Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

SOURCE TESTING--EPA TASK NO. 10
ETB TEST NO. 72-MM-14

Emissions From A Primary Lead Smelter Blast Furnace At

AMERICAN SMELTING AND REFINING COMPANY
Glover, Missouri

By
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Midwest Research Institute
EPA Contract No. 68-02-0228
(MRI Project No. 3585-C, Task 11)

For

Emission Measurements Branch
Emission Standards and Engineering Division
Office of Air Programs
Environmental Protection Agency
Research Triangle Park, North Carolina

Attn: Mr. Clyde E. Riley

PREFACE

The work reported herein was conducted by Midwest Research Institute (MRI), pursuant to Task Order No. 10 issued by the Environmental Protection Agency (EPA), under the terms of EPA Contract No. 68-02-0228 entitled "Field Sampling of Atmospheric Emissions, Field Testing to Determine Efficiencies of Control Equipment, and Chemical Analysis of Collected Atmospheric Emissions From Various Industries."

Mr. Robert C. Tussey, Jr. served as Principal Investigator and directed the field team consisting of: Messrs. Robert Stultz, Edward Cartwright, Robert Conkling, Henry Moloney, Edward Trompeter, Gary Kelso, and Reid Flippin. Mr. Mike Hammons assisted in a portion of field activities and performed pollutant analyses at the MRI laboratories under the direction of Mr. Fred Bergman.

Mr. Clyde E. (Gene) Riley served as testing Project Officer for EPA. He was assisted by Mr. Joe Bazes. Mr. Charles H. Darvin, EPA, was responsible for process control, monitoring, and reporting as presented in this document.

Approved for:

MIDWEST RESEARCH INSTITUTE

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6 January 1973

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II. INTRODUCTION

Under the Clean Air Act, as amended, the Environmental Protection Agency is charged with the establishment of performance standards for new installations or modifications of existing installations in stationary source categories which may contribute significantly to air pollution. A performance standard is a standard for emissions of air pollutants which reflects the best emission control or process systems that have been adequately demonstrated during full-scale production.

The development of realistic performance standards requires accurate data on pollutant emissions within the various source categories. In the primary lead smelting industry, the blast furnace baghouse of the American Smelting and Refining Company (ASARCO) plant in Glover, Missouri, was selected by EPA as representative of a well-controlled operation, and was thereby selected for the emission testing program. This report presents the results of testing and analysis performed during May 1972 by Midwest Research Institute and sample analysis performed by EPA and Battelle, Columbus Laboratories under contract to EPA.

The following sections of this document present: (1) the summary of results; (2) a description of task performance; (3) a process description; (4) the location of sampling points; (5) a description of process operating characteristics during testing as written by EPA; and sampling and analytical procedures.

III. SUMMARY OF RESULTS

Table I presents a summary of combined particulate emissions from all three stacks for each of three testing runs performed on the blast furnace baghouse. Arithmetic average values are presented for temperatures, percent moisture, percent isokinetic, and grain loadings, while other values are combined stack totals. Tables II, III, and IV present, respectively,summaries for Stack 1, 2, and 3 for the three runs. The Table I summary is based on this data. Percent isokinetic for the nine particulate tests varied from 90.2 (Run 1-1) to 99.1 (Run 3-1).

As expected, the flow rate varied considerably from stack-to-stack and from run-to-run due to bag filter "cake" buildup and subsequent cleaning and to dilution damper and water spray chamber variations to control temperature. Grain loading varied more than expected even allowing for variable dilution damper operation. The flowrate in dry standard cubic feet per minute (DSCFM) by stack varied from 34,122 (Run 2-Stack 1) to 50,228 (Run 2-Stack 1). The total flow rate (3 stacks combined per run) varied from 118,858 DSCFM to 131,515 DSCFM which indicates reasonable overall baghouse flow consistency. The grain loading (total particulate catch) in grains per DSCF by stack varied from 0.0124 to 0.0398 while the total varied from 0.0172 to 0.0236. The percent of particulate in the impingers varied from 48.8 for Run 1 to 73.3 for Run 3. The total particulate emission rate varied from 17.65 lb/hr (Run 3) to 27.25 lb/hr (Run 1).

TABLE I

SUMMARY OF COMBINED PARTICULATE EMISSIONS FROM ALL THREE STACKS[e]

	1	2	3
Run Number			
Volume of Gas, Sampled, DSCF[a]	251.19	246.95	239.65
Percent Moisture by Volume	3.67	4.57	4.66
Average Stack Temperature, °F	137	136	145
Stack Volumetric Flow Rate, DSCFM[b]	131,515	126,800	118,858
Stack Volumetric Flow Rate, ACFM[c]	158,629	154,205	146,375
Percent Isokinetic	92.7	94.2	98.1
Particulates - Probe, Cyclone, and Filter Catch			
mg	198.54	114.17	71.58
gr/DSCF	0.0120	0.0071	0.0045
gr/ACF	0.0099	0.0058	0.0037
lb/hr	14.02	7.80	4.74
Particulates - Total Catch			
mg	387.53	324.32	268.13
gr/DSCF	0.0236	0.0202	0.0172
gr/ACF	0.0196	0.0165	0.0140
lb/hr	27.25	22.16	17.65
Percent impinger catch	48.8	64.8	73.3
Lead Emissions - Probe, Cyclone, and Filter Catch			
mg	5.926	17.378	8.325
gr/DSCF	0.000344	0.00106	0.000523
gr/ACF	0.000285	0.000868	0.000425
lb/hr	0.412	1.18	0.556
Lead Emissions - Total Catch			
mg	6.534	17.721	8.860
gr/DSCF	0.000381	0.00108	0.000557
gr/ACF	0.000316	0.000889	0.000~~435~~ 453
lb/hr	0.454	1.21	0.591
Percent Lead in Front Half Particulate Catch	2.98	15.2	11.6
Percent Lead in Impinger Particulate Catch	0.322	0.163	0.272
Percent Lead in Total Particulate Catch[d]	1.69	5.46	3.30

a/ Dry standard cubic feet at 70°F, 29.92 in. Hg.
b/ Dry standard cubic feet per minute at 70°F, 29.92 in. Hg.
c/ Actual cubic feet per minute.
d/ The efficiency of collection of specific elements, including lead, for the EPA particulate Method 5 has not been determined.

TABLE II

SUMMARY OF EMISSIONS - STACK NO. 1

	1-1[d]	2-1	3-1
Run Number			
Date	5-16-72	5-16-72	5-17-72
Volume of Gas Sampled, DSCF[a]	83.63	97.93	75.39
Percent Moisture by Volume	3.8	4.3	4.6
Average Stack Temperature, °F	~~128~~ 137	134	149
Stack Volumetric Flow Rate, DSCFM[b]	45,023	50,228	36,914
Stack Volumetric Flow Rate, ACFM[c]	54,430	60,712	45,638
Percent Isokinetic	90.2	94.0	99.1
Particulates - Probe, Cyclone, and Filter Catch			
mg	138.61	49.65	23.74
gr/DSCF	0.0256	0.0079	0.0048
gr/ACF	0.0212	0.0065	0.0039
lb/hr	9.89	3.40	1.54
Particulates - Total Catch			
mg	215.36	129.30	85.~~79~~97
gr/DSCF	0.0398	0.0206	0.0176
gr/ACF	0.0329	0.0170	0.0142
lb/hr	15.40	8.85	5.55
Percent Impinger Catch	35.6	61.6	72.4
Lead Emissions - Probe, Cyclone, and Filter Catch			
mg	2.435	11.270	2.090
gr/DSCF	0.000449	0.00177	0.000427
gr/ACF	0.000371	0.00147	0.000345
lb/hr	0.173	0.765	0.135
Lead Emissions - Total Catch			
mg	2.615	11.393	2.310
gr/DSCF	0.000482	0.00179	0.000472
gr/ACF	0.000399	0.00149	0.000381
lb/hr	0.186	00.775	0.149
Percent Lead in Front Half Particulate Catch	1.76	22.7	8.80
Percent Lead in Impinger Particulate Catch	0.235	0.154	0.354
Percent Lead in Total Particulate Catch[e]	1.21	8.81	2.69

a/ Dry standard cubic feet at 70°F, 29.92 in. Hg.
b/ Dry standard cubic feet per minute at 70°F, 29.92 in. Hg.
c/ Actual cubic feet per minute.
d/ Run number-stack number
e/ The efficiency of collection of specific elements including lead, for the EPA particulate Method 5 has not been determined.

TABLE III

SUMMARY OF EMISSIONS - STACK NO. 2

	1-2[d]	2-2	3-2
Run Number			
Date	5-16-72	5-16-72	5-17-72
Volume of Gas Sampled, DSCF[a]	93.72	66.43	85.26
Percent Moisture by Volume	3.6	4.9	4.9
Average Stack Temperature, °F	137	141	142
Stack Volumetric Flow Rate, DSCFM[b]	48,792	34,122	44,391
Stack Volumetric Flow Rate, ACFM[c]	58,781	42,011	54,555
Percent Isokinetic	92.6	94.6	93.1
Particulates - Probe, Cyclone, and Filter Catch			
mg	42.68	32.97	29.15
gr/DSCF	0.0071	0.0076	0.0053
gr/ACF	0.0058	0.0062	0.0043
lb/hr	2.97	2.24	2.02
Particulates - Total Catch			
mg	112.94	75.98	102.03
gr/DSCF	0.0188	0.0176	0.0185
gr/ACF	0.0156	0.0143	0.0151
lb/hr	7.85	5.17	7.05
Percent Impinger Catch	62.2	56.5	71.4
Lead Emissions - Probe, Cyclone, and Filter Catch			
mg	3.235	5.683	5.220
gr/DSCF	0.000529	0.00132	0.000943
gr/ACF	0.000440	0.00107	0.000768
lb/hr	0.222	0.385	0.359
Lead Emissions - Total Catch			
mg	3.463	5.768	5.390
gr/DSCF	0.000566	0.00134	0.000974
gr/ACF	0.000471	0.00109	0.000793
lb/hr	0.237	0.392	0.371
Percent Lead in Front Half Particulate Catch	7.58	17.2	17.9
Percent Lead in Impinger Particulate Catch	0.325	0.198	0.233
Percent Lead in Total Particulate Catch[e]	3.07	7.59	5.28

a/ Dry standard cubic feet at 70°F, 29.92 in. Hg.
b/ Dry standard cubic feet per minute at 70°F, 29.92 in. Hg.
c/ Actual cubic feet per minute.
d/ Run number-stack number.
e/ The efficiency of collection of specific elements including lead, for the EPA particulate Method 5 has not been determined.

