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# Appendix A  Approved Test Plan for Test Series DK

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# TECHNIKON TEST PLAN

- **CONTRACT NUMBER: 1256 TASK NUMBER: 120**
- **CONTROL NUMBER: RV 1 00106**
- **SAMPLE FAMILY: DK**
- **SAMPLE EVENTS: 001 thru 009**
- **SITE: X PRE-PRODUCTION (243) PRODUCTION (238)**
- **TEST TYPE: Delta HA Polyether Polyol Urethane No-Bake (20-015 Part I, 23-133 Part II, 17-971 Activator) – Aluminum Baseline**
- **MOLD TYPE: Polyether Polyol Urethane No-Bake Aluminum System**
- **NUMBER OF MOLDS: 9**
- **CORE TYPE: N/A**

TEST DATE: START: 3 Jan 2001
FINISH: 5 Jan 2001

**TEST OBJECTIVES:**

**Primary:** To measure emissions from No-Bake molds, formulated for use with Aluminum, and manufactured based on protocols developed in capability studies CQ and CW. The THC analyzer will be used to monitor the test. Sample tubes and bags will be collected for analysis by an outside laboratory.

**VARIABLES:** Three part No-bake resin at 1.1 % resin (BOS) in the ratio of 50% Delta-HA Techniset® 20-015 resin, 50% Delta-HA Techniset® 23-133 co-reactant, and 7% (BOR Part I) Delta-HA Techniset® 17-971 part III activator.

**BRIEF OVERVIEW:** The molds will be the standard 4-on variable-tooth gear made from Nevada 70 silica sand with the above resin system. The molds will be transferred to the pouring/cooling/shakeout hooded station used for greensand and core baselines.

**SPECIAL CONDITIONS:** A shakeout fixture, which will promote disintegration of the no-bake mold shall be installed on the shakeout device. This fixture will carry the no-bake mold and locate the pouring basin in the standard pouring position. Steel hangers will be implanted in each cavity to promote separation of castings from the no-bake sand during shakeout.

---

Manager Process Engineering (Technikon) — Date: 12-28-00

V.P. Measurement Technologies (Technikon) — Date: 1-04-01

V.P. Operations (Technikon) — Date: 12-28-00

Emissions Team (USCAR) — Date: 2/22/01

Process and Facilities Team (USCAR) — Date: 2/22/01

Project Manager (CTC) — Date: 4/25/01

# Pre-Production No-Bake Process Instructions - DK

## A. Experiment

1. Measure the emissions from an Aluminum Polyether Polyol Urethane No-Bake binder system.

## B. Materials

1. No-Bake molds: Nevada 70 Silica Sand and 1.1 % Delta-HA Techniset NF ® No-bake organic core resin composed of 20-015 part I resin, 23-133 part II co-reactant. This resin is designed for aluminum applications.
2. Metal: A356/357 Aluminum.

**Caution:** Observe all safety precautions attendant to these operations as delineated in the Pre-production operating and safety instruction manual.

## C. No-Bake Core Sand preparation

1. The no-bake sand shall contain 1.1 % total resin (BOS), Part I/Part II ratio 50/50.

**Note**: This material is autocatalytic and therefore does not require a separate catalyst.

2. Calibrate the Kloster no-bake sand mixer to dispense 240 pounds/min more or less.
3. Calibrate the resin pumps:
   a. Part I: Based on the actual measured sand dispensing rate calibrate the Part I resin to be 50% of 1.1 % total resin or 0.55% +/- .01% (BOS).
   b. Part II: Based on the actual measured sand dispensing rate calibrate the Part II co-reactant to be 50 % of 1.1 % total resin or 0.55 % +/- 0.01 % (BOS).

## D. Dog bones

1. Make 24 dogbones: two (2) 12-piece sets of test dogbones using 12-on core box.
2. Use sand measuring 70-80 $^{o}$F when exiting the Kloster mixer. Preheat if necessary.
3. Record the sand temperature.
4. Place the core box on the vibrating compaction table.
5. Start the Kloster mixer and waste a few pounds of sand.
6. Flood the core box with sand then stop the mixer.
7. Strike off the core box to ½ inch deep
8. Turn on the vibrating compaction table for 15 seconds.
9. Screed off most of the excess sand.
10. Screed the core box a second time moving very slowly in a back and forth manner to remove all excess sand.

**Note**: It is important to neither gouge the sand nor leave excess sand in center neck portion of the dogbone or the test results will be affected.

11. Set aside for about 6-7 minutes or until hard to the touch.
12. Carefully remove the cores from the core box by separating the corebox components.
13. Weigh each dogbone and record the weight to the nearest 0.1 grams using the PJ 4000 electronic scale.

    **Note:** Data from dogbones whose weight varies by more than 10 % of the mean value should be recorded but disregarded.

14. Place 6 bones in the 90% Rh cabinet.
15. Perform tensile tests on 6 bones at each of the following times after dogbone manufacture: 30 minutes, 2 hours, 24 hours, and 24 hours@ 90 % Rh. Report the average and standard deviation for each set of six (6) at each time for each mold.
16. Perform scratch the hardness test on six bones 1 hour after core manufacture. The 30-minute tensile test bones may be used for this test. Conduct the test on the smooth mold side of the dogbone. Report the average and standard deviation for each mold.
17. Run a 1400 $^{o}$F core LOI on three (3) of the 30- minute tensile test dogbones. Report the average value for each mold.
18. Run a 1400 oF core LOI on the raw uncoated sand sampled at the same time as the dogbones are made. Calculate a Core Resin LOI as the difference between the average Core LOI and raw sand core LOI. Report this value for each mold.

**E. No-bake mold making: 4 on gear core box**

1. Inspect the box for cracks and other damage. Repair before use.
2. Prepare the core box halves by wire brushing any adhered sand and coating with a light coating of Ashland Zipslip ® IP 78. Allow to fully dry.
3. Place the drag core box on the vibrating compaction table.
4. Begin filling the box.
5. Immediately start the table vibration.
6. Manually spread the sand around the box as it is filling.
7. Strike off the box until it is level full.
8. Allow the vibrator to run an additional 10 seconds after the box is full.
9. a. Strike off the drag core box so that the drag core mold is 5-1/2 inches thick parting line to back.

   **Note:** When the mold is closed the visible drag height will be 6 +/- 1/8 inch)

   b. Strike off the cope core box so that the cope core mold is 5 inches thick parting line to back.

   **Note:** When the mold is closed the visible cope height will be 5 +/- 1/8 inch.

10. Set the core box aside for 5 to 6 minutes or until it is hard to the touch.
11. Invert the box and place a fractional inch above a flat transport pallet.

12. Loosen the core mold half by tapping on the box with a rubber mallet.
13. Lower the mold on to the pallet. Maintain full support of the sand mold while removing it from the core box or warpage of mold will result. Remove the pivot hole pins.
14. Lift the core box off the core mold.
15. Set the drag core box aside.
16. Place the cope core box on the vibrating compaction table.
17. Follow steps E3-E14.
18. Rotate the unboxed core to set it on edge.
19. Drill vent holes as per template.
20. Hand trim the pour basin to promote minimum splash and minimum cup volume.
21. Close cope onto drag. Visually check for closure.
    **Note:** The total mold height should be 10-1/2 +/- 1/8 inch
22. Install two (2) steel straps, one on either side of the pouring cup, with 4 metal corner protectors each to hold the mold tightly closed.
    **Note:** Break the sand edge under the 4 metal corner protectors.
23. Weigh and record the weight of the closed mold. (Nominal 325 +/- 10 Lbs).

**F. Emission hood**

1. Loading

    a. Hoist the mold onto the shakeout deck fixture within the emission hood with the pouring cup side toward the furnace.
    b. Install the cope-weighting device.
    c. Install a half inch re-rod casting hangers through the cope into each of the four riser cavities and suspend them over the horizontal mold retaining bars.
    d. Close, seal, and lock the emission hood.

2. Shakeout

    a. After the cooling time prescribed in the emission test plan has elapsed, turn on the shakeout unit and run for the time prescribed in the emission test plan.
    b. Turn off the shakeout.
    c. Wait for the emission team to signal that they are finished sampling.
    d. Open the hood and remove the castings.
    e. Clean core sand out of the pit and off the shakeout.
    f. Weigh and record cast metal weight.

**G. Melting**

1. Initial charge:

    a. Use the 250 KW Ajax induction furnace.
    b. Charge the furnace with A-356/357 aluminum sows.
    c. No other alloys need to be added for emission testing purposes.

d. Bring the furnace contents to the point of beginning to melt over a period of 1 hour at reduced power.
e. Add the balance of A-356/357 aluminum sows under full power until all is melted and the temperature has reached 1250-1300 $^{o}$F.
f. Slag the furnace and cover it.
g. Hold the furnace at 1250-1300$^{o}$F until near ready to tap.
h. When ready to tap adjust the temperature to 1300-1325$^{o}$F and slag the furnace.
i. Record all metallic additions to the furnace, tap temperature, and pour temperature. Record all furnace activities with the associated time.

2. Back charging

a. Back charging may be necessary because of the pour weight of about 90 pounds. If additional aluminum is desired back charge with A-356/357 Aluminum sows or scrap aluminum of the same source.
b. Follow the above steps beginning with G.1.

3. Emptying the furnace.

a. Pig the extra metal into steel sow molds away from the test hood.
b. It is unnecessary to wait for conclusion of emission testing to pig the metal.

## H. Pouring

1. Preheat the ladle.

a. Tap 180 pounds more or less of 1350$^{o}$F metal into the cold ladle.
b. Casually pour the metal back to the furnace.
c. Cover the ladle.
d. Reheat the metal to 1320 +/- 20 $^{o}$F.
e. Tap 180 pounds, more or less, of Aluminum into the ladle.
f. Cover the ladle to conserve heat.
g. Move the ladle to the pour position, open the emission hood pour door and wait until the metal temperature reaches 1250 +/- 10 $^{o}$F.
h. Commence pouring keeping the sprue full.
i. Upon completion close the hood door, return the extra metal to the furnace, and cover the ladle.

# PRE-PRODUCTION DK SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/3/01 | | | | | | | | | | | |
| EVENT 1 | | | | | | | | | | | |
| AIRSENSE | DK00101 | | | | | | | | | | TOTAL |
| THC | DK00102 | X | | | | | | | | | TOTAL |
| M-18 | DK00103 | | 1 | | | | | | 200 | 1 | TOTAL |
| M-18 | DK00104 | | | 1 | | | | | 200 | 2 | TOTAL |
| M-18 | DK00105 | | | | 1 | | | | 0 | 2 | Manifold Blank |
| M-18 MS | DK00106 | | 1 | | | | | | 200 | 3 | Sample will not be analyzed |
| M-18 MS | DK00107 | | | | 1 | | | | 0 | 3 | Sample will not be analyzed |
| M-18 MS (Quant) | DK00108 | | 1 | | | | | | 200 | 4 | TOTAL |
| M-18 MS (Quant) | DK00109 | | | 1 | | | | | 200 | 5 | TOTAL |
| M-18 MS (Quant) | DK00110 | | | | 1 | | | | 0 | 5 | Manifold Blank |
| Gas, CO+CO2 | DK00111 | | 1 | | | | | | 60 | 6 | Tedlar Bag |
| NIOSH 1500 (long list) | DK00112 | | 1 | | | | | | 1000 | 7 | TOTAL Orbo 32L |
| NIOSH 1500 (long list) | DK00113 | | | | 1 | | | | 0 | 7 | Manifold Blank |
| Excess | --- | | | | | | | | 1000 | 8 | Excess |
| NIOSH 2002 | DK00114 | | 1 | | | | | | 1000 | 9 | TOTAL (SKC 226-15) |
| NIOSH 2002 | DK00115 | | | | 1 | | | | 0 | 9 | Manifold Blank |
| TO11 | DK00116 | | 1 | | | | | | 1000 | 10 | TOTAL |
| TO11 | DK00117 | | | | 1 | | | | 0 | 10 | Manifold Blank |
| Excess | --- | | | | | | | | 1000 | 11 | Excess |
| Moisture | --- | | 1 | | | | | | 500 | 12 | TOTAL |
| Excess | --- | | | | | | | | 2500 | 13 | Excess |
| PUF | DK001 | | | | | | | | 16L | | |

# PRE-PRODUCTION DK SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/3/01 | | | | | | | | | | | |
| EVENT 2 | | | | | | | | | | | |
| AIRSENSE | DK00201 | | | | | | | | | | TOTAL |
| THC | DK00202 | X | | | | | | | | | TOTAL |
| M-18 | DK00203 | | 1 | | | | | | 200 | 1 | TOTAL |
| M-18 | DK00204 | | | | | 1 | | | 200 | 1 | QC - Breakthrough |
| M-18 | DK00205 | | | 1 | | | | | 200 | 2 | TOTAL |
| M-18 | DK00206 | | | | | 1 | | | 200 | 2 | QC - Breakthrough |
| M-18 MS | DK00207 | | 1 | | | | | | 200 | 3 | Sample will not be analyzed |
| M-18 MS | DK00208 | | | | | 1 | | | 200 | 3 | Sample will not be analyzed |
| M-18 MS (Quant) | DK00209 | | 1 | | | | | | 200 | 4 | TOTAL |
| M-18 MS (Quant) | DK00210 | | | | | 1 | | | 200 | 4 | QC - Breakthrough |
| M-18 MS (Quant) | DK00211 | | | 1 | | | | | 200 | 5 | TOTAL |
| M-18 MS (Quant) | DK00212 | | | | | 1 | | | 200 | 5 | QC - Breakthrough |
| Gas, CO+CO2 | DK00213 | | 1 | | | | | | 60 | 6 | Tedlar Bag |
| NIOSH 1500 (long list) | DK00214 | | 1 | | | | | | 1000 | 7 | TOTAL Orbo 32L |
| Excess | --- | | | | | | | | 1000 | 8 | Excess |
| NIOSH 2002 | DK00215 | | 1 | | | | | | 1000 | 9 | TOTAL (SKC 226-15) |
| TO11 | DK00216 | | 1 | | | | | | 1000 | 10 | TOTAL |
| TO11 | DK00217 | | | | | 1 | | | 1000 | 10 | QC - Breakthrough |
| Excess | --- | | | | | | | | 1000 | 11 | Excess |
| Moisture | | | 1 | | | | | | 500 | 12 | TOTAL |
| Excess | --- | | | | | | | | 2500 | 13 | Excess |
| PUF | DK002 | | | | | | | | 16L | | |