TABLE IV

SUMMARY OF EMISSIONS - STACK NO. 3

	1-3[d]	2-3	3-3
Run Number			
Date	5-16-72	5-16-72	5-17-72
Volume of Gas Sampled, DSCF[a]	73.84	82.59	79.00
Percent Moisture by Volume	3.6	4.5	4.5
Average Stack Temperature, °F	137	135	145
Stack Volumetric Flow, DSCFM[b]	37,700	42,450	37,553
Stack Volumetric Flow Rate, ACFM[c]	45,518	51,482	46,182
Percent Isokinetic	95.3	94.1	102.1
Particulates - Probe, Cyclone, and Filter Catch			
mg	17.25	31.55	18.69
gr/DSCF	0.0036	0.0059	0.0036
gr/ACF	0.0029	0.0049	0.0029
lb/hr	1.16	2.16	1.18
Particulates - Total Catch			
mg	59.23	119.04	80.13
gr/DSCF	0.0124	0.0224	0.0156
gr/ACF	0.0103	0.0184	0.0127
lb/hr	4.00	8.14	5.05
Percent Impinger Catch	70.9	73.5	76.7
Lead Emissions - Probe, Cyclone, and Filter Catch			
mg	0.256	0.425	1.015
gr/DSCF	0.0000534	0.0000793	0.000198
gr/ACF	0.0000443	0.0000654	0.000161
lb/hr	0.0174	0.0289	0.0620
Lead Emissions - Total Catch			
mg	0.456	0.560	1.160
gr/DSCF	0.0000952	0.000104	0.000226
gr/ACF	0.0000790	0.0000~~826~~ 862	0.000184
lb/hr	0.0309	0.0383	0.0707
Percent Lead in Front Half Particulate Catch	1.48	1.35	5.43
Percent Lead in Impinger Particulate Catch	0.476	0.154	0.236
Percent Lead in Total Particulate Catch[e]	0.770	0.470	1.45

a/ Dry standard cubic feet at 70°F, 29.92 in. Hg.
b/ Dry standard cubic feet per minute at 70°F, 29.92 in. Hg.
c/ Actual cubic feet per minute.
d/ Run number-stack number.
e/ The efficiency of collection of specific elements including lead for the EPA particulate Method 5 has not been determined.

Particulate samples (and sample-train components) were analyzed for lead and trace elements by EPA/OAP and Battelle Columbus Laboratories. Lead content percentage, grain loadings, and emission rates were calculated and are also presented in Tables I, II, III, and IV. The percent lead in the total particulate catch (combined baghouse emissions) varied from 1.69 (Run 1) to 5.46 (Run 2). The "front half" of the particulate train consistently "caught" most lead mass. The lead emission rate varied from 0.454 lb/hr (Run 1) to 1.21 lb/hr (Run 2). Emission rates for trace elements were not calculated.

The carrier gas composition remained reasonably consistent for each run as indicated in Table V. However, SO_2 concentration varied from 359 ppm (Run 2) to 479 ppm (Run 3).

TABLE V

SUMMARY OF GASEOUS TESTING

A. Carrier Gases

	Gas Composition (Vol. % Dry)			
	CO_2	O_2	CO	N_2
Run 1	1.5	19.0	2.3	77.2
Run 2	1.4	19.1	2.4	77.1
Run 3	1.6	19.3	2.3	76.8

B. Sulfur Dioxide[a/]

Dynascience Continous Monitor

	ppm SO_2, by volume (70°F)
Run 1	372
Run 2	359
Run 3	479

a/ SO_2 monitoring and data reduction by EPA.

IV. PROGRAM PERFORMANCE

A pretest site survey visit was conducted by Mr. Tussey (MRI) and Mr. Riley (EPA) on 25 April 1972. Appropriate process operating and stack configuration parameters were evaluated and incorporated in test design. After the visit by MRI, the testing program along with specifications for equipment and manpower support facilities were summarized in a presurvey report (Appendix L) submitted to EPA on 8 May 1972.

The sampling tasks consisted of three separate runs for particulates (EPA Method 5) on three baghouse stacks simultaneously, for a total of nine tests. Orsat samples were also required for gas density calculations. EPA/OAP personnel operated a continuous SO_2 monitor and recorder during Method 5 testing.

MRI contracted ASARCO to erect personnel and equipment-support platforms on each stack. On 12 May 1972 the MRI field team arrived at the plant site and initiated equipment setup. ASARCO, pursuant to MRI design, erected angle-iron sampling "rail" supports on the square stacks to facilitate probe movement from port-to-port and conserve manpower. The field "laboratory" consisting of a walk-in enclosed truck van was also setup and sampling equipment was prepared.

All three stacks were tested simultaneously by three independent teams. Two runs (6 tests) were completed on 16 May and the remaining run (3 tests) was completed on 17 May 1972. Since the baghouse bag cleaning

system consisted of closing off an entire compartment (six total) for a brief period for vibration cleaning, testing on stacks (two compartments per stack) serving compartments being cleaned was interrupted until cycle completion. Sampling was continued on EPA order when visible emissions compared again with precleaning conditions.

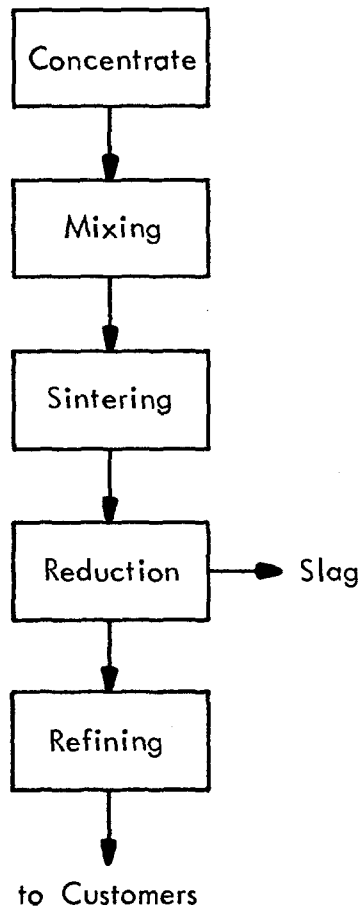
Sampling was performed pursuant to procedures presented in the Federal Register, Vol. 36, No. 247, 23 December 1971. Methods referred to by number in this report refer to this reference. A complete particulate sample train (Method 5) was utilized and the impinger(s) content was analyzed to determine particulate catch. MRI performed all sample analysis for particulate emission rates determination. Trace metals analysis by optical emission spectrography was performed by Battelle Columbus Laboratories (Contract No. 68-02-0447). High lead content samples were checked for lead by atomic absorption spectrophotometry, also by Battelle. EPA/OAP also conducted atomic absorption spectrophotometry analysis for lead for each portion of the nine particulate tests.

V. PROCESS DESCRIPTION

This smelter was designed by ASARCO and built by Kaiser Engineering. It is a custom smelter in that all ore is purchased from other companies. It has a design capacity of 90,000 tons of lead per year and started production in 1968. Presently, this smelter is operating only 5 days per week, but is producing at a 90,000 tons per year rate. The average inlet concentrate analysis is 70-75% lead, 2-1/2% zinc, and 1% copper (see Appendix L and Figure 1).

The blast furnace of Australian step jacket design has a production rate of 300 tons per day. The product bullion and slag are removed continuously from the furnace. Sinter, coke, and other fluxing materials which are stored in charge bins are proportioned by means of controlled feeders into hopper cars which deliver the charge to the blast furnace. Gases from the tapping and furnace operation are combined and sent to a six-chamber baghouse for particulate control and recovery.

The blast furnace gases are cooled by the addition of dilution air and by being pressed through a water spray chamber before going to the baghouse. Lime is added to the carrier gas prior to the baghouse to aid in collection efficiency and to retard ignition of collected dust.



Source: As provided by EPA/OAP

Figure 1 - ASARCO, Glover, Lead Smelter Flow Diagram

The six-compartment baghouse (total cloth area 77,000 ft^2) has an inlet gas rate of 131,000 ACFM at 137°F (air-to-cloth ratio of 1.7 or 2.0 ACFM per square feet with one compartment being cleaned). Gases from the baghouse are vented through three 48 ft stacks (top of inlet breeching to top of stack) with each stack serving two compartments.

The bags in each compartment are mechanically vibrated for cleaning. A damper is closed to prevent flow while vibrating and left closed for ~ 20 sec after vibration to allow particulate settling. Compartments are cleaned on a rotation basis when the pressure drop across the baghouse exceeds a designated value. If cleaning one compartment fails to lower the pressure drop enough to satisfy the preset value, the next compartment is cleaned.

The collected dust from the blast furnace operation usually contains a high percentage of lead and appreciable quantities of cadmium and arsenic. Normally, the dust is burned or charred and recycled back to the sintering machine.

VI. LOCATION OF SAMPLING POINTS

Figure 2 presents a top view and profile view of the baghouse and stacks. Sample ports were located ~ 4 1/2 diameters (36 ft, 6 in.) from the top of the breeching. The stack outlet was ~ 2 diameters (11 ft, 6 in.) from the ports. Figure 2 also illustrates the positioning of the support platforms and the rail support installed to reduce time in moving equipment from port-to-port.

Figure 3 presents the sampling port-point configuration determined from EPA Method 1. Four ports on each stack are numbered from south-to-north. Eight sample points on each traverse are numbered from east-to-west. A total of 32 points in each stack (each stack is identical in testing configuration) were sampled for 4 min at each point.

Orsat samples were taken from a port located at roof level. An integrated sample was drawn from Stack 3 for Run 1. Evacuated bulb (sample through) samples were taken from Stack 3 for Runs 2 and 3. An evacuated bulb sample was also taken from Stack 2 on Run 3 for a check on uniform gas baghouse concentration.

The continuous sample for the SO_2 monitoring instrument was drawn from Stack 1 at roof level.