# PRE-PRODUCTION DK SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/4/01 | | | | | | | | | | | |
| EVENT 3 | | | | | | | | | | | |
| AIRSENSE | DK00301 | | | | | | | | | | TOTAL |
| THC | DK00302 | X | | | | | | | | | TOTAL |
| M-18 | DK00303 | | 1 | | | | | | 200 | 1 | TOTAL |
| M-18 | DK00304 | | | 1 | | | | | 200 | 2 | TOTAL |
| M-18 | DK00305 | | | | 1 | | | | 0 | 2 | QC Blank |
| M-18 MS | DK00306 | | 1 | | | | | | 200 | 3 | Sample will not be analyzed |
| M-18 MS | DK00307 | | | | 1 | | | | 0 | 3 | Sample will not be analyzed |
| M-18 MS (Quant) | DK00308 | | 1 | | | | | | 200 | 4 | TOTAL |
| M-18 MS (Quant) | DK00309 | | | 1 | | | | | 200 | 5 | TOTAL |
| M-18 MS (Quant) | DK00310 | | | | 1 | | | | 0 | 5 | QC Blank |
| Gas, CO+CO2 | DK00311 | | 1 | | | | | | 60 | 6 | Tedlar Bag |
| NIOSH 1500 (long list) | DK00312 | | 1 | | | | | | 1000 | 7 | TOTAL Orbo 32L |
| NIOSH 1500 (long list) | DK00313 | | | 1 | | | | | 1000 | 8 | TOTAL Orbo 32L |
| NIOSH 1500 (long list) | DK00314 | | | | 1 | | | | 0 | 8 | QC Blank |
| NIOSH 2002 | DK00315 | | 1 | | | | | | 1000 | 9 | TOTAL (SKC 226-15) |
| NIOSH 2002 | DK00316 | | | 1 | | | | | 1000 | 10 | TOTAL (SKC 226-15) |
| NIOSH 2002 | DK00317 | | | | 1 | | | | 0 | 10 | QC Blank |
| TO11 | DK00318 | | 1 | | | | | | 1000 | 11 | TOTAL |
| TO11 | DK00319 | | | | 1 | | | | 0 | 11 | QC Blank |
| Moisture | | | 1 | | | | | | 500 | 12 | TOTAL |
| Excess | --- | | | | | | | | 2500 | 13 | Excess |
| PUF | DK003 | | | | | | | | 16L | | |

# PRE-PRODUCTION DK SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/4/01 | | | | | | | | | | | |
| EVENT 4 | | | | | | | | | | | |
| AIRSENSE | DK00401 | | | | | | | | | | TOTAL |
| THC | DK00402 | X | | | | | | | | | TOTAL |
| M-18 | DK00403 | | 1 | | | | | | 200 | 1 | TOTAL |
| M-18 | DK00404 | | | 1 | | | | | 200 | 2 | TOTAL |
| M-18 MS | DK00405 | | 1 | | | | | | 200 | 3 | Sample will not be analyzed |
| M-18 MS (Quant) | DK00406 | | 1 | | | | | | 200 | 4 | TOTAL |
| M-18 MS (Quant) | DK00407 | | | 1 | | | | | 200 | 5 | TOTAL |
| Gas, CO+CO2 | DK00408 | | 1 | | | | | | 60 | 6 | Tedlar Bag |
| NIOSH 1500 (long list) | DK00409 | | 1 | | | | | | 1000 | 7 | TOTAL Orbo 32L |
| Excess | --- | | | | | | | | 1000 | 8 | Excess |
| NIOSH 2002 | DK00410 | | 1 | | | | | | 1000 | 9 | TOTAL (SKC 226-15) |
| TO11 | DK00411 | | 1 | | | | | | 1000 | 10 | TOTAL |
| TO11 | DK00412 | | | 1 | | | | | 1000 | 11 | TOTAL |
| Moisture | | | 1 | | | | | | 500 | 12 | TOTAL |
| Excess | --- | | | | | | | | 2500 | 13 | Excess |
| PUF | DK004 | | | | | | | | 16L | | |

# PRE-PRODUCTION DK SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/4/01 | | | | | | | | | | | |
| EVENT 5 | | | | | | | | | | | |
| AIRSENSE | DK00501 | | | | | | | | | | TOTAL |
| THC | DK00502 | X | | | | | | | | | TOTAL |
| M-18 | DK00503 | | 1 | | | | | | 200 | 1 | TOTAL |
| M-18 | DK00504 | | | 1 | | | | | 200 | 2 | TOTAL |
| M-18 MS | DK00505 | | 1 | | | | | | 200 | 3 | Sample will not be analyzed |
| M-18 MS (Quant) | DK00506 | | 1 | | | | | | 200 | 4 | TOTAL |
| M-18 MS (Quant) | DK00507 | | | 1 | | | | | 200 | 5 | TOTAL |
| Gas, CO+CO2 | DK00508 | | 1 | | | | | | 60 | 6 | Tedlar Bag |
| NIOSH 1500 (long list) | DK00509 | | 1 | | | | | | 1000 | 7 | TOTAL Orbo 32L |
| Excess | --- | | | | | | | | 1000 | 8 | Excess |
| NIOSH 2002 | DK00510 | | 1 | | | | | | 1000 | 9 | TOTAL (SKC 226-15) |
| TO11 | DK00511 | | 1 | | | | | | 1000 | 10 | TOTAL |
| Excess | --- | | | | | | | | 1000 | 11 | Excess |
| Moisture | | | 1 | | | | | | 500 | 12 | TOTAL |
| Excess | --- | | | | | | | | 2500 | 13 | Excess |
| PUF | DK005 | | | | | | | | 16L | | |

# PRE-PRODUCTION DK SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/4/01 | | | | | | | | | | | |
| EVENT 6 | | | | | | | | | | | |
| AIRSENSE | DK00601 | | | | | | | | | | TOTAL |
| THC | DK00602 | X | | | | | | | | | TOTAL |
| M-18 | DK00603 | | 1 | | | | | | 200 | 1 | TOTAL |
| M-18 | DK00604 | | | 1 | | | | | 200 | 2 | TOTAL |
| M-18 MS | DK00605 | | 1 | | | | | | 200 | 3 | Sample will not be analyzed |
| M-18 MS (Quant) | DK00606 | | 1 | | | | | | 200 | 4 | TOTAL |
| M-18 MS (Quant) | DK00607 | | | 1 | | | | | 200 | 5 | TOTAL |
| Gas, CO+CO2 | DK00608 | | 1 | | | | | | 60 | 6 | Tedlar Bag |
| NIOSH 1500 (long list) | DK00609 | | 1 | | | | | | 1000 | 7 | TOTAL Orbo 32L |
| Excess | --- | | | | | | | | 1000 | 8 | Excess |
| NIOSH 2002 | DK00610 | | 1 | | | | | | 1000 | 9 | TOTAL (SKC 226-15) |
| TO11 | DK00611 | | 1 | | | | | | 1000 | 10 | TOTAL |
| Excess | --- | | | | | | | | 1000 | 11 | Excess |
| Moisture | | | 1 | | | | | | 500 | 12 | TOTAL |
| Excess | --- | | | | | | | | 2500 | 13 | Excess |
| PUF | DK006 | | | | | | | | 16L | | |

# PRE-PRODUCTION DK SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/5/01 | | | | | | | | | | | |
| EVENT 7 | | | | | | | | | | | |
| AIRSENSE | DK00701 | | | | | | | | | | TOTAL |
| THC | DK00702 | X | | | | | | | | | TOTAL |
| M-18 | DK00703 | | 1 | | | | | | 200 | 1 | TOTAL |
| M-18 | DK00704 | | | 1 | | | | | 200 | 2 | TOTAL |
| M-18 | DK00705 | | | | 1 | | | | 0 | 2 | QC Blank |
| M-18 MS | DK00706 | | 1 | | | | | | 200 | 3 | Sample will not be analyzed |
| M-18 MS | DK00707 | | | | 1 | | | | 0 | 3 | Sample will not be analyzed |
| M-18 MS (Quant) | DK00708 | | 1 | | | | | | 200 | 4 | TOTAL |
| M-18 MS (Quant) | DK00709 | | | 1 | | | | | 200 | 5 | TOTAL |
| M-18 MS (Quant) | DK00710 | | | | 1 | | | | 0 | 5 | QC Blank |
| Gas, CO+CO2 | DK00711 | | 1 | | | | | | 60 | 6 | Tedlar Bag |
| NIOSH 1500 (long list) | DK00712 | | 1 | | | | | | 1000 | 7 | TOTAL Orbo 32L |
| NIOSH 1500 (long list) | DK00713 | | | 1 | | | | | 1000 | 8 | TOTAL Orbo 32L |
| NIOSH 1500 (long list) | DK00714 | | | | 1 | | | | 0 | 8 | QC Blank |
| NIOSH 2002 | DK00715 | | 1 | | | | | | 1000 | 9 | TOTAL (SKC 226-15) |
| NIOSH 2002 | DK00716 | | | 1 | | | | | 1000 | 10 | TOTAL (SKC 226-15) |
| NIOSH 2002 | DK00717 | | | | 1 | | | | 0 | 10 | QC Blank |
| TO11 | DK00718 | | 1 | | | | | | 1000 | 11 | TOTAL |
| TO11 | DK00719 | | | | 1 | | | | 0 | 11 | QC Blank |
| Moisture | | | 1 | | | | | | 500 | 12 | TOTAL |
| Excess | --- | | | | | | | | 2500 | 13 | Excess |
| PUF | DK007 | | | | | | | | 16L | | |

# PRE-PRODUCTION DK SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/5/01 | | | | | | | | | | | |
| EVENT 8 | | | | | | | | | | | |
| AIRSENSE | DK00801 | | | | | | | | | | TOTAL |
| THC | DK00802 | X | | | | | | | | | TOTAL |
| M-18 | DK00803 | | 1 | | | | | | 200 | 1 | TOTAL |
| M-18 | DK00804 | | | 1 | | | | | 200 | 2 | TOTAL |
| M-18 MS | DK00805 | | 1 | | | | | | 200 | 3 | Sample will not be analyzed |
| M-18 MS (Quant) | DK00806 | | 1 | | | | | | 200 | 4 | TOTAL |
| M-18 MS (Quant) | DK00807 | | | 1 | | | | | 200 | 5 | TOTAL |
| Gas, CO+CO2 | DK00808 | | 1 | | | | | | 60 | 6 | Tedlar Bag |
| NIOSH 1500 (long list) | DK00809 | | 1 | | | | | | 1000 | 7 | TOTAL Orbo 32L |
| Excess | --- | | | | | | | | 1000 | 8 | Excess |
| NIOSH 2002 | DK00810 | | 1 | | | | | | 1000 | 9 | TOTAL (SKC 226-15) |
| TO11 | DK00811 | | 1 | | | | | | 1000 | 10 | TOTAL |
| TO11 | DK00812 | | | 1 | | | | | 1000 | 11 | TOTAL |
| Moisture | | | 1 | | | | | | 500 | 12 | TOTAL |
| Excess | --- | | | | | | | | 2500 | 13 | Excess |
| PUF | DK008 | | | | | | | | 16L | | |

# PRE-PRODUCTION DK SERIES SAMPLE PLAN

| Method | Sample # | Data | Sample | Duplicate | Blank | Breakthrough | Spike | Spike Duplicate | Flow (ml/min) | Train Channel | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/5/01 | | | | | | | | | | | |
| EVENT 9 | | | | | | | | | | | |
| AIRSENSE | DK00901 | | | | | | | | | | TOTAL |
| THC | DK00902 | X | | | | | | | | | TOTAL |
| M-18 | DK00903 | | 1 | | | | | | 200 | 1 | TOTAL |
| M-18 | DK00904 | | | 1 | | | | | 200 | 2 | TOTAL |
| M-18 MS | DK00905 | | 1 | | | | | | 200 | 3 | Sample will not be analyzed |
| M-18 MS (Quant) | DK00906 | | 1 | | | | | | 200 | 4 | TOTAL |
| M-18 MS (Quant) | DK00907 | | | 1 | | | | | 200 | 5 | TOTAL |
| Gas, CO+CO2 | DK00908 | | 1 | | | | | | 60 | 6 | Tedlar Bag |
| NIOSH 1500 (long list) | DK00909 | | 1 | | | | | | 1000 | 7 | TOTAL Orbo 32L |
| Excess | --- | | | | | | | | 1000 | 8 | Excess |
| NIOSH 2002 | DK00910 | | 1 | | | | | | 1000 | 9 | TOTAL (SKC 226-15) |
| TO11 | DK00911 | | 1 | | | | | | 1000 | 10 | TOTAL |
| Excess | --- | | | | | | | | 1000 | 11 | Excess |
| Moisture | | | 1 | | | | | | 500 | 12 | TOTAL |
| Excess | --- | | | | | | | | 2500 | 13 | Excess |
| PUF | DK009 | | | | | | | | 16L | | |
| M-18 | DK00912 | | | | | | X | | 200 | | BOTTLE - Mix 1A |
| M-18 | DK00913 | | | | | | X | | 200 | | BOTTLE - Mix 1A |
| TO11 | DK00914 | | | | | | X | | 1000 | | BOTTLE - Mix 2 |
| TO11 | DK00915 | | | | | | X | | 1000 | | BOTTLE - Mix 2 |

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# Appendix B  Test Series DK Detailed Results and TIC Results

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## Test Plan DK Individual Test Results 1

| POMs | HAPs | COMPOUND / SAMPLE NUMBER | DK001 | DK002 | DK003 | DK004 | DK005 | DK006 | DK007 | DK008 | DK009 | AVERAGE | STDEV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Pour Date** | **1/2/01** | **1/2/01** | **1/2/01** | **1/3/01** | **1/3/01** | **1/3/01** | **1/4/01** | **1/4/01** | **1/4/01** | | |
| | | **TGOM (THC) as Propane** | 3.72E+01 | 3.35E+01 | 2.95E+01 | 2.85E+01 | 2.91E+01 | 2.89E+01 | 2.92E+01 | 2.82E+01 | 2.55E+01 | 2.99E+01 | 3.40E+00 |
| | | **HC as Hexane** | 3.72E+01 | 3.56E+01 | 2.94E+01 | 2.93E+01 | 2.99E+01 | 2.98E+01 | 2.84E+01 | 2.87E+01 | 2.44E+01 | 3.03E+01 | 3.88E+00 |
| | | **Sum of VOCs** | 2.48E+00 | 3.03E+00 | 3.73E+00 | 2.98E+00 | 4.12E+00 | 5.11E+00 | 2.88E+00 | 4.80E+00 | 2.96E+00 | 3.57E+00 | 9.28E-01 |
| | | **Sum of HAPs** | 1.14E+00 | 1.97E+00 | 2.04E+00 | 1.53E+00 | 1.46E+00 | 3.19E+00 | 1.48E+00 | 1.99E+00 | 1.33E+00 | 1.79E+00 | 6.14E-01 |
| | | **Sum of POMs** | 2.86E-01 | 1.16E+00 | 2.80E-01 | 1.74E-01 | 1.92E-01 | 3.44E-01 | 1.85E-01 | 1.89E-01 | 2.08E-01 | 3.36E-01 | 3.16E-01 |
| | | | **Individual HAPs and VOCs** | | | | | | | | | | |
| | z | **o-Cresol** | 2.04E-01 | 1.11E-01 | 1.27E+00 | 8.28E-01 | 6.76E-01 | 2.30E+00 | 7.12E-01 | 1.25E+00 | 6.58E-01 | 8.89E-01 | 6.57E-01 |
| | z | **Phenol** | 3.46E-01 | 3.80E-01 | 2.62E-01 | 2.81E-01 | 3.15E-01 | 2.97E-01 | 3.25E-01 | 3.08E-01 | 2.77E-01 | 3.10E-01 | 3.68E-02 |
| x | z | **Naphthalene** | 2.12E-01 | 1.08E+00 | 2.16E-01 | 1.04E-01 | 1.22E-01 | 2.68E-01 | 1.12E-01 | 1.13E-01 | 1.32E-01 | 2.62E-01 | 3.11E-01 |
| | z | **Acetaldehyde** | 1.02E-01 | 1.09E-01 | 8.05E-02 | 9.07E-02 | 9.92E-02 | 9.87E-02 | 7.93E-02 | 8.74E-02 | 7.20E-02 | 9.10E-02 | 1.22E-02 |
| | z | **Aniline** | 9.49E-02 | 1.10E-01 | 5.49E-02 | 6.61E-02 | 7.74E-02 | 6.35E-02 | 8.63E-02 | 6.74E-02 | 6.92E-02 | 7.66E-02 | 1.74E-02 |
| | z | **Propionaldehyde** | 5.27E-02 | 5.58E-02 | 4.64E-02 | 5.67E-02 | 5.55E-02 | 5.31E-02 | 5.28E-02 | 4.76E-02 | I | 5.26E-02 | 3.77E-03 |
| x | z | **2-Methylnaphthalene** | 3.78E-02 | 3.95E-02 | 2.99E-02 | 3.28E-02 | 3.35E-02 | 3.43E-02 | 3.27E-02 | 3.38E-02 | 3.83E-02 | 3.47E-02 | 3.15E-03 |
| x | z | **1-Methylnaphthalene** | 1.88E-02 | 2.12E-02 | 1.77E-02 | 1.94E-02 | 1.74E-02 | 2.09E-02 | 1.96E-02 | 2.13E-02 | 2.03E-02 | 1.96E-02 | 1.45E-03 |
| | z | **Biphenyl** | 1.36E-02 | 6.27E-03 | 1.56E-02 | 3.50E-03 | 1.34E-02 | 1.01E-02 | 7.34E-03 | 1.19E-02 | 1.48E-02 | 1.07E-02 | 4.20E-03 |
| | z | **Toluene** | 1.03E-02 | 1.09E-02 | 9.87E-03 | 8.50E-03 | 8.23E-03 | 9.45E-03 | 1.16E-02 | 8.42E-03 | 7.42E-03 | 9.41E-03 | 1.38E-03 |
| | z | **m,p-Xylene** | 8.26E-03 | 8.10E-03 | 7.48E-03 | 6.89E-03 | 6.63E-03 | 6.83E-03 | 7.89E-03 | 6.64E-03 | 5.98E-03 | 7.19E-03 | 7.77E-04 |
| x | z | **1,3-Dimethylnaphthalene** | 6.96E-03 | 7.74E-03 | 5.73E-03 | 6.05E-03 | 6.90E-03 | 6.71E-03 | 6.69E-03 | 6.83E-03 | 5.74E-03 | 6.59E-03 | 6.51E-04 |
| | z | **2-Butanone** | 4.99E-03 | 5.35E-03 | 2.81E-03 | 3.40E-03 | 4.12E-03 | 3.97E-03 | 3.11E-03 | 3.50E-03 | 3.64E-03 | 3.88E-03 | 8.39E-04 |
| | z | **Benzene** | 4.50E-03 | 4.37E-03 | 4.05E-03 | 3.57E-03 | 3.57E-03 | 3.99E-03 | 4.20E-03 | 3.48E-03 | 3.06E-03 | 3.87E-03 | 4.74E-04 |
| x | z | **2,7-Dimethylnaphthalene** | 2.42E-03 | 4.13E-03 | 3.03E-03 | 3.20E-03 | 3.61E-03 | 3.43E-03 | 3.48E-03 | 3.45E-03 | 2.97E-03 | 3.30E-03 | 4.75E-04 |
| x | z | **2,6-Dimethylnaphthalene** | 2.42E-03 | 4.13E-03 | 3.03E-03 | 3.19E-03 | 3.60E-03 | 3.44E-03 | 3.49E-03 | 3.45E-03 | 2.97E-03 | 3.30E-03 | 4.77E-04 |
| x | z | **2,3-Dimethylnaphthalene** | 3.30E-03 | 3.62E-03 | 2.72E-03 | 2.85E-03 | 3.15E-03 | 3.21E-03 | 3.14E-03 | 2.92E-03 | 2.41E-03 | 3.03E-03 | 3.52E-04 |
| x | z | **1,6-Dimethylnaphthalene** | 2.62E-03 | 2.96E-03 | 2.18E-03 | 2.33E-03 | 2.56E-03 | 2.59E-03 | 2.56E-03 | 2.61E-03 | 2.22E-03 | 2.52E-03 | 2.41E-04 |
| | z | **o-Xylene** | 2.92E-03 | 2.06E-03 | 1.22E-03 | 2.46E-03 | 2.13E-03 | 1.17E-03 | 2.45E-03 | 2.15E-03 | 2.35E-03 | 2.10E-03 | 5.74E-04 |
| | z | **Hexane** | 1.88E-03 | 1.95E-03 | 2.20E-03 | 2.22E-03 | 1.56E-03 | 2.24E-03 | 2.16E-03 | 1.48E-03 | 1.54E-03 | 1.91E-03 | 3.16E-04 |
| | z | **Ethylbenzene** | 1.31E-03 | 2.13E-03 | 1.68E-03 | 1.33E-03 | 1.14E-03 | 1.51E-03 | 1.97E-03 | 1.13E-03 | 1.10E-03 | 1.48E-03 | 3.78E-04 |
| | z | **Formaldehyde** | 1.49E-03 | 1.58E-03 | 1.34E-03 | 1.63E-03 | 1.46E-03 | 1.39E-03 | 1.56E-03 | 1.38E-03 | 1.17E-03 | 1.44E-03 | 1.42E-04 |
| x | z | **1,5-Dimethylnaphthalene** | ND | 2.38E-03 | ND | ND | ND | 1.90E-03 | 1.81E-03 | 1.57E-03 | 1.08E-03 | 1.75E-03 | 4.75E-04 |

| POMs | HAPs | COMPOUND / SAMPLE NUMBER | DK001 | DK002 | DK003 | DK004 | DK005 | DK006 | DK007 | DK008 | DK009 | AVERAGE | STDEV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Pour Date** | **1/2/01** | **1/2/01** | **1/2/01** | **1/3/01** | **1/3/01** | **1/3/01** | **1/4/01** | **1/4/01** | **1/4/01** | | |
| | z | **Cumene** | ND | ND | 1.40E-03 | ND | 7.06E-04 | 1.58E-03 | 1.16E-03 | 7.64E-04 | 6.52E-04 | 1.04E-03 | 3.95E-04 |
| | z | **Styrene** | 3.33E-04 | 7.50E-04 | 1.92E-04 | 2.91E-04 | 4.06E-04 | 3.11E-04 | 5.32E-04 | 3.41E-04 | ND | 3.95E-04 | 1.74E-04 |
| | z | **m,p-Cresol** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| x | z | **1,2-Dimethylnaphthalene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| x | z | **1,8-Dimethylnaphthalene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| x | z | **2,3,5-Trimethylnaphthalene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | z | **Acrolein** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | z | **N,N-Dimethylaniline** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **2,4,6-Trimethylphenol** | 6.27E-01 | 7.83E-01 | 3.45E-01 | 2.76E-01 | 6.49E-01 | 3.74E-01 | 6.19E-01 | 6.16E-01 | 2.12E-01 | 5.00E-01 | 2.00E-01 |
| | | **2,5-Dimethylphenol** | ND | ND | 5.46E-01 | 5.21E-01 | 7.20E-01 | 7.60E-01 | ND | 1.29E+00 | 5.73E-01 | 7.35E-01 | 2.90E-01 |
| | | **2,4-Dimethylphenol** | 3.55E-01 | I | 2.47E-01 | 1.30E-01 | 3.69E-01 | 2.62E-01 | 3.65E-01 | 3.57E-01 | 4.69E-01 | 3.19E-01 | 1.03E-01 |
| | | **Indan** | 5.20E-02 | ND | 4.55E-01 | 2.67E-01 | 7.04E-01 | 3.42E-01 | 3.18E-01 | 3.12E-01 | 1.21E-01 | 3.21E-01 | 2.00E-01 |
| | | **1,2,4-Trimethylbenzene** | 1.84E-01 | 9.38E-02 | 1.60E-02 | 1.78E-01 | 1.13E-01 | 6.07E-02 | ND | 1.34E-01 | 1.59E-01 | 1.17E-01 | 5.87E-02 |
| | | **Tetradecane** | 3.82E-02 | 3.98E-02 | 3.06E-02 | 3.08E-02 | 3.31E-02 | 3.29E-02 | 3.16E-02 | 3.17E-02 | 2.79E-02 | 3.30E-02 | 3.76E-03 |
| | | **3-Ethyltoluene** | 2.21E-02 | 2.42E-02 | 1.67E-02 | 1.79E-02 | 2.01E-02 | 1.90E-02 | 2.07E-02 | 1.97E-02 | 1.77E-02 | 1.98E-02 | 2.34E-03 |
| | | **Decane** | 3.66E-02 | 9.09E-02 | ND | ND | ND | ND | ND | ND | ND | 6.38E-02 | 3.84E-02 |
| | | **sec-Butylbenzene** | 1.20E-02 | ND | 6.15E-03 | ND | 1.96E-02 | 3.14E-02 | 1.51E-02 | 1.82E-02 | 2.40E-02 | 1.81E-02 | 8.20E-03 |
| | | **2-Ethyltoluene** | 5.75E-03 | 1.38E-02 | 9.25E-03 | 9.17E-03 | 1.14E-02 | 1.14E-02 | 4.51E-03 | 1.24E-02 | 1.23E-02 | 1.00E-02 | 3.14E-03 |
| | | **Benzaldehyde** | 4.80E-03 | 5.29E-03 | 3.82E-03 | 4.60E-03 | 4.59E-03 | 4.45E-03 | 4.43E-03 | 4.16E-03 | 3.58E-03 | 4.41E-03 | 5.13E-04 |
| | | **Isobutylbenzene** | ND | ND | 1.43E-03 | ND | ND | 8.78E-03 | 3.27E-03 | 4.80E-03 | 1.00E-02 | 5.66E-03 | 3.64E-03 |
| | | **Butyraldehyde/Methacrolien** | 3.08E-03 | 3.36E-03 | 2.59E-03 | 3.23E-03 | 3.11E-03 | 2.95E-03 | 2.93E-03 | 2.70E-03 | 2.25E-03 | 2.91E-03 | 3.44E-04 |
| | | **Nonane** | 3.18E-03 | 3.07E-03 | 2.52E-03 | 3.09E-03 | 2.82E-03 | 2.69E-03 | 2.66E-03 | 2.65E-03 | 2.74E-03 | 2.82E-03 | 2.30E-04 |
| | | **n-Propylbenzene** | 1.80E-03 | 2.24E-03 | 2.91E-03 | 2.01E-03 | 2.59E-03 | 1.48E-03 | 1.37E-03 | 3.06E-03 | 2.92E-03 | 2.26E-03 | 6.40E-04 |
| | | **o,m,p-Tolualdehyde** | 3.36E-03 | I | 1.57E-03 | 1.80E-03 | 2.13E-03 | 1.99E-03 | 1.73E-03 | 7.45E-04 | ND | 1.90E-03 | 7.81E-04 |
| | | **Pentanal** | 8.30E-04 | 1.32E-03 | 1.03E-03 | 1.27E-03 | 1.18E-03 | 1.07E-03 | 1.15E-03 | 1.04E-03 | 8.52E-04 | 1.08E-03 | 1.70E-04 |
| | | **Hexaldehyde** | ND | 8.85E-04 | ND | 1.10E-03 | 7.70E-04 | ND | 7.10E-04 | 6.69E-04 | ND | 8.28E-04 | 1.75E-04 |
| | | **Cyclohexane** | ND | ND | 2.67E-03 | ND | ND | ND | ND | 1.29E-03 | ND | 1.98E-03 | 9.81E-04 |
| | | **1,3-Diisopropylbenzene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **Undecane** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **3,5-Dimethylphenol** | ND | ND | I | ND | ND | I | ND | ND | I | N/A | N/A |
| | | **3,4-Dimethylphenol** | ND | I | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **1,2,3-Trimethylbenzene** | I | I | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |

| POMs | HAPs | COMPOUND / SAMPLE NUMBER | DK001 | DK002 | DK003 | DK004 | DK005 | DK006 | DK007 | DK008 | DK009 | AVERAGE | STDEV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Pour Date** | **1/2/01** | **1/2/01** | **1/2/01** | **1/3/01** | **1/3/01** | **1/3/01** | **1/4/01** | **1/4/01** | **1/4/01** | | |
| | | **1,2-Diethylbenzene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **1,3,5-Trimethylbenzene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **1,3-Diethylbenzene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **1,4-Diethylbenzene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **2,3,5-Trimethylphenol** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **2,3-Dimethylphenol** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **2,6-Dimethylphenol** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **4-Ethyltoluene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| x | | **Acenaphthalene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **a-Methylstyrene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **Anthracene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **Butylbenzene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **Crotonaldehyde** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **Dodecane** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **Heptane** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **Indene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **Octane** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **p-Cymene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **tert-Butylbenzene** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **Tridecane** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | | **Other Analytes** | | | | | | | | | | |
| | | **Carbon Monoxide** | 1.94E+00 | 1.80E+00 | 1.81E+00 | 1.80E+00 | 1.71E+00 | 1.82E+00 | 1.62E+00 | 2.44E+00 | 1.58E+00 | 1.84E+00 | 2.54E-01 |
| | | **Methane** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **Carbon Dioxide** | 1.22E+02 | 1.08E+02 | 1.18E+02 | 1.11E+02 | 1.10E+02 | 1.12E+02 | 1.18E+02 | 1.18E+02 | 1.06E+02 | 1.14E+02 | 5.53E+00 |
| | | **Ethane** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **Propane** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **Isobutane** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **Butane** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **Neopentane** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **Isopentane** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **Pentane** | ND | ND | ND | ND | ND | ND | ND | ND | ND | N/A | N/A |
| | | **Condensables** | 2.67E+00 | 2.54E+00 | 2.45E+00 | 2.10E+00 | 2.53E+00 | 2.29E+00 | 2.14E+00 | 1.77E+00 | 1.89E+00 | 2.26E+00 | 3.10E-01 |

| POMs | HAPs | COMPOUND / SAMPLE NUMBER | DK001 | DK002 | DK003 | DK004 | DK005 | DK006 | DK007 | DK008 | DK009 | AVERAGE | STDEV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Pour Date** | **1/2/01** | **1/2/01** | **1/2/01** | **1/3/01** | **1/3/01** | **1/3/01** | **1/4/01** | **1/4/01** | **1/4/01** | | |
| | | **Acetone** | 1.12E-01 | I | 3.82E-02 | 3.80E-02 | 5.96E-02 | 7.28E-02 | 2.61E-02 | 5.30E-02 | 9.93E-02 | 6.24E-02 | 3.05E-02 |

**I: Data was rejected based on data validation considerations.**
**All "Other Analytes" are not included in the sum of HAPs or VOCs.**
**N/A: Not Applicable; NT: Not Tested; ND: Non-Detect**

| M-18 (GC/MS) - Listing Of TICs Detected In Amounts Greater Than 5000 ng | | |
|---|---|---|
| **Sample ID** | **Amount** | **Compound** |
| DK00108 | 11640 ng | 1-Phenoxy-propanol |
| DK00108 | 20282 ng | Azulene |
| DK00108 | 13490 ng | Benzene, 1,2,3,4-tetramethyl- |
| DK00108 | 9190 ng | Benzene, 1,2,3,5-tetramethyl- |
| DK00108 | 10002 ng | Benzene, 1-ethyl-2,4,5-trimethyl- (26.98) |
| DK00108 | 5700 ng | Benzene, 1-ethyl-2,4,5-trimethyl- (27.6) |
| DK00108 | 9500 ng | Benzene, 1-ethyl-4-(1-methylethyl)- |
| DK00108 | 24120 ng | Benzene, 2-ethenyl-1,4-dimethyl- (23.62) |
| DK00108 | 11890 ng | Benzene, 2-ethenyl-1,4-dimethyl- (24.27) |
| DK00108 | 5200 ng | Benzene, 2-ethyl-1,3-dimethyl- |
| DK00108 | 5310 ng | Benzene, diethylmethyl- |
| DK00108 | 30444 ng | unknown cyclic hydrocarbon at r.t.- (18.3) |
| | | |
| DK00109 | 8100 ng | 1-Phenoxy-propanol |
| DK00109 | 9140 ng | Benzene, 1,2,3,5-tetramethyl- |
| DK00109 | 7180 ng | Benzene, 1-ethyl-2,4,5-trimethyl- (26.96) |
| DK00109 | 24290 ng | Benzene, 1-ethyl-2-methyl- |
| DK00109 | 13540 ng | Benzene, 1-ethyl-3,5-dimethyl- |
| DK00109 | 20276 ng | Benzene, 2-ethenyl-1,3-dimethyl- |
| DK00109 | 20040 ng | unknown cyclic hydrocarbon at r.t.- (18.29) |
| DK00109 | 26480 ng | unknown cyclic hydrocarbon at r.t.- (24.33) |
| | | |
| DK00209 | 17570 ng | 1-Phenoxypropan-2-ol |
| DK00209 | 7130 ng | Benzene, (1,1-dimethylpropyl)- (25.5) |
| DK00209 | 6040 ng | Benzene, 1,2,3,4-tetramethyl- |
| DK00209 | 9330 ng | Benzene, 1,3-diethyl-5-methyl- |

| M-18 (GC/MS) - Listing Of TICs Detected In Amounts Greater Than 5000 ng | | |
|---|---|---|
| **Sample ID** | **Amount** | **Compound** |
| DK00209 | 6890 ng | Benzene, 1-ethyl-2,4,5-trimethyl- (27.05) |
| DK00209 | 9610 ng | Benzene, 1-ethyl-2,4,5-trimethyl- (27.63) |
| DK00209 | 54580 ng | Benzene, 1-ethyl-2-methyl- |
| DK00209 | 44970 ng | Benzene, 1-methyl-4-(1-methylethyl) |
| DK00209 | 7220 ng | Benzene, 2-ethenyl-1,3-dimethyl- |
| DK00209 | 5510 ng | Ethanone, 1-(2-methylphenyl)- |
| | | |
| DK00212 | 11570 ng | 1-Phenoxy-propanol |
| DK00212 | 12360 ng | 1H-Indene, 2,3-dihydro-5-methyl- |
| DK00212 | 12310 ng | Benzene, 1,2,3,4-tetramethyl- |
| DK00212 | 10799 ng | Benzene, 1,2,3,5-tetramethyl- |
| DK00212 | 9510 ng | Benzene, 1-ethyl-2,4,5-trimethyl- (27) |
| DK00212 | 5210 ng | Benzene, 1-ethyl-2,4,5-trimethyl- (27.6) |
| DK00212 | 15960 ng | Benzene, 1-ethyl-4-methyl- |
| DK00212 | 23570 ng | Benzene, 2-ethenyl-1,4-dimethyl- |
| DK00212 | 5490 ng | Benzene, diethylmethyl- (24.87) |
| DK00212 | 9340 ng | Benzene, diethylmethyl- (25.14) |
| DK00212 | 28930 ng | unknown cyclic hydrocarbon at r.t.- (18.3) |
| | | |
| **Sample ID** | **Amount** | **Compound** |
| DK00308 | 11930 ng | 1-Phenoxy-propanol |
| DK00308 | 23390 ng | Azulene |
| DK00308 | 20406 ng | Benzene, (1-methyl-1-propenyl)-, (Z |
| DK00308 | 23480 ng | Benzene, (2-methyl-1-propenyl)- |
| DK00308 | 37070 ng | Benzene, 1,3-diethyl- |
| DK00308 | 6330 ng | Benzene, 1,3-diethyl-5-methyl- |

| M-18 (GC/MS) - Listing Of TICs Detected In Amounts Greater Than 5000 ng | | |
|---|---|---|
| **Sample ID** | **Amount** | **Compound** |
| DK00308 | 5790 ng | Benzene, 1-ethyl-2,4,5-trimethyl- |
| DK00308 | 5620 ng | Benzene, 1-methyl-3-(1-methylethyl) |
| DK00308 | 38570 ng | Benzene, 1-methyl-4-(1-methylethyl) |
| DK00308 | 9340 ng | Benzene, 2,4-dimethyl-1-(1-methylethyl) |
| DK00308 | 24110 ng | Benzene, 2-ethyl-1,4-dimethyl- |
| DK00308 | 10056 ng | Benzene, ethyl-1,2,4-trimethyl- (26.92) |
| | | |
| DK00309 | 13170 ng | 1-Phenoxy-propanol |
| DK00309 | 5170 ng | 2-Methyl-3-ethylbicyclo(3.3. |
| DK00309 | 32360 ng | Azulene |
| DK00309 | 43900 ng | Benzene, 1,3-diethyl- |
| DK00309 | 8930 ng | Benzene, 1,3-diethyl-5-methyl- |
| DK00309 | 5930 ng | Benzene, 1-ethyl-2,4,5-trimethyl- |
| DK00309 | 26560 ng | Benzene, 1-ethyl-4-methyl- |
| DK00309 | 9590 ng | Benzene, 1-methyl-4-(1-methylethyl) (19.68) |
| DK00309 | 24160 ng | Benzene, 1-methyl-4-(1-methylethyl) (22.19) |
| DK00309 | 9520 ng | Benzene, 2,4-dimethyl-1-(1-methylet |
| DK00309 | 31180 ng | Benzene, 2-ethenyl-1,4-dimethyl- (23.53) |
| DK00309 | 48930 ng | Benzene, 2-ethenyl-1,4-dimethyl- (24.25) |
| DK00309 | 23960 ng | Benzene, 4-ethyl-1,2-dimethyl- |
| DK00309 | 10513 ng | Benzene, ethyl-1,2,4-trimethyl- (26.9) |
| DK00309 | 5290 ng | unknown at retention time- (23.75) |
| DK00309 | 5420 ng | unknown at retention time- (25.63) |
| | | |
| DK00406 | 24550 ng | 1H-Indene, 2,3-dihydro-2-methyl- |
| DK00406 | 29740 ng | Azulene |
| DK00406 | 23270 ng | Benzene, 1,2,3,4-tetramethyl- |

| M-18 (GC/MS) - Listing Of TICs Detected In Amounts Greater Than 5000 ng | | |
|---|---|---|
| **Sample ID** | **Amount** | **Compound** |
| DK00406 | 32430 ng | Benzene, 1,2,4-trimethyl- |
| DK00406 | 43030 ng | Benzene, 1,3-diethyl- |
| DK00406 | 5510 ng | Benzene, 1-(1,1-dimethylethyl)-4-methyl- |
| DK00406 | 6140 ng | Benzene, 1-ethyl-2,4,5-trimethyl- |
| DK00406 | 6980 ng | Benzene, 1-methyl-4-(1-methylethyl) |
| DK00406 | 28860 ng | Benzene, 2-ethenyl-1,3-dimethyl- |
| DK00406 | 27400 ng | Benzene, 2-ethyl-1,4-dimethyl- |
| DK00406 | 6740 ng | Benzene, diethylmethyl- |
| DK00406 | 11150 ng | Benzene, ethyl-1,2,4-trimethyl- (26.95) |
| DK00406 | 12720 ng | Ethanol, 2-phenoxy- |
| DK00406 | 18560 ng | unknown at retention time- (20.31) |
| | | |
| **Sample ID** | **Amount** | **Compound** |
| DK00407 | 14870 ng | 1-Phenoxy-propanol |
| DK00407 | 7030 ng | Benzene, 1-ethyl-2,4,5-trimethyl- |
| DK00407 | 11470 ng | Benzene, 1-ethyl-4-(1-methylethyl)- |
| DK00407 | 22970 ng | Benzene, 1-methyl-4-(1-methylethyl) |
| DK00407 | 28120 ng | Benzene, 2-ethyl-1,4-dimethyl- |
| DK00407 | 8010 ng | Benzene, diethylmethyl- |
| DK00407 | 12230 ng | Benzene, ethyl-1,2,4-trimethyl- |
| DK00407 | 57050 ng | unknown cyclic hydrocarbon at r.t.- (18.5) |
| DK00407 | 7320 ng | unknown cyclic hydrocarbon at r.t.- (23.34) |
| DK00407 | 8270 ng | unknown cyclic hydrocarbon at r.t.- (23.56) |
| DK00407 | 5470 ng | unknown cyclic hydrocarbon at r.t.- (27.03) |
| | | |
| DK00506 | 12770 ng | 1-Phenoxy-propanol |