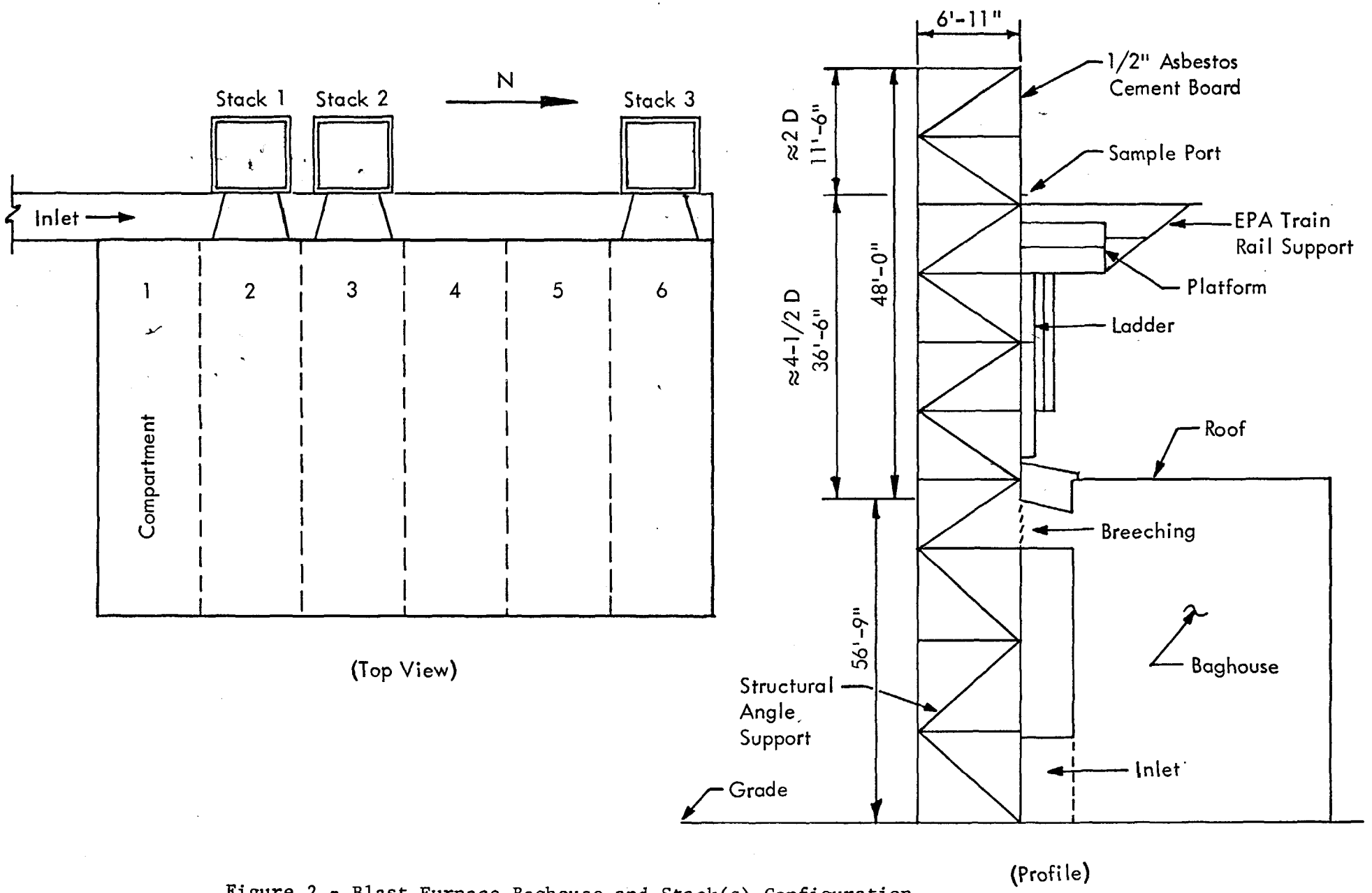


Figure 2 - Blast Furnace Baghouse and Stack(s) Configuration

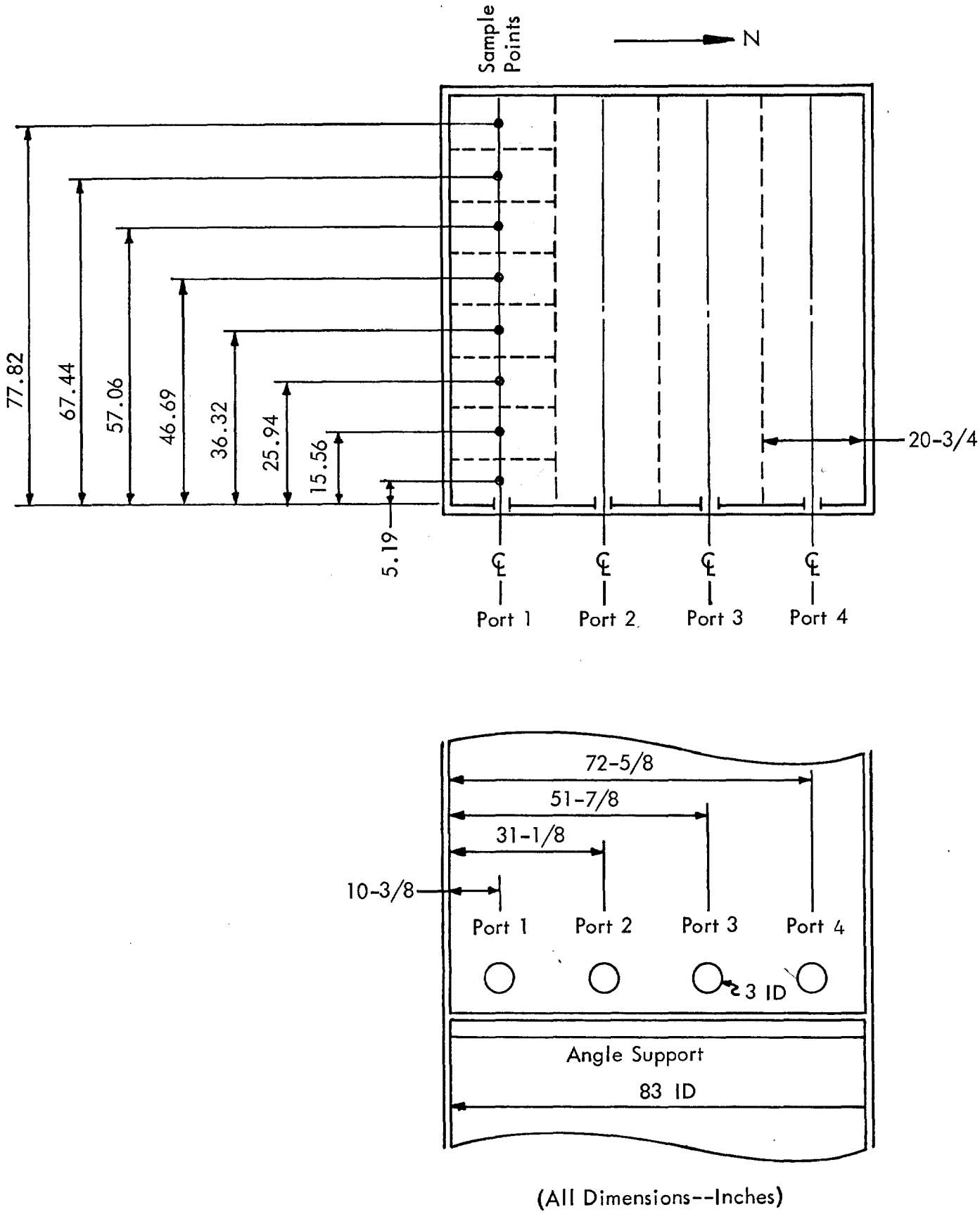


Figure 3 - Sample Port-Point Configuration

VII. PROCESS OPERATIONS[1/]

Just prior to the testing program, the blast furnace and baghouse operations had been shut down for maintenance repair.

A meeting was held on May 15, 1972 between EPA and ASARCO personnel in which discussions were held concerning the blast furnace and baghouse operations. The purpose of the meeting was to make sure all process equipment would be performing normally during the source testing program. It was stated by ASARCO personnel that operational variations were considered to be within normal limits and that the No. 1 and No. 2 baghouse compartments contained all new bags, with the remaining compartments having been inspected and checked for any visible bag leakage during the shut down. Routine baghouse maintenance is usually performed once per day. It was pointed out, however, that the baghouse fan located on the inlet side showed signs of excessive vibration. This was considered normal for a fan that is positioned in a moist gas stream before a collector. The vibration was caused by the accumulation of moist dust particles adhering to the fan blades, resulting in a buildup of deposits which were being thrown into the connecting duct work.

Due to the nature of the blast furnace process, periodic slow downs or "pull backs" are a common occurrence. During a "pull back," the charge and air flow to the blast furnace is reduced so as to eliminate

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1/ Written and supplied by EPA/OAP.

"slips." Slips are caused by arching of the furnace charge as it slides down into the settler. As the arch breaks, the burden materials slip into the void. There is a rush of gas to the top of the furnace, which develops abnormally high pressures, much greater than can be handled through the gas-cleaning equipment. Dynamite may also be used to eliminate slips by blasting the arch before it becomes too large. It was decided not to test during a "pull back" because of the possibility of a slip. One "pull back" occurred during the testing program on May 16, 1972. Testing was discontinued during this period until normal operation could be resumed.

The operations at the blast furnace were monitored from the systems control room by Mr. C. Darvin of EPA. From this vantage point, Mr. Darvin was able to collect data and communicate any upsets or abnormalities during the testing periods to the test crew via a two-way radio. Data recorded included feed times and rates, production rates, and other additional information related to the furnace and baghouse operation (Appendix C tabulates this information).

From the control gages anticipation of the forthcoming pressure-actuated cleaning cycle could be relayed to the test crew. Plans called for the sampling to cease when the associated compartment was being cleaned. It is believed that all tests were carried out during operational periods, however, it is possible that a test may have included a short segment of a cleaning cycle.

The blast furnace was operated at a feed rate of approximately one hopper car per 25 min. Each car contained ~ 14 tons of sinter and 1.25 tons of coke. Iron, fluxing materials, litharge, and refinery by-products were added periodically to the charge when required.

There were some fluctuations in the furnace and baghouse operation during testing, but these were all considered to be within normal operational limits (for additional details see Appendix C).

Opacity readings were taken by Mr. Darvin approximately twice hourly with values for each of the three stacks averaging less than 10%. However, immediately after shaking, opacity readings increased to as much as 15% for a period of ~ 2 min.

VIII. SAMPLING AND ANALYTICAL PROCEDURES

Particulate sampling was performed pursuant to methods presented in the Federal Register, Vol. 36, No. 247, 23 December 1971. Sample recovery and analysis, however, were performed pursuant to Method 5 of the 17 August 1971, Vol. 36, No. 159 issue of the Federal Register in that the impinger portion of the total particulate catch was analyzed and included in emissions calculations.

Standard Research Appliance Company (RAC) equipment (console and sample box) with MRI modifications, was used for particulate sampling. The 8-ft glass-lined probe was fabricated by MRI. The number of sample points and ports agree with method requirements. A standard, glass-fiber filter (RAC) and glass-frit filter support (RAC) was used.

Sampling was started simultaneously on all three stacks. After starting, however, testing was not synchronized on a port-point basis due to different port-to-port transfer times and due to different shutdown periods by stack for bag cleaning. Each stack console would shut down alone during its associated compartment cleaning cycle. The unit would start again on the same port-point and complete the 4-min sample on that point after EPA/OAP instructions that the cycle was complete.

According to EPA/OAP, sampling during a baghouse cleaning cycle was as follows for a single compartment:

1. Main damper closes on one of the six compartments - sampling was stopped only on the associated stack.

2. Time period of cleaning cycle - 45 sec.

3. Main damper opens - definite increase of emissions for a period of 2 to 3 min due to no reverse air system as a part of the operation; wait 2 min each time a damper opens.

4. After 2-min period - visible emissions compare again with precleaning conditions. After this, another 2-min waiting period was observed.

5. After second 2-min period - resume sampling.

Thus, the total console downtime for a cleaning cycle was ~ 5 min.

Sample boxes were leak checked at the truck lab after assembly for sampling. Prior to at least one run (2-3), a leak check was also performed at the truck through the entire train (probe tip through pumps). High sensitivity manometers (0-0.25 in. H_2O) were used during low flow rates.

An integrated, carrier-gas sample was collected (Method 3) on Stack 3 during Run 1, for Orsat analysis of gas composition. Because of the time required to setup and operate this unit, a grab sample was collected during Run 2 at the same location on the same day (presumably at the same blast furnace operating rate) to compare the grab-method results with the integrated-method results and determine the acceptability of the grab method. As Table V indicates the values agreed well enough to allow continued use of the grab procedure. The procedure consisted of purging a sample line

of stainless steel tubing in the stack and tygon tubing connected to a 250-ml glass flask for several minutes, then evacuating the flask several times, and finally sampling through the flask for 5-10 min. Glass wool in the stainless steel tube acted as a prefilter.