| M-18 (GC/MS) - Listing Of TICs Detected In Amounts Greater Than 5000 ng | | |
|---|---|---|
| **Sample ID** | **Amount** | **Compound** |
| DK00506 | 20418 ng | Azulene |
| DK00506 | 28970 ng | Benzene, 1,2,4-trimethyl- |
| DK00506 | 50704 ng | Benzene, 1,2-diethyl- |
| DK00506 | 7320 ng | Benzene, 1,3-diethyl-5-methyl- |
| DK00506 | 16740 ng | Benzene, 1-methyl-2-(2-propenyl)- |
| DK00506 | 10011 ng | Benzene, 1-methyl-3-(1-methylethyl) |
| DK00506 | 12930 ng | Benzene, 1-methyl-4-(1-methylethyl) (21.4) |
| DK00506 | 19930 ng | Benzene, 1-methyl-4-(1-methylethyl) (22.18) |
| DK00506 | 24150 ng | Benzene, 2-ethenyl-1,3-dimethyl- |
| DK00506 | 10664 ng | Benzene, diethylmethyl- |
| DK00506 | 11400 ng | Benzene, ethyl-1,2,4-trimethyl- (26.91) |
| DK00506 | 6610 ng | Benzene, ethyl-1,2,4-trimethyl- (27.53) |
| | | |
| DK00507 | 13870 ng | 1-Phenoxy-propanol |
| DK00507 | 38780 ng | Azulene |
| DK00507 | 10591 ng | Benzene, (1,1-dimethylethyl)methyl- |
| DK00507 | 8680 ng | Benzene, (1,1-dimethylpropyl)- |
| DK00507 | 18270 ng | Benzene, (2-methoxyethenyl)- |
| DK00507 | 46730 ng | Benzene, 1,2,4,5-tetramethyl- |
| DK00507 | 7030 ng | Benzene, 1,3-diethyl-5-methyl- |
| DK00507 | 10564 ng | Benzene, 1,3-dimethyl-5-(1-methylet (26.61) |
| DK00507 | 7250 ng | Benzene, 1,4-dimethyl-2-(1-methylet (27.27) |
| DK00507 | 27060 ng | Benzene, 1-methyl-2-(2-propenyl)- |
| DK00507 | 40148 ng | Benzene, 1-methyl-2-propyl- (18) |
| DK00507 | 17950 ng | Benzene, 1-methyl-2-propyl- (18.88) |
| DK00507 | 59940 ng | Benzene, 1-methyl-3-(1-methylethyl) |
| DK00507 | 78480 ng | Benzene, 1-methyl-4-(1-methylethyl) (19.54) |

| M-18 (GC/MS) - Listing Of TICs Detected In Amounts Greater Than 5000 ng | | |
|---|---|---|
| **Sample ID** | **Amount** | **Compound** |
| DK00507 | 75670 ng | Benzene, 1-methyl-4-(1-methylethyl) (22.05) |
| DK00507 | 27400 ng | Benzene, 2-ethyl-1,4-dimethyl- |
| DK00507 | 27880 ng | Benzene, 4-ethenyl-1,2-dimethyl- |
| DK00507 | 9120 ng | Benzene, diethylmethyl- |
| DK00507 | 12850 ng | unknown at retention time- (23.35) |
| | | |
| **Sample ID** | **Amount** | **Compound** |
| DK00606 | 13090 ng | 1-Phenoxypropan-2-ol |
| DK00606 | 5880 ng | Benzene, (1,1-dimethylpropyl)- (25.62) |
| DK00606 | 33630 ng | Benzene, 1,2,3,4-tetramethyl- |
| DK00606 | 11260 ng | Benzene, 1-ethyl-2,4,5-trimethyl- (26.9) |
| DK00606 | 6120 ng | Benzene, 1-ethyl-2,4,5-trimethyl- (27.5) |
| DK00606 | 13410 ng | Benzene, 1-ethyl-3,5-dimethyl- |
| DK00606 | 8930 ng | Benzene, diethylmethyl- (24.73) |
| DK00606 | 9970 ng | Benzene, diethylmethyl- (25.02) |
| DK00606 | 9370 ng | unknown at retention time- (23.62) |
| DK00606 | 41550 ng | unknown cyclic hydrocarbon at r.t.- (18.4) |
| DK00606 | 6770 ng | unknown cyclic hydrocarbon at r.t.- (19.65) |
| DK00606 | 10873 ng | unknown cyclic hydrocarbon at r.t.- (21.46) |
| DK00606 | 7970 ng | unknown cyclic hydrocarbon at r.t.- (23.31) |
| DK00606 | 16680 ng | unknown cyclic hydrocarbon at r.t.- (23.51) |
| DK00606 | 50899 ng | unknown cyclic hydrocarbon at r.t.- (24.2) |
| | | |
| DK00607 | 13870 ng | 1-Phenoxy-propanol |
| DK00607 | 36880 ng | Benzene, 1,2,3,4-tetramethyl- |
| DK00607 | 13010 ng | Benzene, 1-ethyl-2,4,5-trimethyl- (26.88) |

| M-18 (GC/MS) - Listing Of TICs Detected In Amounts Greater Than 5000 ng | | |
|---|---|---|
| **Sample ID** | **Amount** | **Compound** |
| DK00607 | 5620 ng | Benzene, 1-ethyl-2,4,5-trimethyl- (26.98) |
| DK00607 | 6980 ng | Benzene, 1-ethyl-2,4,5-trimethyl- (27.49) |
| DK00607 | 5660 ng | Benzene, 1-methyl-3-propyl- |
| DK00607 | 34020 ng | Benzene, 4-ethyl-1,2-dimethyl- |
| DK00607 | 8710 ng | Benzene, diethylmethyl- |
| DK00607 | 53160 ng | unknown cyclic hydrocarbon at r.t.- (18.37) |
| DK00607 | 14930 ng | unknown cyclic hydrocarbon at r.t.- (19.69) |
| DK00607 | 21380 ng | unknown cyclic hydrocarbon at r.t.- (23.53) |
| DK00607 | 39520 ng | unknown cyclic hydrocarbon at r.t.- (24.24) |
| DK00607 | 5620 ng | unknown cyclic hydrocarbon at r.t.- (24.53) |
| DK00607 | 5950 ng | unknown cyclic hydrocarbon at r.t.- (24.99) |
| | | |
| DK00708 | 15110 ng | 1-Phenoxy-propanol |
| DK00708 | 27910 ng | 1H-Indene, 2,3-dihydro-5-methyl- |
| DK00708 | 54160 ng | Benzene, 1,2,3,4-tetramethyl- |
| DK00708 | 8290 ng | Benzene, 1-ethyl-2,3-dimethyl- |
| DK00708 | 7440 ng | Benzene, 1-ethyl-2,4,5-trimethyl- |
| DK00708 | 15450 ng | Benzene, 1-ethyl-3,5-dimethyl- |
| DK00708 | 6010 ng | Benzene, 1-methyl-4-(1-methylethyl) |
| DK00708 | 8150 ng | Benzene, diethylmethyl- |
| DK00708 | 31810 ng | unknown cyclic hydrocarbon at r.t.- (18.27) |
| DK00708 | 10619 ng | unknown cyclic hydrocarbon at r.t.- (21.5) |
| DK00708 | 29630 ng | unknown cyclic hydrocarbon at r.t.- (23.61) |
| DK00708 | 12510 ng | unknown cyclic hydrocarbon at r.t.- (25.06) |
| DK00708 | 12960 ng | unknown cyclic hydrocarbon at r.t.- (26.92) |
| | | |
| **Sample ID** | **Amount** | **Compound** |

| M-18 (GC/MS) - Listing Of TICs Detected In Amounts Greater Than 5000 ng | | |
|---|---|---|
| **Sample ID** | **Amount** | **Compound** |
| DK00709 | 19700 ng | 1-Phenoxy-propanol |
| DK00709 | 5110 ng | Benzene, (1,1-dimethylpropyl)- (25.35) |
| DK00709 | 9690 ng | Benzene, 1-ethyl-2,4,5-trimethyl- |
| DK00709 | 9140 ng | Benzene, 1-methyl-2-propyl- |
| DK00709 | 23200 ng | Benzene, 1-methyl-3-(1-methylethyl) |
| DK00709 | 43710 ng | Benzene, 1-methyl-3-propyl- |
| DK00709 | 26410 ng | Benzene, 1-methyl-4-(1-methylethyl) |
| DK00709 | 17860 ng | Benzene, 4-ethyl-1,2-dimethyl- |
| DK00709 | 11350 ng | Benzene, diethylmethyl- (24.72) |
| DK00709 | 16000 ng | Benzene, diethylmethyl- (25.01) |
| DK00709 | 7600 ng | Benzene, diethylmethyl- (26.99) |
| DK00709 | 16430 ng | Benzene, ethyl-1,2,4-trimethyl- |
| DK00709 | 10820 ng | unknown cyclic hydrocarbon at r.t.- (23.3) |
| DK00709 | 22990 ng | unknown cyclic hydrocarbon at r.t.- (23.54) |
| DK00709 | 14060 ng | unknown cyclic hydrocarbon at r.t.- (24.23) |
| DK00709 | 5970 ng | unknown cyclic hydrocarbon at r.t.- (24.56) |
| | | |
| DK00806 | 13710 ng | 1-Phenoxy-propanol |
| DK00806 | 46800 ng | 1H-Indene, 2,3-dihydro-5-methyl- |
| DK00806 | 24430 ng | Benzene, 1,2,3,5-tetramethyl- |
| DK00806 | 8310 ng | Benzene, 1-ethyl-2,3-dimethyl- |
| DK00806 | 11770 ng | Benzene, 1-ethyl-2,4,5-trimethyl- |
| DK00806 | 37770 ng | Benzene, 2-ethyl-1,4-dimethyl- |
| DK00806 | 8570 ng | Benzene, diethylmethyl- (24.76) |
| DK00806 | 5510 ng | Benzene, diethylmethyl- (27.02) |
| DK00806 | 13490 ng | Benzene, ethyl-1,2,4-trimethyl- |

| M-18 (GC/MS) - Listing Of TICs Detected In Amounts Greater Than 5000 ng | | |
|---|---|---|
| **Sample ID** | **Amount** | **Compound** |
| DK00806 | 7140 ng | Benzene, pentamethyl- (27.51) |
| DK00806 | 70116 ng | unknown cyclic hydrocarbon at r.t.- (18.49) |
| DK00806 | 9520 ng | unknown cyclic hydrocarbon at r.t.- (23.34) |
| DK00806 | 10416 ng | unknown cyclic hydrocarbon at r.t.- (23.56) |
| | | |
| DK00807 | 15520 ng | 1-Phenoxy-propanol |
| DK00807 | 8710 ng | Benzene, 1,2,3,5-tetramethyl- |
| DK00807 | 13380 ng | Benzene, 1,3-dimethyl-5-(1-methylethyl) (26.86) |
| DK00807 | 22490 ng | Benzene, 1-methyl-2-propyl- (18.11) |
| DK00807 | 15790 ng | Benzene, 2-ethyl-1,4-dimethyl- |
| DK00807 | 18690 ng | Benzene, 4-ethyl-1,2-dimethyl- |
| DK00807 | 9350 ng | Benzene, diethylmethyl- (24.7) |
| DK00807 | 6240 ng | Benzene, diethylmethyl- (26.98) |
| DK00807 | 7340 ng | Benzene, ethyl-1,2,4-trimethyl- |
| DK00807 | 6520 ng | unknown cyclic hydrocarbon at r.t.- (18.37) |
| DK00807 | 27470 ng | unknown cyclic hydrocarbon at r.t.- (20.23) |
| DK00807 | 13040 ng | unknown cyclic hydrocarbon at r.t.- (21.41) |
| DK00807 | 5210 ng | unknown cyclic hydrocarbon at r.t.- (22.13) |
| DK00807 | 44080 ng | unknown cyclic hydrocarbon at r.t.- (23.5) |
| DK00807 | 32180 ng | unknown cyclic hydrocarbon at r.t.- (24.2) |
| DK00807 | 5090 ng | unknown cyclic hydrocarbon at r.t.- (24.53) |
| DK00807 | 6200 ng | unknown cyclic hydrocarbon at r.t.- (24.99) |
| | | |
| **Sample ID** | **Amount** | **Compound** |
| DK00906 | 17080 ng | 1-Phenoxy-propanol |
| DK00906 | 74360 ng | Benzene, 1,2,3,5-tetramethyl- |

| M-18 (GC/MS) - Listing Of TICs Detected In Amounts Greater Than 5000 ng | | |
|---|---|---|
| **Sample ID** | **Amount** | **Compound** |
| DK00906 | 14870 ng | Benzene, 1-ethyl-2,4,5-trimethyl- |
| DK00906 | 32530 ng | Benzene, 1-ethyl-3,5-dimethyl- |
| DK00906 | 8060 ng | Benzene, 1-ethyl-4-(1-methylethyl)- |
| DK00906 | 25900 ng | Benzene, 1-methyl-2-propyl- (18.11) |
| DK00906 | 8060 ng | Benzene, 1-methyl-2-propyl- (19.03) |
| DK00906 | 16350 ng | Benzene, 2-ethyl-1,4-dimethyl- |
| DK00906 | 10529 ng | Benzene, diethylmethyl- (24.7) |
| DK00906 | 6870 ng | Benzene, diethylmethyl- (26.97) |
| DK00906 | 8750 ng | Benzene, ethyl-1,2,4-trimethyl- |
| DK00906 | 7130 ng | unknown cyclic hydrocarbon at r.t.- (18.4) |
| DK00906 | 42780 ng | unknown cyclic hydrocarbon at r.t.- (23.5) |
| DK00906 | 35450 ng | unknown cyclic hydrocarbon at r.t.- (24.2) |
| | | |
| DK00907 | 18010 ng | 1-Phenoxy-propanol |
| DK00907 | 8110 ng | Benzene, (1,1-dimethylpropyl)- (25.55) |
| DK00907 | 11750 ng | Benzene, (1-methylpropyl)- |
| DK00907 | 15060 ng | Benzene, 1,3-dimethyl-5-(1-methylethyl) (26.83) |
| DK00907 | 8440 ng | Benzene, 1-ethyl-2,4,5-trimethyl- |
| DK00907 | 30059 ng | Benzene, 1-ethyl-2,4-dimethyl- |
| DK00907 | 8080 ng | Benzene, 1-ethyl-4-(1-methylethyl)- |
| DK00907 | 31010 ng | Benzene, 1-methyl-4-(1-methylethyl) |
| DK00907 | 19090 ng | Benzene, 2-ethyl-1,4-dimethyl- |
| DK00907 | 12910 ng | Benzene, diethylmethyl- (24.66) |
| DK00907 | 7660 ng | Benzene, diethylmethyl- (26.95) |
| DK00907 | 75440 ng | unknown cyclic hydrocarbon at r.t.- (18.45) |
| DK00907 | 43270 ng | unknown cyclic hydrocarbon at r.t.- (23.47) |
| DK00907 | 7950 ng | unknown cyclic hydrocarbon at r.t.- (23.67) |

| M-18 (GC/MS) - Listing Of TICs Detected In Amounts Greater Than 5000 ng | | |
|---|---|---|
| **Sample ID** | **Amount** | **Compound** |
| DK00907 | 41300 ng | unknown cyclic hydrocarbon at r.t.- (24.18) |
| DK00907 | 30406 ng | unknown cyclic hydrocarbon at r.t.- (24.26) |
| DK00907 | 6180 ng | unknown cyclic hydrocarbon at r.t.- (24.5) |

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# Appendix C Test Series DK Detailed Process And Source Data

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| **Description** | DK001 | DK002 | DK003 | DK004 | DK005 | DK006 | DK007 | DK008 | DK009 | Averages |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1/3/01 | 1/3/01 | 1/4/01 | 1/4/01 | 1/4/01 | 1/4/01 | 1/5/01 | 1/5/01 | 1/5/01 | |
| Casting Metal Weight, lbs. (Note 1) | 49 | 52 | 52 | 52 | 50 | 47 | 54 | 51 | 54 | 51 |
| Total No Bake Mold Weight, lbs. | 326 | 332 | 328 | 330 | 332 | 331 | 331 | 332 | 334 | 331 |
| Total Binder Weight including catalyst, lbs | 3.572 | 3.638 | 3.569 | 3.590 | 3.612 | 3.601 | 3.594 | 3.604 | 3.626 | 3.60 |
| No. Cavities Poured (four-on gear) | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| No Bake Mold LOI, % 1400°F | 1.35 | 1.43 | 1.37 | 1.34 | 1.47 | 1.44 | Note 4 | 1.26 | 1.30 | 1.37 |
| Pouring Temperature, °F | 1259 | 1260 | 1241 | 1236 | 1250 | 1257 | 1242 | 1260 | 1258 | 1251 |
| Dog Bone Tensile Strength 30 min., psi | 33.50 | 13.00 | 29.67 | 31.17 | 30.33 | 29.17 | 35.17 | 36.33 | ND | 29.79 |
| Dog Bone Tensile Strength 2 hrs, psi | 70.00 | 28.67 | 60.83 | 73.83 | 67.50 | 43.67 | 73.17 | 83.33 | ND | 62.63 |
| Dog Bone Tensile Strength 24 hrs, psi | 90.83 | 46.00 | 80.50 | 104.00 | 88.00 | 53.67 | 87.33 | 96.33 | ND | 80.83 |
| Dog Bone Tensile Strength 24 hrs at 90% RH, psi | 25.33 | 15.67 | 21.00 | 30.00 | 24.67 | 14.17 | 26.5 | 24.33 | ND | 22.71 |
| Sand Flow Rate, lbs / 15 seconds | 51.65 | 51.65 | 47.50 | 47.50 | 47.50 | 47.50 | 47 | 47.00 | 47.00 | 48.26 |
| Resin(part I+part II), % BOS | 1.11 | 1.11 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 |
| Resin Part 1, grams | 129.40 | 129.40 | 118.90 | 118.90 | 118.90 | 118.90 | 116.80 | 116.80 | 116.80 | 120.53 |
| Co-reactant Part 2, grams | 130.40 | 130.40 | 118.30 | 118.30 | 118.30 | 118.30 | 117.4 | 117.40 | 117.40 | 120.69 |
| Catalyst Part 3, BO Pt.1, grams | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total Binder, true %(resins + catalyst) | 1.10 | 1.10 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 |
| Total Binder, true %(resins only) | 1.10 | 1.10 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 |
| | | | | | | | | | | |
| Average Stack Temperature, °F | 78 | 82 | 74 | 78 | 80 | 81 | 74 | 78 | 82 | 79 |
| Total Moisture Content, % | 0.86 | 0.84 | 0.76 | 0.83 | 0.86 | 0.84 | 0.75 | 0.81 | 0.85 | 0.82 |
| Average Stack Velocity, ft./sec. | 15.90 | 15.70 | 15.60 | 15.70 | 15.70 | 15.80 | 15.90 | 15.70 | 15.80 | 15.76 |
| Avg. Stack Pressure, in. Hg | 30.39 | 30.34 | 30.30 | 30.21 | 30.18 | 30.15 | 30.20 | 30.14 | 30.07 | 30.22 |
| Stack Flow Rate, scfm | 741 | 726 | 731 | 728 | 726 | 725 | 742 | 727 | 723 | 730 |

Binder fraction = binder including catalyst(lbs)/(sand + binder including catalyst(lbs)). Binder fraction x mold weight used in mold = Total Binder Weight including catalyst.

Example: (0.5723/(51.65 + 0.5723)) = 0.01096. 0.01096x 326 = 3.5726 (lbs binder per mold) 1.1% No Bake resin DK001-009.

NOTE 1: Casting metal used is Aluminum.

NOTE 2: Dog Bone Tensile Strength values are the average of six samples.

NOTE 3 DK006, Low total metal weight reflects malformed pour cup, casting is complete; ref picture DK006a

NOTE 4: DK007, Use this test, mixer calibration data, Dogbone test data, and THC data support correct manufacture even in absence of LOI confirmation.

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## Appendix D  Method 25A Charts