During Run 3 grab samples were collected for both Stack 2 and Stack 3. Analysis revealed little difference, indicating acceptable carrier gas mixing prior to the sampling points thus validating the use of only one stack for gas sampling during each run. A new oxygen solution (O_x sorbent) was added to the Orsat after the first run, since the solution was suspect.

After completing sampling, the "sample box" was allowed to cool. Then the probe was removed and the probe tip and ball-joint ends of the probe as well as the socket inlet to the cyclone bypass were plugged using plastic caps. These units were placed in protective cases and then transferred to the truck lab for sample removal and cleanup. The probe inserts were brush cleaned using a stainless steel cleaning rod. The glass insert was left in place (sheathed) for sample removal and cleaning. A visual inspection was performed before and after sample removal to detect breaks in the glass tube. One tube was broken during cleanup (Run 3-2); however, the break occurred near the tip (rod insert end) after brushing from the tip end. Thus, the sample had been collected from the break area prior to its having been broken. Apparently, the cleaning rod was inserted off center, causing the break.

Samples were stored in glass containers and these containers were numbered as indicated in Appendix G. The volume of condensate and water in the first three impingers were measured and recorded. The impingers (and connecting glassware) were then water washed and the washings were added to the collected water. Finally the impingers were rinsed with acetone, which was also retained for mass analysis. An ultrasonic cleaner was used to aid in sample removal from the cyclone bypass, the probe tip and glass connections.

Analysis was performed at MRI pursuant to the stated method. Acetone washings were evaporated in covered beakers under an operating laboratory hood at room conditions. Water washings were evaporated on a steam bath under the same conditions. The filters along with the above evaporation residues were desiccated to constant weights (see Appendix F). Weight and volume results are reported on the last sheet of the field data form. Appendix I presents analysis data and results. Appendix A presents data (including analysis results input data) and sampling summary results for particulate tests performed.

The probe used with the SO_2 Dynascience instrument was a 1/4 in. ID by 36 in. long stainless steel tube.2/ The stainless steel tube was connected to the instrument via a polyethylene tube. Glass wool placed in this tube was replaced after each run. Observations of the glass wool after each run showed that it was heavily loaded with particulate.

2/ This paragraph was supplied by EPA/OAP.

Warm-up time for the instrument was usually 1 hr. Flow rates ranged between 0.5 and 1.0 standard cubic feet per hour throughout the test periods. The instrument was calibrated on 3 May 1972, to a curve based on 25% of scale reading. This was done by using a calibration gas of 985 ppm SO_2. Zero setting was 7.0 and span gas was 8.2 (see Appendix B).

APPENDIX A

PARTICULATE DATA AND SAMPLING RESULTS

This Appendix contains sampling and analysis data and results, example calculations, and a listing of field data for each run.

TABLE A-I

PARTICULATE EMISSION DATA

NAME	DESCRIPTION	UNITS	1-1	1-2	1-3
	DATE OF RUN		5-16-72	5-16-72	5-16-72
DN	PROBE TIP DIAMETER	IN	.375	.375	.375
TT	NET TIME OF RUN	MIN	128.0	128.0	128.0
PB	BAROMETRIC PRESSURE	IN.HG	29.03	29.03	29.03
PM	AVG ORIFICE PRES DROP	IN.H2O	1.988	2.309	1.369
VM	VOL DRY GAS-METER COND	DCF	92.20	102.10	79.28
TM	AVG GAS METER TEMP	DEG.F	109.7	103.4	93.9
VMSTD	VOL DRY GAS-STD COND	DSCF	83.63	93.72	73.84
VW	TOTAL H2O COLLECTED	ML	66.6	73.2	57.6
VWV	VOL H2O VAPOR-STD COND	SCF	3.25	3.47	2.73
PWOS	PERCENT MOISTURE BY VOL		3.8	3.6	3.6
MD	MOLE FRACTION DRY GAS		.962	.964	.964
PCO2	PERCENT CO2 BY VOL, DRY		1.5	1.5	1.5
PO2	PERCENT O2 BY VOL. DRY		19.0	19.0	19.0
PCO	PERCENT CO BY VOL, DRY		2.3	2.3	2.3
PN2	PERCENT N2 BY VOL, DRY		77.2	77.2	77.2
MWD	MOLECULAR WT-DRY STK GAS		29.00	29.00	29.00
MW	MOLECULAR WT-STK GAS		28.59	28.60	28.61
CP	PITOT TUBE COEFFICIENT		.850	.850	.850
DPS	AVG STK VELOCITY HEAD	IN.H2O	.104	.125	.070
TS	AVG STACK TEMPERATURE	DEG.F	138.2	137.0	137.2
NP	NET SAMPLING POINTS		32	32	32
PST	STATIC PRES OF STACK	IN.HG	-.00	-.00	-.01
PS	STACK PRESSURE. ABSOLUTE	IN.HG	29.03	29.03	29.02
VS	AVG STACK GAS VELOCITY	FPM	1138	1229	949
AS	STACK AREA	IN2	6889	6889	6889
QS	STK FLOWRATE, DRY,STD CN	DSCFM	45023	48792	37700
QA	ACTUAL STACK FLOWRATE	ACFM	54430	58781	45418
PERI	PERCENT ISOKINETIC		90.2	92.6	95.3
B	ANISO CORRECTION FACTOR		1.000	1.000	1.000
MF	PARTICULATE WT-PARTIAL	MG	138.61	42.68	17.25
MT	PARTICULATE WT-TOTAL	MG	215.36	112.94	59.23
IC	PERC IMPINGER CATCH		35.6	62.2	70.9
CAN	PART. LOAD-PTL,STD CN	GR/DSCF	.02566	.00710	.00361
CAO	PART. LOAD-TTL,STD CN	GR/DSCF	.03986	.01879	.01239
CAT	PART. LOAD-PTL,STK CN	GR/ACF	.02121	.00589	.00299
CAU	PART. LOAD-TTL,STK CN	GR/ACF	.03295	.01559	.01028
CAW	PARTIC EMIS-PARTIAL	LB/HR	9.89	2.97	1.16
CAX	PARTIC EMIS-TOTAL	LB/HR	15.37	7.85	4.00
EA	PERCENT EXCESS AIR		705.3	705.3	705.3

TABLE A-I (Continued)

NAME	DESCRIPTION	UNITS	2-1	2-2	2-3
	DATE OF RUN		5-16-72	5-16-72	5-16-72
DN	PROBE TIP DIAMETER	IN	.375	.375	.375
TT	NET TIME OF RUN	MIN	128.0	128.0	128.0
PB	BAROMETRIC PRESSURE	IN.HG	29.00	29.00	29.00
PM	AVG ORIFICE PRES DROP	IN.H2O	2.786	1.043	1.859
VM	VOL DRY GAS-METER COND	DCF	106.88	72.01	89.19
TM	AVG GAS METER TEMP	DEG.F	104.5	98.2	97.2
VMSTD	VOL DRY GAS-STD COND	DSCF	97.93	66.43	82.59
VW	TOTAL H2O COLLECTED	ML	91.0	72.5	81.0
VWV	VOL H2O VAPOR-STD COND	SCF	4.31	3.44	3.84
PMOS	PERCENT MOISTURE BY VOL		4.3	4.9	4.5
MD	MOLE FRACTION DRY GAS		.957	.951	.955
PCO2	PERCENT CO2 BY VOL, DRY		1.4	1.4	1.4
PO2	PERCENT O2 BY VOL, DRY		19.1	19.1	19.1
PCO	PERCENT CO BY VOL, DRY		2.4	2.4	2.4
PN2	PERCENT N2 BY VOL, DRY		77.1	77.1	77.1
MWD	MOLECULAR WT-DRY STK GAS		28.99	28.99	28.99
MW	MOLECULAR WT-STK GAS		28.52	28.45	28.50
CP	PITOT TUBE COEFFICIENT		.850	.850	.850
DPS	AVG STK VELOCITY HEAD	IN.H2O	.135	.061	.095
TS	AVG STACK TEMPERATURE	DEG.F	134.3	141.2	135.0
NP	NET SAMPLING POINTS		32	32	32
PST	STATIC PRES OF STACK	IN.HG	-.00	-.00	-.00
PS	STACK PRESSURE, ABSOLUTE	IN.HG	29.00	29.00	29.00
VS	AVG STACK GAS VELOCITY	FPM	1269	878	1076
AS	STACK AREA	IN2	6889	6889	6889
QS	STK FLOWRATE, DRY,STD CN	DSCFM	50228	34122	42450
QA	ACTUAL STACK FLOWRATE	ACFM	60712	42011	51482
PERI	PERCENT ISOKINETIC		94.0	94.6	94.1
B	ANISO CORRECTION FACTOR		1.000	1.000	1.000
MF	PARTICULATE WT-PARTIAL	MG	49.65	32.97	31.55
MT	PARTICULATE WT-TOTAL	MG	129.30	75.98	119.04
IC	PERC IMPINGER CATCH		61.6	56.6	73.5
CAN	PART. LOAD-PTL,STD CN	GR/DSCF	.00790	.00767	.00593
CAO	PART. LOAD-TTL,STD CN	GR/DSCF	.02057	.01768	.02238
CAT	PART. LOAD-PTL,STK CN	GR/ACF	.00653	.00623	.00489
CAU	PART. LOAD-TTL,STK CN	GR/ACF	.01701	.01435	.01844
CAW	PARTIC EMIS-PARTIAL	LB/HR	3.40	2.24	2.16
CAX	PARTIC EMIS-TOTAL	LB/HR	8.85	5.17	8.14
EA	PERCENT EXCESS AIR		729.3	729.3	729.3

TABLE A-I (Concluded)