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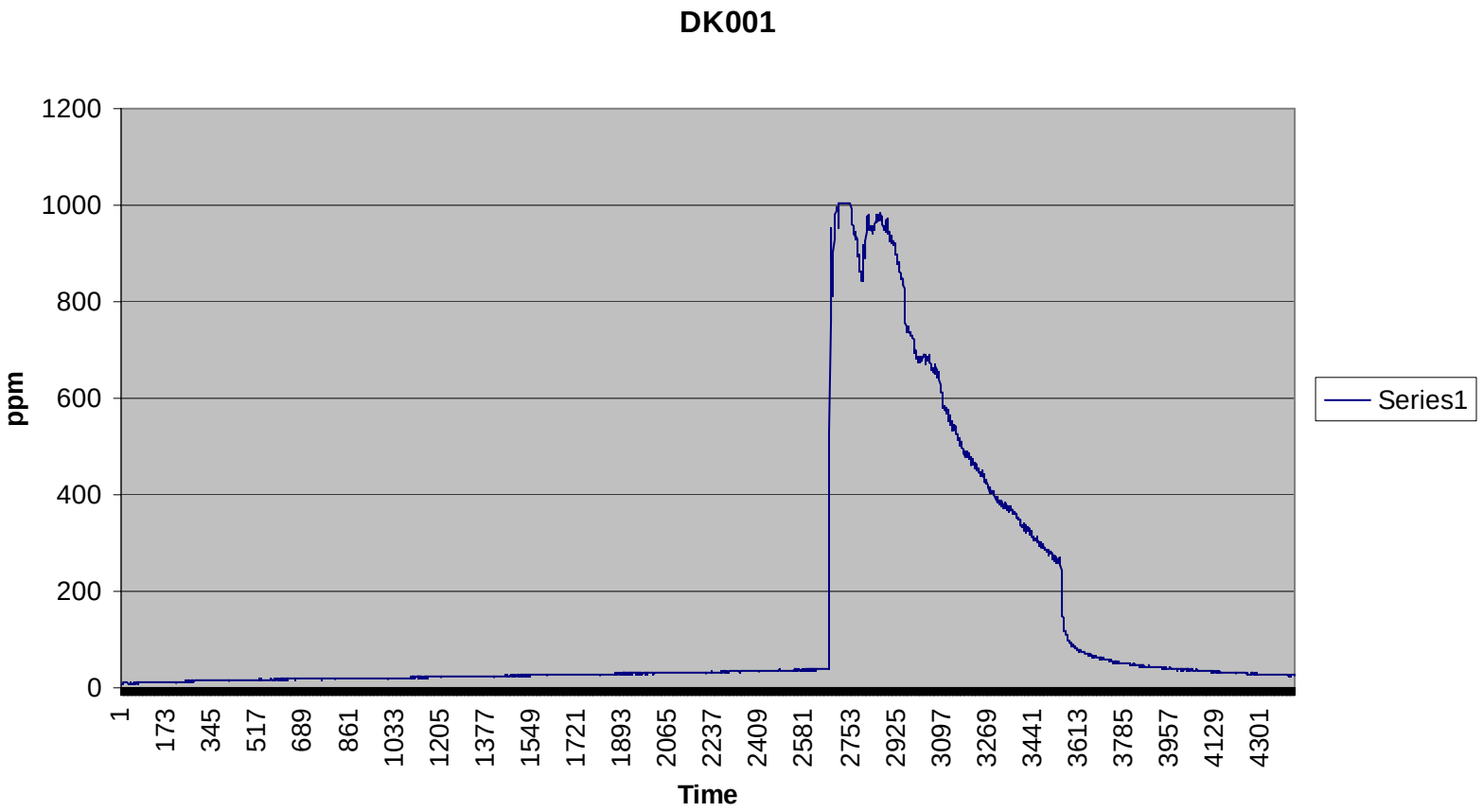
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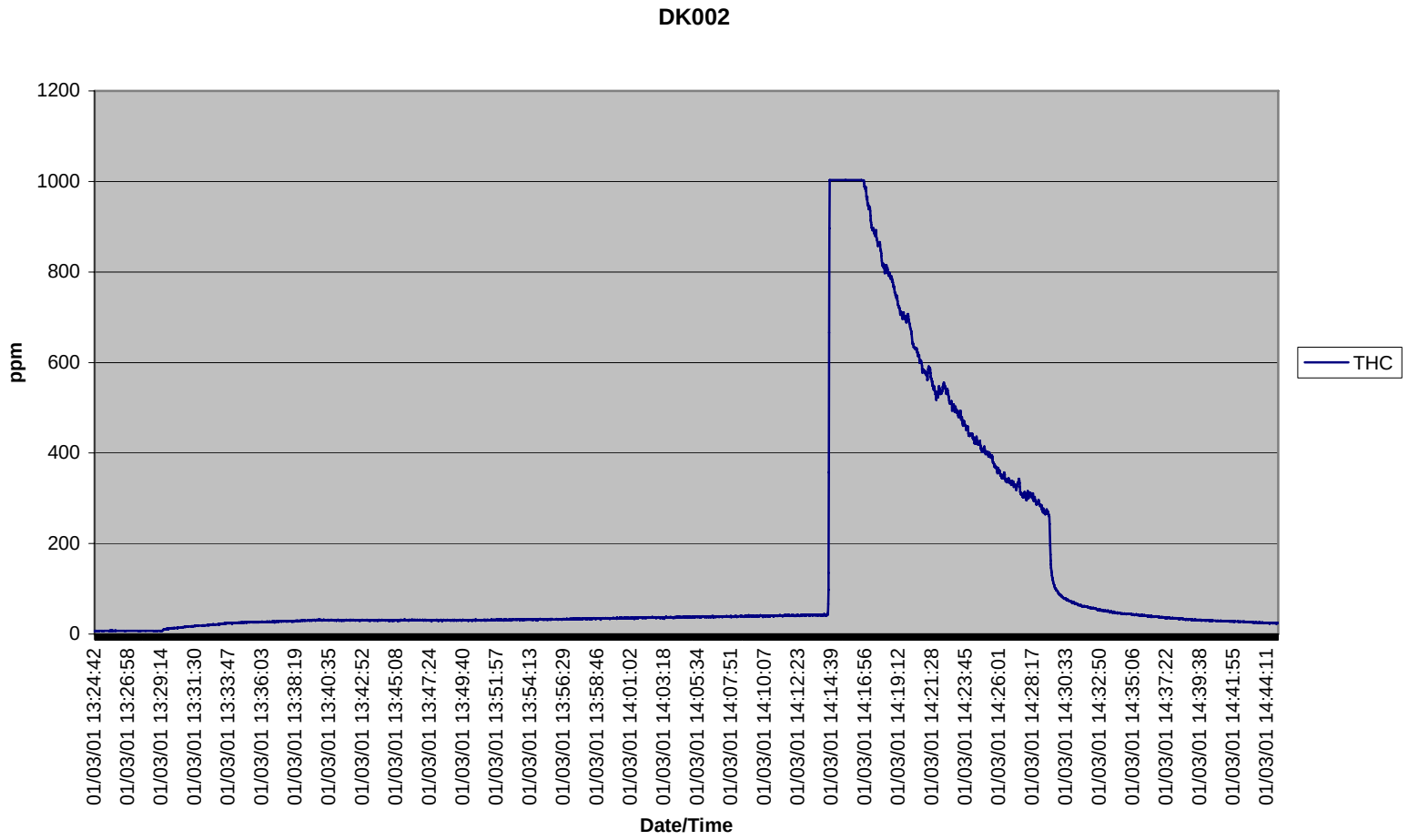
Time
Series1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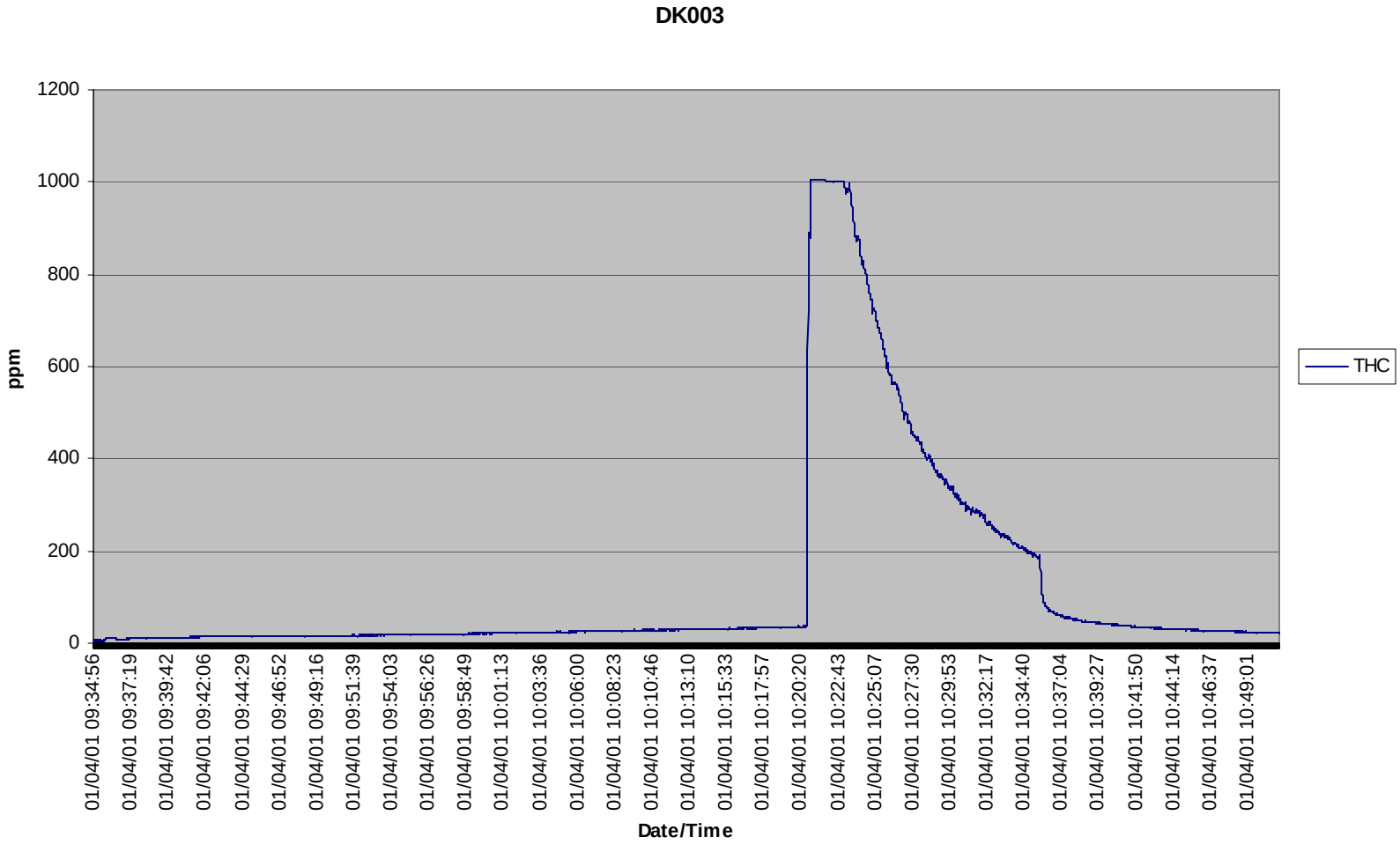
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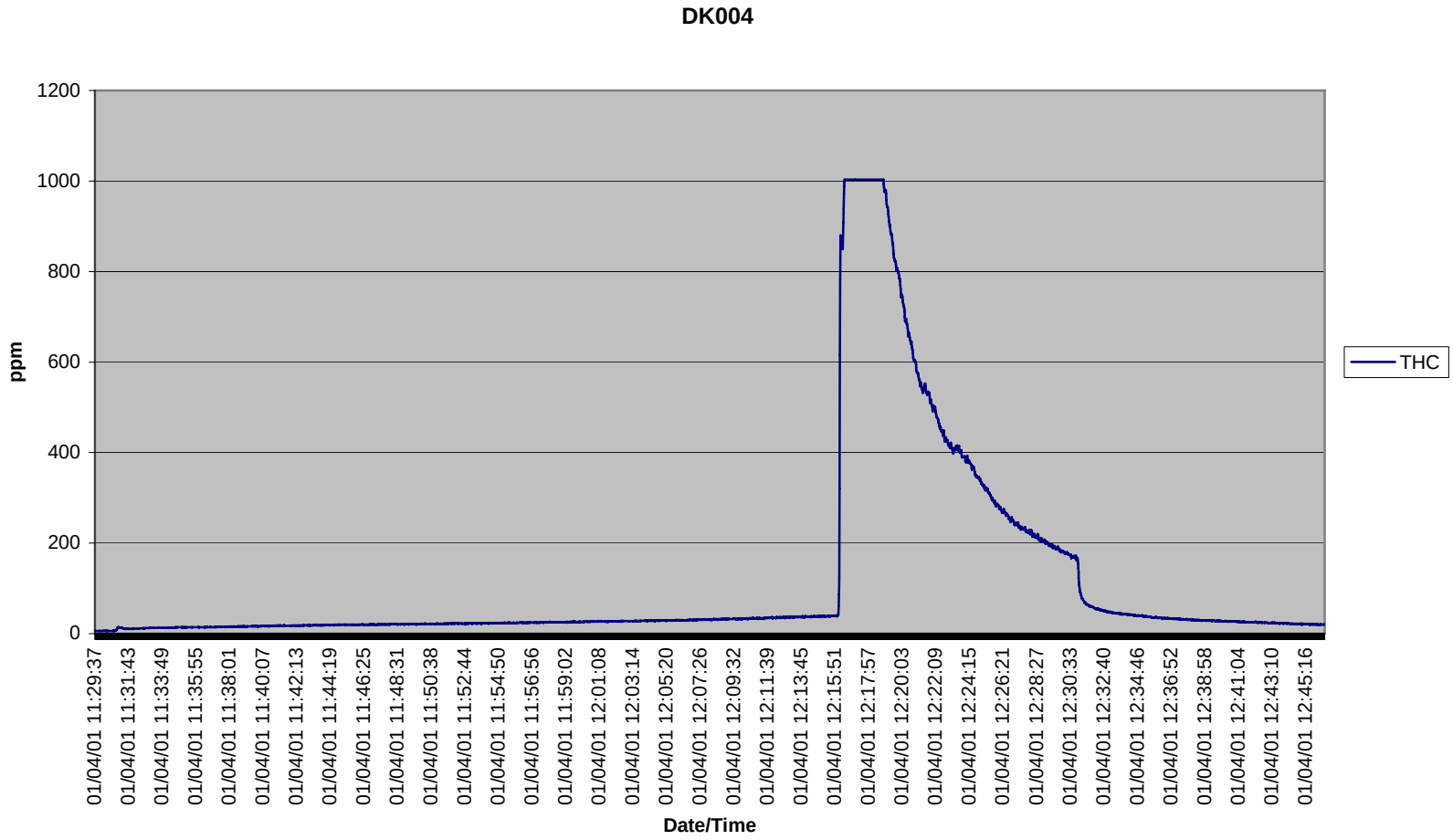
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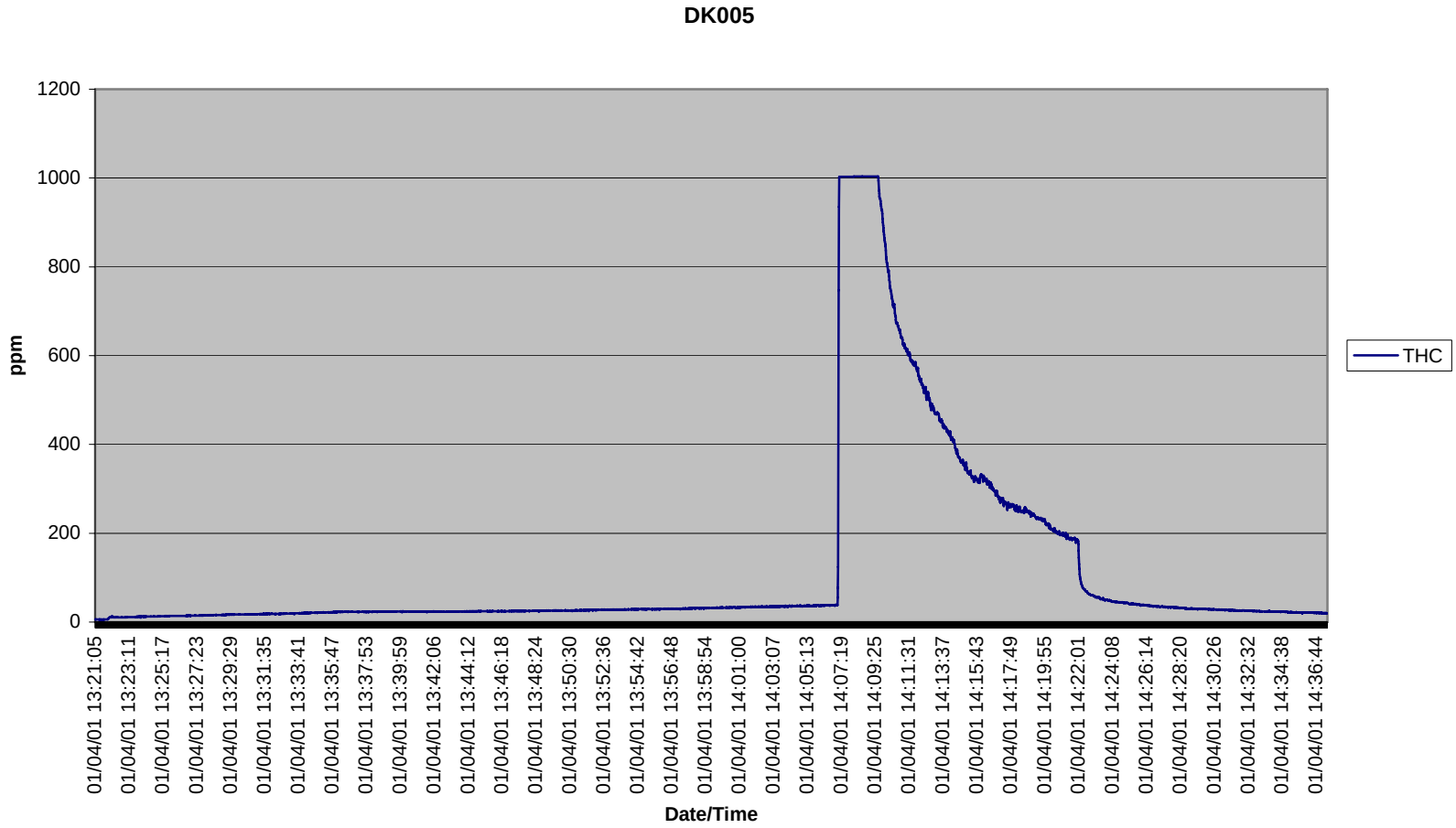
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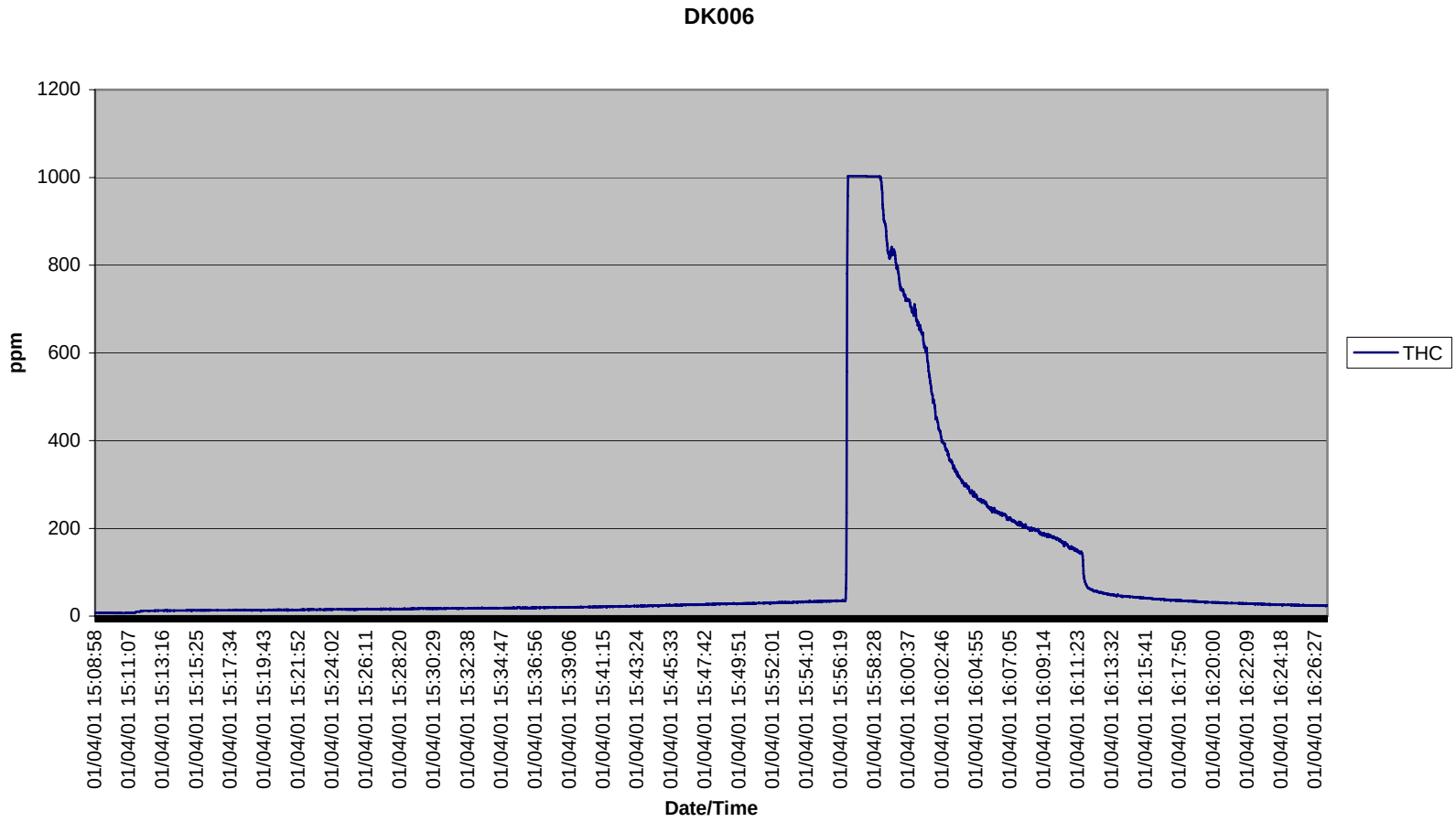
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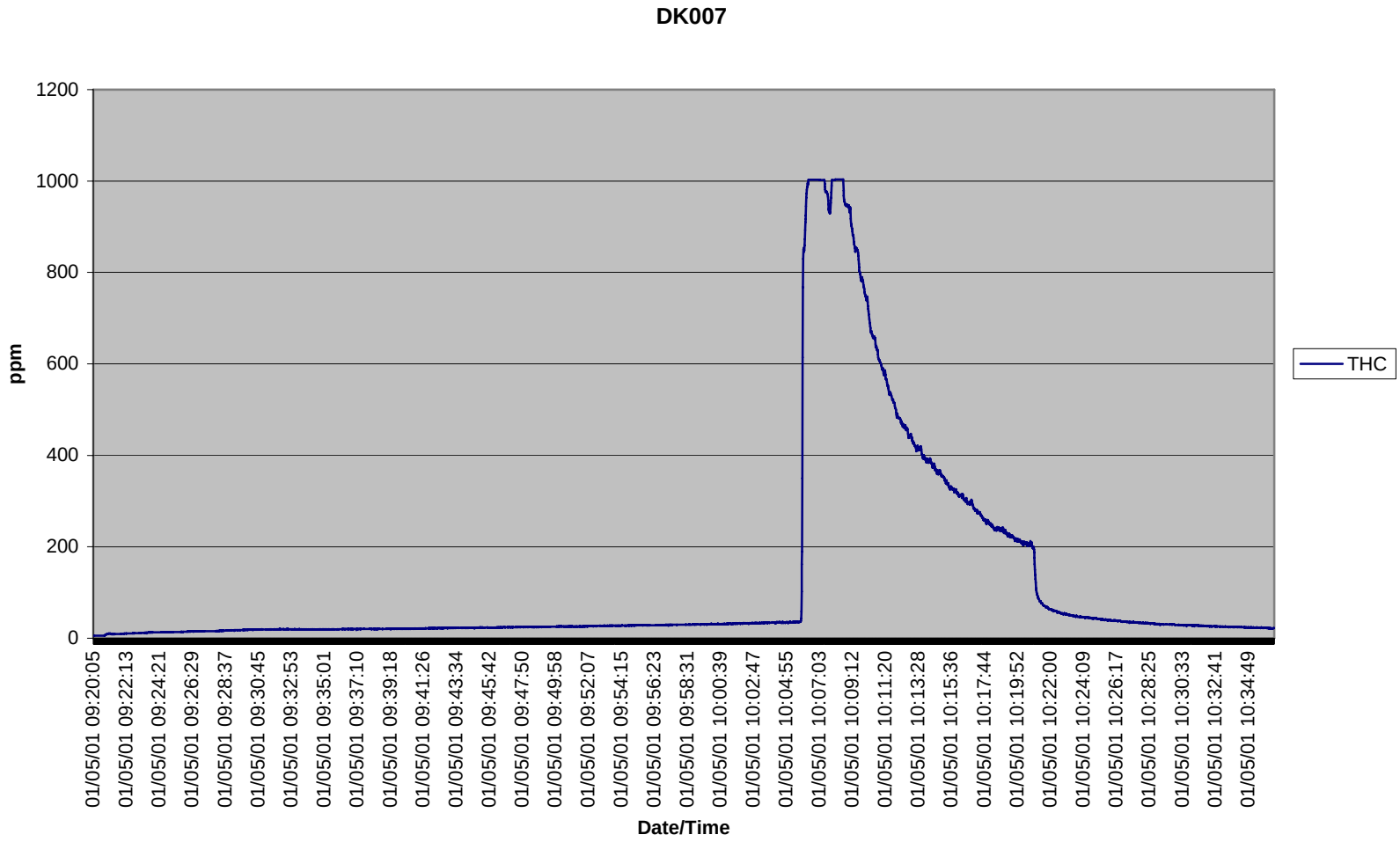
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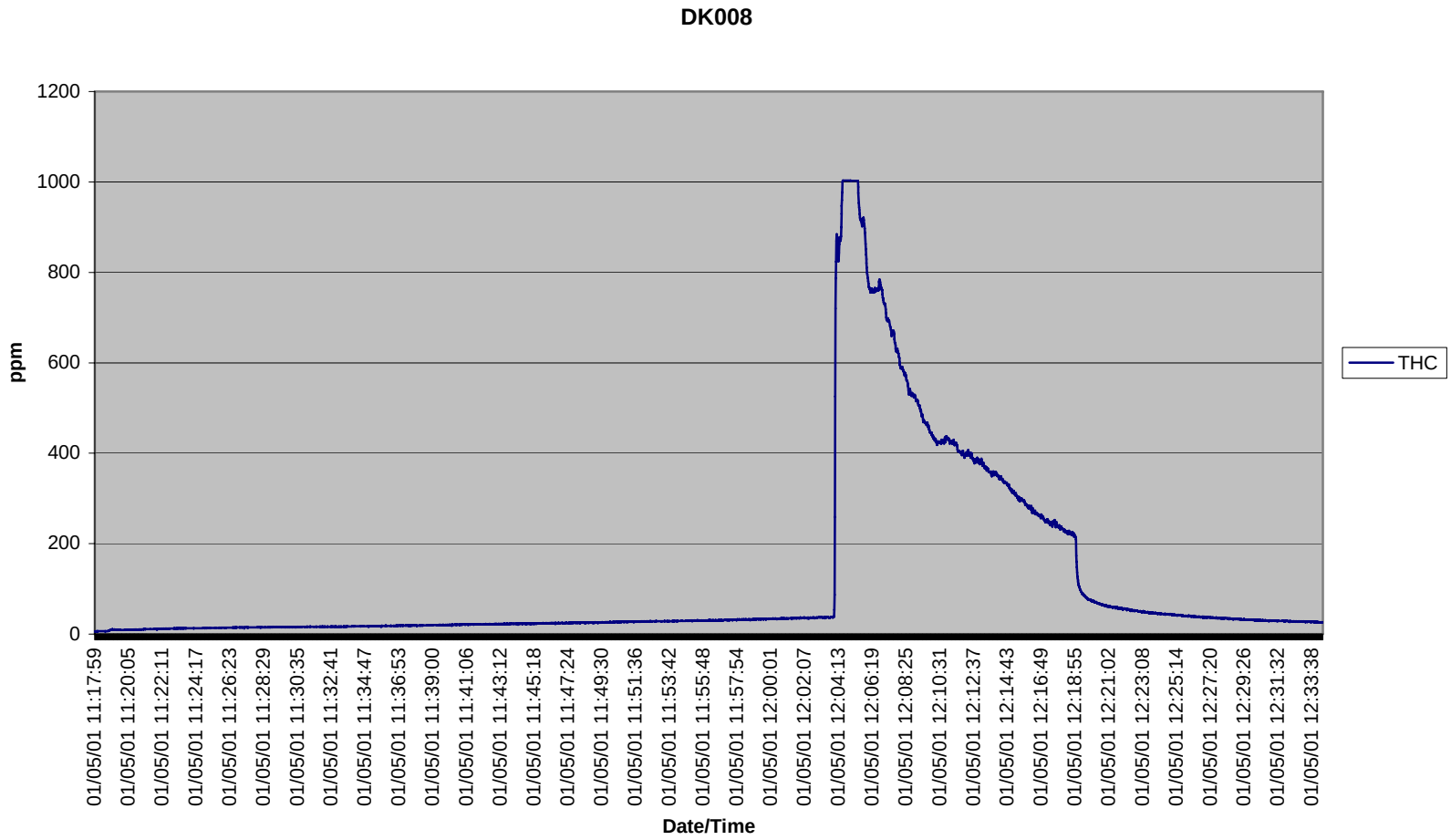
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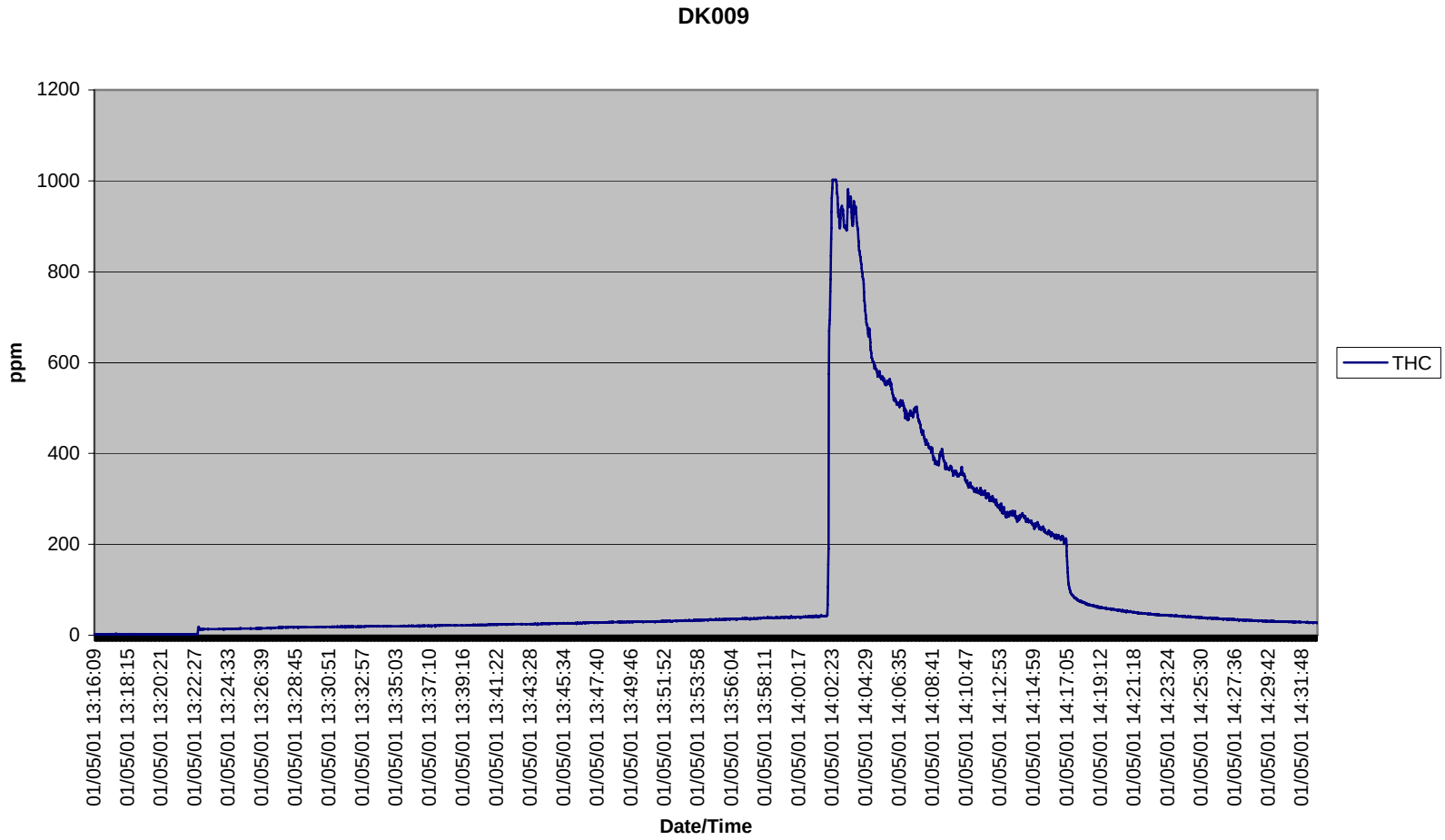
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## Appendix E Validation Log (Available in Hard Copy Only)