NAME	DESCRIPTION	UNITS	3-1	3-2	3-3
	DATE OF RUN		5-17-72	5-17-72	5-17-72
DN	PROBE TIP DIAMETER	IN	.375	.375	.375
TT	NET TIME OF RUN	MIN	128.0	128.0	128.0
PB	BAROMETRIC PRESSURE	IN.HG	29.13	29.13	29.13
PM	AVG ORIFICE PRES DROP	IN.H2O	1.406	1.725	1.524
VM	VOL DRY GAS-METER COND	DCF	81.16	91.04	84.16
TM	AVG GAS METER TEMP	DEG.F	97.3	93.3	91.7
VMSTD	VOL DRY GAS-STD COND	DSCF	75.39	85.26	79.00
VW	TOTAL H2O COLLECTED	ML	75.9	93.0	78.6
VWV	VOL H2O VAPOR-STD COND	SCF	3.60	4.41	3.73
PMOS	PERCENT MOISTURE BY VOL		4.6	4.9	4.5
MD	MOLE FRACTION DRY GAS		.954	.951	.955
PCO2	PERCENT CO2 BY VOL, DRY		1.6	1.6	1.4
PO2	PERCENT O2 BY VOL, DRY		19.3	19.3	18.9
PCO	PERCENT CO BY VOL, DRY		2.3	2.3	2.3
PN2	PERCENT N2 BY VOL, DRY		76.8	76.8	77.4
MWD	MOLECULAR WT-DRY STK GAS		29.03	29.03	28.98
MW	MOLECULAR WT-STK GAS		28.52	28.48	28.48
CP	PITOT TUBE COEFFICIENT		.850	.850	.850
DPS	AVG STK VELOCITY HEAD	IN.H2O	.069	.108	.071
TS	AVG STACK TEMPERATURE	DEG.F	148.6	142.7	145.6
NP	NET SAMPLING POINTS		32	32	32
PST	STATIC PRES OF STACK	IN.HG	-.00	-.00	-.01
PS	STACK PRESSURE, ABSOLUTE	IN.HG	29.13	29.13	29.12
VS	AVG STACK GAS VELOCITY	FPM	954	1140	965
AS	STACK AREA	IN2	6889	6889	6889
QS	STK FLOWRATE, DRY,STD CN	DSCFM	36914	44391	37553
QA	ACTUAL STACK FLOWRATE	ACFM	45638	54555	46182
PERI	PERCENT ISOKINETIC		99.1	93.1	102.1
B	ANISO CORRECTION FACTOR		1.000	1.000	1.000
MF	PARTICULATE WT-PARTIAL	MG	23.74	29.15	18.69
MT	PARTICULATE WT-TOTAL	MG	85.79	102.03	80.13
IC	PERC IMPINGER CATCH		72.3	71.4	76.7
CAN	PART. LOAD-PTL,STD CN	GR/DSCF	.00487	.00530	.00366
CAO	PART. LOAD-TTL,STD CN	GR/DSCF	.01762	.01855	.01570
CAT	PART. LOAD-PTL,STK CN	GR/ACF	.00394	.00431	.00298
CAU	PART. LOAD-TTL,STK CN	GR/ACF	.01424	.01508	.01276
CAW	PARTIC EMIS-PARTIAL	LB/HR	1.54	2.02	1.18
CAX	PARTIC EMIS-TOTAL	LB/HR	5.57	7.05	5.05
EA	PERCENT EXCESS AIR		854.0	854.0	661.4

EXAMPLE PARTICULATE CALCULATIONS

Run (1-1)

1. VOLUME OF DRY GAS SAMPLED AT STANDARD CONDITIONS

$$VMSTD = \frac{17.71*VM*(PB + PM/13.6)}{TM+460.}$$

$$= \frac{17.71*\ 92.20*(29.03+\ 1.988/13.6)}{109.7+460.} = 83.63\ DSCF^{a/}$$

2. VOLUME OF WATER VAPOR AT STANDARD CONDITIONS

$$VWV = 0.0474*VW = 0.0474*\ 68.6 = 3.25\ SCF^{b/}$$

3. PERCENT MOISTURE IN STACK GAS

$$PMOS = \frac{100.*VWV}{VMSTD+VWV} = \frac{100.*\ 3.25}{83.63+\ 3.25} = 3.8\ PERCENT$$

4. MOLE FRACTION OF DRY STACK GAS

$$MD = \frac{100.-PMOS}{100.} = \frac{100.-\ 3.8}{100.} = .962$$

5. AVERAGE MOLECULAR WEIGHT OF DRY STACK GAS

$$MWD = (PCO2 * 44/100) + (PO2 * 32/100) + (PN2+PCO * 28/100)$$

$$= (1.5 * 44/100) + (19.0 * 32/100) + (79.5 * 28/100) = 29.00$$

6. MOLECULAR WEIGHT OF STACK GAS

$$MW = MWD*MD + 18*(1-MD)$$

$$= 29.0*\ .962 + 18*(1-\ .962) = 28.59$$

7. STACK GAS VELOCITY AT STACK CONDITIONS

```
VS    =  4360* SQRT(DPS* (TS+460)) *
             SQRT(1/(PS*MW))

      =  4360* SQRT(    .104*( 138.2+460))
            *SQRT(1/(29.03*    28.59))      =        1138 FPM[c/]
```

8. STACK GAS VOLUMETRIC FLOW AT STANDARD CONDITIONS, DRY BASIS

```
                0.123*VS*AS*MD*PS
QS    =  -------------------
                   TS+460

                0.123*  1138*  6889* .962*29.03
      =  -------------------------------
                      138.2 +460
                                                =        45023 DSCFM[d/]
```

9. STACK GAS VOLUMETRIC FLOW AT STACK CONDITIONS

```
                QS * (TS+460)
QA    =  -----------------
                17.71 * PS * MD

                 45023*( 138.2+460)
      =  ---------------------                  =        54430 ACFM
                17.71*29.03* .962
```

10. PERCENT ISOKINETIC AND ANISO CORRECTION FACTOR

```
                1032*(TS+460)*VMSTD
PERI  =  ---------------------
                VS*TT*PS*MD*(DN*DN)

                1032*( 138.2+460)*    83.63
      =  ------------------------------  =        90.2 PERCENT
                 1138* 128.0*29.03* .962* .375
                                        * .375

B     =                                           1.000[e/]
```

11. PARTICULATE LOADING -- PROBE, CYCLONE, AND FILTER
(AT STANDARD CONDITIONS)

CAN = 0.0154 * (MF/VMSTD) * B

= 0.0154*(138.61/ 83.63)*1.000 = .02566 GR/DSCF[f/]

12. PARTICULATE LOADING -- TOTAL
(AT STANDARD CONDITIONS)

CAO = 0.0154 * (MT/VMSTD) * B

= 0.0154*(215.36/ 83.63)*1.000 = .03986 GR/DSCF

13. PARTICULATE LOADING -- PROBE, CYCLONE, AND FILTER
(AT STACK CONDITIONS)

$$CAT = \frac{17.71*CAN*PS*MD}{TS+460}$$

$$= \frac{17.71* .0257*29.03* .962}{138.2+460} = .02121 \text{ GR/ACF}$$

14. PARTICULATE LOADING -- TOTAL
(AT STACK CONDITIONS)

$$CAU = \frac{17.71*CAO*PS*MD}{TS+460}$$

$$= \frac{17.71* .0399*29.03* .962}{138.2+460} = .03295 \text{ GR/ACF}$$

---

a/ Dry standard cubic feet at 70°F, 29.92 in. Hg.
b/ Standard conditions at 70°F, 29.92 in. Hg.
c/ Determined by averaging velocity from each sample point.
d/ Dry standard cubic feet per minute.
e/ Correction factor for anisokinetic sampling (not used).
f/ Grains per dry standard cubic foot.

15. PARTICULATE EMISSION RATE
-- PROBE, CYCLONE, AND FILTER

CAW = 0.00857*CAN*QS

= 0.00857* .0257* 45023 = 9.89 LB/HR

16. PARTICULATE EMISSION RATE
-- TOTAL

CAX = 0.00857*CAO*QS

= 0.00857* .0399* 45023 = 15.37 LB/HR

17. PERCENT EXCESS AIR AT SAMPLING POINT

$$EA = \frac{100. * (PO2-0.5*PCO)}{0.264*PN2-PO2+0.5*PCO}$$

$$= \frac{100. *(19.0-0.5* 2.3)}{0.264*77.2-19.0+0.5* 2.3} = 705.3 \text{ PERCENT}$$

TABLE A-II

PARTICULATE DATA AND CALCULATED VALUES

RUN- 1-1 DATE- 5-16-72

ATMOS TEMP (DG.F)	ATMOS PRES (I.HG)	STACK VAC (I.H2O)	H2O COND (ML)	PARTIC WT-PTL (MG)	PARTIC WT-TTL (MG)	STACK AREA (FT2)	INIT VOL (DCF)	PERC O2 DRY	PERC CO2 DRY	PERC CO DRY	PITOT TUBE COEF
55.0	29.03	.03	68.6	138.61	215.36	47.84	504.53	19.0	1.5	2.3	.850

PORT- POINT		SAMP TIME (MIN)	METER VOL (DCF)	DELTA P (I.H2O)	DELTA H (I.H2O)	TEMP IN (D.F)	TEMP OUT (D.F)	TRAIN VAC (I.HG)	STACK TEMP (D.F)	BOX TEMP (D.F)	PROBE T DIA (IN)	VEL (FPM)
1	1	4.00	506.60	.046	.890	81.0	81.0	3.6	115.0		.375	778.1
1	2	4.00	508.87	.060	1.170	88.0	84.0	4.0	124.0		.375	895.6
1	3	4.00	511.21	.075	1.460	91.0	85.0	4.8	120.0		.375	997.8
1	4	4.00	513.74	.100	1.940	90.0	85.0	4.8	128.0		.375	1160.1
1	5	4.00	516.71	.093	1.810	95.0	86.0	5.2	138.0		.375	1128.3
1	6	4.00	521.29	.260	5.000	104.0	87.0	12.0	143.0		.375	1894.3
1	7	4.00	526.99	.255	4.900	115.0	90.0	12.1	140.0	73.0	.375	1871.4
1	8	4.00	529.70	.200	2.850	124.0	94.0	7.4	134.0		.375	1649.0
2	1	4.00	533.01	.120	2.310	111.0	96.0	6.1	120.0		.375	1262.2
2	2	4.00	536.31	.130	2.500	119.0	98.0	6.5	126.0		.375	1320.5
2	3	4.00	539.66	.140	2.700	124.0	100.0	7.0	135.0		.375	1380.8
2	4	4.00	543.67	.165	3.200	127.0	101.0	7.8	141.0	73.0	.375	1506.6
2	5	4.00	547.45	.160	3.100	128.0	102.0	7.7	152.0		.375	1497.1
2	6	4.00	551.75	.200	3.900	128.0	102.0	9.0	155.0	72.0	.375	1677.9
2	7	4.00	556.18	.240	4.600	127.0	102.0	10.9	136.0		.375	1809.4
2	8	4.00	560.16	.180	3.500	132.0	102.0	8.0	125.0		.375	1552.5
3	1	4.00	562.35	.080	1.600	112.0	102.0	4.2	133.0		.375	1042.0
3	2	4.00	564.42	.039	.760	111.0	102.0	3.2	135.0		.375	728.8
3	3	4.00	566.72	.060	1.190	118.0	103.0	4.0	138.0		.375	906.2
3	4	4.00	569.10	.060	1.190	123.0	104.0	4.0	139.0		.375	907.0
3	5	4.00	571.54	.065	1.250	127.0	105.0	4.0	140.0	72.0	.375	944.8
3	6	4.00	574.20	.075	1.480	128.0	106.0	4.5	140.0		.375	1014.9
3	7	4.00	576.88	.075	1.480	131.0	108.0	4.6	141.0		.375	1015.7
3	8	4.00	579.60	.075	1.480	136.0	109.0	4.6	146.0		.375	1020.0
4	1	4.00	581.37	.030	.590	128.0	109.0	3.0	149.0		.375	646.7
4	2	4.00	583.30	.043	.840	126.0	110.0	3.5	150.0		.375	774.8
4	3	4.00	585.38	.040	.780	125.0	111.0	3.5	151.0		.375	747.9
4	4	4.00	587.50	.045	.880	126.0	111.0	3.5	151.0		.375	793.3
4	5	4.00	589.69	.043	.840	130.0	112.0	3.5	151.0		.375	775.5
4	6	4.00	592.05	.060	1.150	130.0	112.0	4.0	149.0	76.0	.375	914.5
4	7	4.00	594.42	.060	1.150	129.0	112.0	4.0	140.0		.375	907.7
4	8	4.00	596.73	.058	1.120	132.0	112.0	4.0	132.0		.375	886.5

TABLE A-II (Continued)

RUN- 1-2 DATE- 5-16-72

ATMOS TEMP (DG.F)	ATMOS PRES (I.HG)	STACK VAC (I.H2O)	H2O COND (ML)	PARTIC WT-PTL (MG)	PARTIC WT-TTL (MG)	STACK AREA (FT2)	INIT VOL (DCF)	PERC O2 DRY	PERC CO2 DRY	PERC CO DRY	PITC TUE COE
65.0	29.03	.02	73.2	42.68	112.94	47.84	19.82	19.0	1.5	2.3	.85

PORT-POINT		SAMP TIME (MIN)	METER[a/] VOL (DCF)	DELTA P (I.H2O)	DELTA H (I.H2O)	TEMP IN (D.F)	TEMP OUT (D.F)	TRAIN VAC (I.HG)	STACK TEMP (D.F)	BOX TEMP (D.F)	PROBE T DIA (IN)	VEL (FPM)
1	1	4.00	22.01	.050	.960	80.0	80.0	3.5	125.0		.375	818.0
1	2	4.00	24.45	.075	1.470	84.0	80.0	4.5	135.0		.375	1010.4
1	3	4.00	27.04	.067	1.200	84.0	83.0	4.5	142.0		.375	960.6
1	4	4.00	29.55	.065	1.210	85.0	83.0	4.2	135.0		.375	940.6
1	5	4.00	32.20	.080	1.530	89.0	84.0	5.5	150.0	75.0	.375	1056.6
1	6	4.00	34.21	.032	.610	96.0	85.0	3.0	155.0		.375	671.0
1	7	4.00	36.41	.050	.930	99.0	86.0	4.0	147.0		.375	833.2
1	8	4.00	38.62	.047	.880	103.0	87.0	3.7	150.0		.375	809.8
2	1	4.00	40.83	.047	.880	98.0	89.0	3.7	128.0		.375	795.1
2	2	4.00	43.05	.047	.880	103.0	90.0	4.0	125.0		.375	793.1
2	3	4.00	45.17	.042	.790	106.0	91.0	3.5	120.0		.375	746.5
2	4	4.00	47.33	.040	.750	108.0	93.0	3.2	126.0		.375	732.3
2	5	4.00	49.35	.042	.840	110.0	94.0	3.5	131.0		.375	753.5
2	6	4.00	51.83	.055	1.050	110.0	95.0	4.0	132.0	85.0	.375	863.0
2	7	4.00	54.01	.058	.990	110.0	95.0	3.7	130.0		.375	884.8
2	8	4.00	56.65	.080	1.420	110.0	96.0	4.5	122.0		.375	1032.0
3	1	4.00	58.74	.045	.900	108.0	96.0	3.7	118.0		.375	771.4
3	2	4.00	60.94	.055	1.050	108.0	97.0	4.0	120.0		.375	854.2
3	3	4.00	64.76	.260	4.810	108.0	96.0	12.0	124.0		.375	1863.7
3	4	4.00	69.69	.270	4.970	121.0	97.0	14.0	120.0		.375	1892.7
3	5	4.00	74.69	.245	4.520	130.0	99.0	11.0	138.0		.375	1830.7
3	6	4.00	79.28	.240	4.450	130.0	101.0	9.2	125.0		.375	1792.1
3	7	4.00	84.03	.250	4.650	130.0	105.0	9.8	127.0		.375	1832.2
3	8	4.00	88.58	.220	4.120	134.0	103.0	8.2	126.0		.375	1717.3
4	1	4.00	92.43	.150	2.810	123.0	104.0	6.1	156.0		.375	1453.9
4	2	4.00	96.37	.180	3.380	124.0	104.0	7.5	151.0		.375	1586.1
4	3	4.00	100.40	.180	3.350	125.0	104.0	7.1	159.0		.375	1596.5
4	4	4.00	104.78	.225	4.100	126.0	105.0	8.8	160.0		.375	1786.4
4	5	4.00	109.20	.220	4.000	130.0	106.0	8.8	151.0		.375	1753.5
4	6	4.00	113.54	.200	3.700	134.0	107.0	8.1	150.0		.375	1670.6
4	7	4.00	117.75	.200	3.360	130.0	107.0	7.5	142.0		.375	1659.6
4	8	4.00	121.92	.180	3.320	132.0	107.0	7.5	129.0		.375	1557.3

a/ The meter volume readings used in calculations have been adjusted to allow for different initial readings when transferring from port-to-port due to new leak checks and meter momentum (this run only).

TABLE A-II (Continued)

RUN- 1-3 DATE- 5-16-72

ATMOS TEMP (DG.F)	ATMOS PRES (I.HG)	STACK VAC (I.H2O)	H2O COND (ML)	PARTIC WT-PTL (MG)	PARTIC WT-TTL (MG)	STACK AREA (FT2)	INIT VOL (DCF)	PERC O2 DRY	PERC CO2 DRY	PERC CO DRY	PITOT TUBE COEF
65.0	29.03	.08	57.6	17.25	59.23	47.84	707.77	19.0	1.5	2.3	.85(

PORT-POINT		SAMP TIME (MIN)	METER VOL (DCF)	DELTA P (I.H2O)	DELTA H (I.H2O)	TEMP IN (D.F)	TEMP OUT (D.F)	TRAIN VAC (I.HG)	STACK TEMP (D.F)	BOX TEMP (D.F)	PROBE T DIA (IN)	VEL (FPM)
1	1	4.00	710.17	.090	1.740	73.0	74.0	5.8	127.0		.375	1099.3
1	2	4.00	713.21	.125	2.430	81.0	77.0	8.5	144.0		.375	1314.2
1	3	4.00	716.43	.115	2.210	80.0	79.0	8.0	128.0		.375	1243.7
1	4	4.00	719.62	.120	2.300	82.0	79.0	8.0	125.0		.375	1267.2
1	5	4.00	722.67	.080	1.580	84.0	80.0	6.1	143.0		.375	1050.5
1	6	4.00	726.21	.140	2.700	92.0	81.0	9.5	142.0	65.0	.375	1388.5
1	7	4.00	729.38	.113	2.200	100.0	82.0	8.0	141.0		.375	1246.4
1	8	4.00	732.35	.095	1.850	103.0	84.0	7.0	142.0		.375	1143.8
2	1	4.00	734.90	.073	1.420	94.0	86.0	6.0	128.0		.375	990.9
2	2	4.00	737.60	.082	1.600	98.0	87.0	6.0	127.0		.375	1049.3
2	3	4.00	740.46	.092	1.790	102.0	88.0	6.7	132.0		.375	1116.2
2	4	4.00	743.43	.098	1.900	106.0	89.0	7.0	137.0		.375	1156.9
2	5	4.00	746.39	.095	1.850	108.0	90.0	7.0	143.0	65.0	.375	1144.7
2	6	4.00	749.46	.095	1.850	107.0	91.0	7.0	148.0		.375	1149.5
2	7	4.00	752.76	.120	2.300	107.0	92.0	8.0	142.0		.375	1285.5
2	8	4.00	755.93	.100	1.930	110.0	92.0	7.0	132.0		.375	1163.7
3	1	4.00	758.18	.070	1.370	94.0	90.0	5.8	122.0		.375	965.4
3	2	4.00	760.04	.035	.690	97.0	90.0	4.0	121.0		.375	682.0
3	3	4.00	762.04	.043	.830	102.0	91.0	4.2	128.0		.375	760.5
3	4	4.00	764.05	.043	.830	102.0	92.0	4.5	130.0		.375	761.8
3	5	4.00	765.95	.035	.690	104.0	92.0	4.0	132.0	70.0	.375	688.5
3	6	4.00	767.93	.038	.740	102.0	93.0	4.2	132.0		.375	717.4
3	7	4.00	769.99	.043	.830	103.0	93.0	4.4	135.0		.375	765.0
3	8	4.00	772.14	.049	.945	107.0	94.0	4.4	140.0		.375	820.1
4	1	4.00	773.72	.018	.358	96.0	94.0	3.2	142.0		.375	497.9
4	2	4.00	775.35	.029	.573	98.0	94.0	3.3	152.0		.375	637.2
4	3	4.00	777.22	.033	.648	100.0	94.0	4.0	152.0		.375	679.7
4	4	4.00	779.11	.035	.685	104.0	95.0	4.0	153.0		.375	700.6
4	5	4.00	781.00	.034	.670	105.0	95.0	4.0	152.0		.375	689.9
4	6	4.00	782.95	.037	.730	105.0	96.0	4.2	143.0	70.0	.375	714.4
4	7	4.00	784.93	.038	.740	108.0	96.0	4.2	140.0		.375	722.2
4	8	4.00	787.05	.043	.833	109.0	97.0	4.5	138.0		.375	767.0

TABLE A-II (Continued)

RUN- 2-1 DATE- 5-16-72

ATMOS TEMP (DG.F)	ATMOS PRES (I.HG)	STACK VAC (I.H2O)	H2O COND (ML)	PARTIC WT-PTL (MG)	PARTIC WT-TTL (MG)	STACK AREA (FT2)	INIT VOL (DCF)	PERC O2 DRY	PERC CO2 DRY	PERC CO DRY	PITOT TUBE COEF
85.0	29.00	.03	91.0	49.65	129.30	47.84	596.83	19.1	1.4	2.4	.850

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTA P (I.H2O)	DELTA H (I.H2O)	TEMP IN (D.F)	TEMP OUT (D.F)	TRAIN VAC (I.HG)	STACK TEMP (D.F)	BOX TEMP (D.F)	PROBE T DIA (IN)	VEL (FPM)
4 1	4.00	599.01	.050	1.000	85.0	89.0	3.9	149.0		.375	836.3
4 2	4.00	601.62	.070	1.400	89.0	88.0	4.9	146.0		.375	987.0
4 3	4.00	604.30	.075	1.500	94.0	88.0	4.5	130.0		.375	1008.1
4 4	4.00	606.97	.075	1.500	101.0	88.0	4.5	130.0		.375	1008.1
4 5	4.00	609.58	.070	1.400	107.0	88.0	4.5	141.0		.375	983.0
4 6	4.00	612.25	.075	1.500	114.0	88.0	4.8	152.0		.375	1026.7
4 7	4.00	615.00	.080	1.610	119.0	89.0	5.0	165.0	68.0	.375	1071.6
4 8	4.00	617.92	.092	1.820	123.0	90.0	5.5	150.0		.375	1135.3
3 1	4.00	620.54	.073	1.450	113.0	92.0	4.5	138.0		.375	1001.3
3 2	4.00	623.41	.090	1.800	116.0	92.0	5.2	132.0		.375	1106.2
3 3	4.00	626.32	.085	1.720	120.0	93.0	5.2	131.0		.375	1074.1
3 4	4.00	629.27	.092	1.850	119.0	94.0	5.5	136.0		.375	1122.2
3 5	4.00	631.62	.075	1.500	121.0	94.0	4.8	140.0		.375	1016.6
3 6	4.00	633.85	.050	1.000	116.0	94.0	4.0	137.0	63.0	.375	828.0
3 7	4.00	636.13	.052	1.010	115.0	94.0	4.0	139.0		.375	845.8
3 8	4.00	638.71	.067	1.320	115.0	94.0	4.5	142.0		.375	962.5
2 1	4.00	640.96	.055	1.100	104.0	93.0	4.0	104.0		.375	844.0
2 2	4.00	643.35	.063	1.250	107.0	93.0	4.3	103.0		.375	902.5
2 3	4.00	646.10	.078	1.550	111.0	93.0	4.8	105.0		.375	1006.0
2 4	4.00	649.10	.098	1.950	114.0	93.0	5.7	102.0		.375	1124.7
2 5	4.00	652.06	.097	1.920	118.0	93.0	5.6	102.0	61.0	.375	1118.9
2 6	4.00	654.94	.088	1.750	122.0	93.0	5.4	110.0		.375	1073.3
2 7	4.00	659.61	.420	8.500	120.0	93.0	16.0	105.0		.375	2334.5
2 8	4.00	664.84	.320	6.100	117.0	94.0	10.5	98.0		.375	2025.1
1 1	4.00	668.95	.019	3.800	114.0	94.0	6.7	145.0		.375	513.8
1 2	4.00	673.55	.230	4.500	123.0	94.0	7.7	150.0		.375	1795.0
1 3	4.00	678.43	.265	5.150	127.0	94.0	8.5	153.0		.375	1931.5
1 4	4.00	683.54	.300	5.900	130.0	95.0	10.0	159.0		.375	2065.2
1 5	4.00	688.78	.295	5.800	130.0	96.0	9.8	158.0		.375	2046.2
1 6	4.00	694.11	.310	6.300	137.0	97.0	10.6	145.0	60.0	.375	2075.4
1 7	4.00	699.28	.300	5.900	142.0	98.0	10.2	130.0		.375	2016.2
1 8	4.00	703.71	.220	4.300	137.0	100.0	7.5	129.0		.375	1725.1