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# Appendix F  Listing of Support Documents

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# Listing of Support Documents

The following documents contain specific test results, procedures, and documentation used in support of this Test Plan

1. Casting Emission Reduction Program – Foundry Product Testing Guide: Reducing Emissions by Comparative Testing, May 4, 1998.

2. CERP Emissions Testing and Analytical Testing Standard Operating Procedures.

3. Emission Baseline Test Results for the CERP Pre-Production Foundry Processes.

4. Evaluation of the Required Number of Replicate Tests to Provide Statistically Significant Air Emission Reduction Comparisons for the CERP Pre-Production Foundry Test Program.

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# Appendix G Glossary

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## Glossary

**t-Test** The calculated T statistic, Ts, is compared against a table value. The table value is a function of the sample size and on the level of confidence desired. For tests with nine sample values each, the T value associated with a confidence level of 95% is 2.12. Calculated values of Ts greater than or equal to this value would indicate that there is 95% or better probability that the differences between the two test series were not the result of test variability.

**ND** Non Detect; No Data

**No Test** Lab testing was not done on this analyte.

**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.

**POM** Polycyclic Organic Matter (POM) including Naphthalene and other compounds that contain more than one benzene ring and have a boiling point greater than or equal to 100 degrees Celsius.

**LOI** Loss of Ignition. LOI represents the change in weight of a sample expressed as % of the original dry weight as a consequence of combustion in air at the test temperature of 1400˚F.