TABLE A-II (Continued)

RUN- 2-2 DATE- 5-16-72

ATMOS TEMP (DG.F)	ATMOS PRES (I.HG)	STACK VAC (I.H2O)	H2O COND (ML)	PARTIC WT-PTL (MG)	PARTIC WT-TTL (MG)	STACK AREA (FT2)	INIT VOL (DCF)	PERC O2 DRY	PERC CO2 DRY	PERC CO DRY	PITO TUB COE
85.0	29.00	.02	72.5	32.97	75.98	47.84	122.59	19.1	1.4	2.4	.85

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTA P (I.H2O)	DELTA H (I.H2O)	TEMP IN (D.F)	TEMP OUT (D.F)	TRAIN VAC (I.HG)	STACK TEMP (D.F)	BOX TEMP (D.F)	PROBE T DIA (IN)	VEL (FPM)
4 1	4.00	125.06	.055	1.030	84.0	84.0	4.5	150.0		.375	878.9
4 2	4.00	127.72	.080	1.510	88.0	83.0	5.0	142.0		.375	1053.0
4 3	4.00	130.59	.095	1.800	94.0	84.0	6.0	130.0		.375	1136.0
4 4	4.00	133.62	.125	1.970	100.0	84.0	6.3	132.0		.375	1305.3
4 5	4.00	136.70	.125	1.970	104.0	84.0	6.2	144.0		.375	1318.5
4 6	4.00	139.89	.097	1.860	112.0	86.0	6.0	160.0		.375	1176.7
4 7	4.00	142.89	.110	1.920	116.0	88.0	6.2	160.0		.375	1253.1
4 8	4.00	145.93	.105	2.010	117.0	89.0	6.0	150.0		.375	1214.4
3 1	4.00	148.50	.060	1.150	113.0	92.0	4.2	136.0		.375	907.4
3 2	4.00	151.25	.080	1.570	115.0	93.0	5.2	134.0		.375	1046.0
3 3	4.00	154.09	.085	1.650	118.0	94.0	5.5	135.0		.375	1079.1
3 4	4.00	156.99	.090	1.735	120.0	95.0	5.2	141.0		.375	1116.0
3 5	4.00	159.80	.071	1.331	121.0	96.0	7.0	149.0		.375	997.8
3 6	4.00	161.94	.045	.865	116.0	97.0	3.7	141.0		.375	789.1
3 7	4.00	164.08	.045	.865	113.0	97.0	3.9	145.0		.375	791.7
3 8	4.00	166.33	.053	1.000	110.0	96.0	3.9	143.0		.375	857.8
2 1	4.00	168.30	.035	.685	100.0	93.0	3.3	136.0		.375	693.0
2 2	4.00	170.23	.035	.685	102.0	93.0	3.2	140.0		.375	695.4
2 3	4.00	172.31	.044	.823	102.0	92.0	3.5	142.0		.375	781.0
2 4	4.00	174.49	.047	.885	104.0	92.0	4.0	138.0		.375	804.5
2 5	4.00	176.65	.045	.865	106.0	92.0	4.0	135.0		.375	785.2
2 6	4.00	178.71	.040	.761	109.0	92.0	3.8	139.0		.375	742.8
2 7	4.00	180.62	.035	.678	110.0	92.0	3.2	142.0		.375	696.5
2 8	4.00	182.42	.025	.495	108.0	92.0	3.2	135.0		.375	585.2
1 1	4.00	183.61	.010	.190	98.0	90.0	2.1	122.0		.375	366.1
1 2	4.00	184.86	.015	.290	98.0	91.0	2.5	131.0		.375	451.8
1 3	4.00	186.26	.185	.355	99.0	90.0	2.5	136.0		.375	1593.3
1 4	4.00	187.78	.020	.389	101.0	90.0	2.7	141.0		.375	526.1
1 5	4.00	189.42	.024	.347	102.0	90.0	3.1	141.0		.375	576.3
1 6	4.00	191.19	.032	.612	100.0	90.0	3.5	143.0		.375	666.6
1 7	4.00	193.06	.035	.667	102.0	89.0	4.0	140.0		.375	695.4
1 8	4.00	194.60	.020	.385	103.0	91.0	3.0	129.0		.375	520.8

TABLE A-II (Continued)

RUN- 2-3 DATE- 5-16-72

ATMOS TEMP (DG.F)	ATMOS PRES (I.HG)	STACK VAC (I.H2O)	H2O COND (ML)	PARTIC WT-PTL (MG)	PARTIC WT-TTL (MG)	STACK AREA (FT2)	INIT VOL (DCF)	PERC O2 DRY	PERC CO2 DRY	PERC CO DRY	PITO TUB COE
85.0	29.00	.06	81.0	31.55	119.04	47.84	787.74	19.1	1.4	2.4	.85

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTA P (I.H2O)	DELTA H (I.H2O)	TEMP IN (D.F)	TEMP OUT (D.F)	TRAIN VAC (I.HG)	STACK TEMP (D.F)	BOX TEMP (D.F)	PROBE T DIA (IN)	VEL (FPM)
4 1	4.00	789.15	.018	.375	81.0	83.0	3.0	141.0		.375	498.7
4 2	4.00	790.82	.027	.550	83.0	83.0	3.7	142.0		.375	611.3
4 3	4.00	792.60	.033	.665	88.0	83.0	4.0	128.0		.375	667.9
4 4	4.00	792.42	.030	.620	93.0	84.0	4.0	122.0		.375	633.5
4 5	4.00	796.27	.037	.750	96.0	84.0	4.1	128.0		.375	707.2
4 6	4.00	798.03	.031	.630	100.0	84.0	4.0	132.0	65.0	.375	649.5
4 7	4.00	800.29	.065	1.290	104.0	85.0	5.5	141.0		.375	947.6
4 8	4.00	802.38	.040	.800	109.0	86.0	4.5	135.0		.375	739.7
3 1	4.00	804.41	.040	.800	96.0	86.0	4.3	127.0		.375	734.7
3 2	4.00	806.55	.052	.950	101.0	88.0	4.7	127.0		.375	837.6
3 3	4.00	808.79	.053	1.060	106.0	88.0	4.9	131.0		.375	848.5
3 4	4.00	812.88	.240	4.650	108.0	91.0	15.0	135.0		.375	1811.8
3 5	4.00	817.07	.195	3.800	113.0	90.0	13.0	138.0		.375	1637.2
3 6	4.00	821.35	.210	4.000	118.0	90.0	13.0	143.0	65.0	.375	1706.1
3 7	4.00	825.78	.230	4.400	123.0	91.0	15.0	129.0		.375	1764.7
3 8	4.00	830.10	.215	4.100	125.0	92.0	14.0	121.0		.375	1694.5
2 1	4.00	833.24	.110	2.130	101.0	90.0	7.5	133.0		.375	1224.5
2 2	4.00	836.64	.130	2.580	106.0	90.0	9.0	128.0		.375	1325.6
2 3	4.00	840.14	.130	2.580	115.0	90.0	9.0	136.0		.375	1334.5
2 4	4.00	843.58	.165	3.230	121.0	91.0	11.0	150.0		.375	1521.1
2 5	4.00	846.37	.080	1.610	121.0	92.0	6.5	140.0		.375	1050.4
2 6	4.00	849.24	.085	1.700	108.0	92.0	6.8	129.0		.375	1072.8
2 7	4.00	852.04	.080	1.610	110.0	92.0	6.5	130.0		.375	1041.6
2 8	4.00	854.40	.055	1.100	112.0	91.0	5.0	132.0	60.0	.375	865.1
1 1	4.00	856.40	.043	.860	105.0	92.0	4.5	142.0		.375	771.4
1 2	4.00	858.83	.059	1.180	104.0	92.0	5.5	145.0		.375	905.8
1 3	4.00	861.53	.076	1.530	102.0	91.0	6.0	147.0		.375	1029.8
1 4	4.00	864.55	.095	1.890	104.0	90.0	7.2	145.0		.375	1149.4
1 5	4.00	867.82	.115	2.300	109.0	89.0	8.3	142.0		.375	1261.5
1 6	4.00	871.27	.123	2.460	114.0	90.0	8.5	132.0		.375	1293.8
1 7	4.00	874.38	.097	1.950	108.0	89.0	7.2	128.0	60.0	.375	1145.0
1 8	4.00	876.93	.067	1.330	102.0	87.0	5.0	130.0		.375	953.2

TABLE A-II (Continued)

RUN- 3-1 DATE- 5-17-72

ATMOS TEMP (DG.F)	ATMOS PRES (I.HG)	STACK VAC (I.H2O)	H2O COND (ML)	PARTIC WT-PTL (MG)	PARTIC WT-TTL (MG)	STACK AREA (FT2)	INIT VOL (DCF)	PERC O2 DRY	PERC CO2 DRY	PERC CO DRY	PITO TUB COE
70.0	29.13	.06	75.9	23.74	85.79	47.84	.703.81	19.3	1.6	2.3	.85

PORT- POINT		SAMP TIME (MIN)	METER VOL (DCF)	DELTA P (I.H2O)	DELTA H (I.H2O)	TEMP IN (D.F)	TEMP OUT (D.F)	TRAIN VAC (I.HG)	STACK TEMP (D.F)	BOX TEMP (D.F)	PROBE T DIA (IN)	VEL (FPM)
1	1	4.00	705.91	.043	.860	84.0	84.0	3.0	141.0		.375	768.7
1	2	4.00	708.27	.055	1.120	92.0	85.0	3.5	148.0		.375	874.4
1	3	4.00	710.79	.080	1.640	97.0	85.0	3.8	160.0		.375	1064.9
1	4	4.00	713.11	.053	1.100	96.0	86.0	3.5	160.0		.375	866.8
1	5	4.00	715.62	.062	1.250	98.0	86.0	3.7	160.0	72.0	.375	937.5
1	6	4.00	718.54	.080	1.620	102.0	86.0	5.0	160.0		.375	1064.9
1	7	4.00	721.56	.095	1.920	106.0	87.0	5.0	153.0		.375	1153.9
1	8	4.00	724.31	.080	1.650	110.0	88.0	4.5	148.0		.375	1054.5
2	1	4.00	726.58	.050	1.010	100.0	89.0	3.5	153.0		.375	837.1
2	2	4.00	728.84	.053	1.070	100.0	90.0	3.4	160.0		.375	866.8
2	3	4.00	731.31	.063	1.290	102.0	90.0	3.7	166.0		.375	949.6
2	4	4.00	734.16	.087	1.780	110.0	91.0	4.7	163.0		.375	1113.2
2	5	4.00	737.09	.090	1.830	117.0	94.0	4.7	160.0	73.0	.375	1129.5
2	6	4.00	740.11	.098	1.980	115.0	94.0	4.9	152.0		.375	1171.0
2	7	4.00	743.09	.090	1.850	112.0	95.0	4.9	145.0		.375	1115.7
2	8	4.00	745.54	.065	1.310	108.0	96.0	4.0	140.0		.375	944.3
3	1	4.00	747.43	.040	.820	96.0	93.0	3.3	155.0		.375	749.9
3	2	4.00	748.99	.020	.410	96.0	93.0	2.0	155.0		.375	530.3
3	3	4.00	750.81	.030	.620	101.0	94.0	2.5	150.0		.375	646.8
3	4	4.00	752.74	.035	.710	101.0	94.0	3.0	142.0		.375	694.1
3	5	4.00	754.51	.033	.680	101.0	94.0	2.5	140.0	69.0	.375	672.8
3	6	4.00	756.41	.035	.710	100.0	94.0	3.0	152.0		.375	699.8
3	7	4.00	758.59	.043	.870	101.0	94.0	3.0	163.0		.375	782.6
3	8	4.00	760.73	.048	.970	102.0	94.0	3.1	152.0		.375	819.5
4	1	4.00	762.44	.018	.370	96.0	92.0	2.0	140.0		.375	496.9
4	2	4.00	765.85	.115	2.340	94.0	92.0	5.5	130.0		.375	1245.5
4	3	4.00	769.25	.115	2.340	103.0	92.0	5.8	130.0		.375	1245.5
4	4	4.00	772.51	.118	2.390	110.0	92.0	5.6	131.0		.375	1262.7
4	5	4.00	775.56	.100	2.020	116.0	92.0	5.0	139.0	65.0	.375	1170.2
4	6	4.00	778.53	.090	1.830	117.0	94.0	4.6	145.0		.375	1115.7
4	7	4.00	781.76	.115	2.390	114.0	94.0	5.4	143.0		.375	1259.1
4	8	4.00	784.97	.110	2.250	113.0	95.0	5.5	135.0		.375	1223.3

TABLE A-II (Continued)

RUN- 3-2 DATE- 5-17-72

ATMOS TEMP (DG.F)	ATMOS PRES (I.HG)	STACK VAC (I.H2O)	H2O COND (ML)	PARTIC WT-PTL (MG)	PARTIC WT-TTL (MG)	STACK AREA (FT2)	INIT VOL (DCF)	PERC O2 DRY	PERC CO2 DRY	PERC CO DRY	PITOT TUBE COEF
70.0	29.13	.04	93.0	29.15	102.03	47.84	196.21	19.3	1.6	2.3	.85

PORT-POINT	SAMP TIME (MIN)	METER VOL (DCF)	DELTA P (I.H2O)	DELTA H (I.H2O)	TEMP IN (D.F)	TEMP OUT (D.F)	TRAIN VAC (I.HG)	STACK TEMP (D.F)	BOX TEMP (D.F)	PROBE T DIA (IN)	VEL (FPM)
1 1	4.00	198.03	.028	.525	82.0	82.0	1.9	140.0		.375	620.2
1 2	4.00	200.06	.040	.785	87.0	82.0	2.0	139.0		.375	740.6
1 3	4.00	202.13	.040	.785	90.0	82.0	2.0	140.0		.375	741.3
1 4	4.00	205.06	.112	2.200	91.0	83.0	4.1	150.0		.375	1250.6
1 5	4.00	208.17	.100	1.930	96.0	83.0	3.7	156.0		.375	1187.5
1 6	4.00	211.44	.115	2.230	101.0	84.0	4.0	156.0		.375	1273.5
1 7	4.00	215.10	.150	2.895	106.0	85.0	4.9	136.0		.375	1430.6
1 8	4.00	218.73	.137	2.653	110.0	86.0	5.0	125.0		.375	1354.6
2 1	4.00	221.82	.100	1.960	100.0	88.0	3.3	137.0		.375	1169.1
2 2	4.00	225.14	.120	2.320	102.0	88.0	4.1	149.0		.375	1293.5
2 3	4.00	228.56	.128	2.465	104.0	89.0	4.1	156.0		.375	1343.6
2 4	4.00	232.06	.125	2.450	106.0	90.0	4.5	155.0		.375	1326.6
2 5	4.00	235.55	.130	2.550	115.0	91.0	4.5	145.0	70.0	.375	1341.9
2 6	4.00	239.07	.130	2.550	115.0	92.0	4.5	136.0		.375	1331.8
2 7	4.00	242.78	.155	3.005	112.0	92.0	5.0	131.0		.375	1448.2
2 8	4.00	246.17	.118	2.293	106.0	92.0	4.2	131.0		.375	1263.6
3 1	4.00	249.27	.105	1.990	90.0	87.0	3.7	156.0		.375	1216.9
3 2	4.00	251.81	.065	1.260	94.0	87.0	2.8	145.0		.375	948.8
3 3	4.00	254.49	.720	1.470	98.0	87.0	3.0	140.0		.375	3144.9
3 4	4.00	257.32	.083	1.695	101.0	88.0	3.0	136.0		.375	1064.2
3 5	4.00	260.05	.080	1.620	104.0	88.0	3.0	130.0		.375	1039.5
3 6	4.00	262.58	.062	1.265	99.0	88.0	3.0	155.0	75.0	.375	934.3
3 7	4.00	265.29	.077	1.570	98.0	88.0	3.0	166.0		.375	1050.5
3 8	4.00	268.25	.090	1.835	98.0	88.0	3.5	149.0		.375	1120.2
4 1	4.00	270.70	.050	1.100	92.0	86.0	2.5	135.0		.375	825.3
4 2	4.00	273.28	.057	1.070	95.0	86.0	3.0	135.0		.375	881.2
4 3	4.00	275.03	.040	.815	94.0	86.0	2.2	137.0		.375	739.4
4 4	4.00	277.40	.050	1.100	96.0	86.0	2.5	136.0		.375	826.0
4 5	4.00	279.83	.060	1.190	96.0	86.0	2.7	134.0		.375	903.3
4 6	4.00	282.40	.065	1.310	100.0	86.0	3.0	140.0		.375	944.9
4 7	4.00	284.86	.060	1.200	104.0	88.0	2.9	139.0	75.0	.375	907.1
4 8	4.00	287.25	.050	1.100	104.0	89.0	2.5	139.0		.375	828.1

TABLE A-II (Concluded)

RUN- 3-3 DATE- 5-17-72

ATMOS TEMP (DG.F)	ATMOS PRES (I.HG)	STACK VAC (I.H2O)	H2O COND (ML)	PARTIC WT-PTL (MG)	PARTIC WT-TTL (MG)	STACK AREA (FT2)	INIT VOL (DCF)	PERC O2 DRY	PERC CO2 DRY	PERC CO DRY	PITO TUB COE
70.0	29.13	.13	78.6	18.69	80.13	47.84	877.09	18.9	1.4	2.3	.85

PORT- POINT		SAMP TIME (MIN)	METER VOL (DCF)	DELTA P (I.H2O)	DELTA H (I.H2O)	TEMP IN (D.F)	TEMP OUT (D.F)	TRAIN VAC (I.HG)	STACK TEMP (D.F)	BOX TEMP (D.F)	PROBE T DIA (IN)	VEL (FPM)
1	1	4.00	879.26	.047	1.030	78.0	79.0	4.6	137.0		.375	801.6
1	2	4.00	882.03	.069	1.530	86.0	80.0	6.0	142.0		.375	975.3
1	3	4.00	885.19	.090	1.980	94.0	81.0	6.8	151.0		.375	1122.1
1	4	4.00	888.15	.120	2.570	102.0	82.0	6.0	154.0		.375	1298.9
1	5	4.00	890.60	.065	1.390	104.0	84.0	5.2	158.0		.375	959.1
1	6	4.00	893.09	.060	1.290	100.0	85.0	5.0	158.0		.375	921.5
1	7	4.00	895.63	.060	1.290	102.0	86.0	5.0	155.0		.375	919.2
1	8	4.00	898.24	.070	1.520	102.0	87.0	5.5	148.0	75.0	.375	987.2
2	1	4.00	900.33	.045	.960	95.0	87.0	4.5	141.0		.375	787.0
2	2	4.00	902.69	.062	1.320	97.0	88.0	5.1	144.0		.375	926.0
2	3	4.00	905.24	.070	1.520	100.0	89.0	5.5	148.0		.375	987.2
2	4	4.00	907.88	.065	1.390	101.0	89.0	5.5	153.0		.375	955.2
2	5	4.00	910.74	.080	1.740	104.0	89.0	6.0	158.0		.375	1064.0
2	6	4.00	913.57	.080	1.740	112.0	91.0	6.0	153.0	77.0	.375	1059.7
2	7	4.00	916.33	.075	1.610	111.0	93.0	58.0	149.0		.375	1022.7
2	8	4.00	918.48	.037	.800	113.0	93.0	4.4	142.0		.375	714.2
3	1	4.00	920.26	.025	.548	87.0	88.0	3.7	143.0		.375	587.5
3	2	4.00	922.83	.034	.740	88.0	88.0	4.2	151.0		.375	689.7
3	3	4.00	926.31	.130	2.780	93.0	86.0	8.0	132.0		.375	1327.5
3	4	4.00	929.96	.140	2.980	100.0	87.0	8.3	126.0	73.0	.375	1370.6
3	5	4.00	933.69	.150	3.200	106.0	87.0	9.0	132.0		.375	1426.0
3	6	4.00	936.87	.100	2.120	100.0	87.0	6.8	158.0		.375	1189.6
3	7	4.00	940.15	.100	2.120	96.0	87.0	7.0	167.0		.375	1198.2
3	8	4.00	943.80	.130	2.800	97.0	87.0	8.2	152.0		.375	1349.7
4	1	4.00	946.24	.050	1.080	92.0	84.0	5.0	138.0		.375	827.4
4	2	4.00	948.70	.065	1.400	93.0	85.0	5.2	137.0		.375	942.6
4	3	4.00	950.73	.038	.830	91.0	85.0	4.3	136.0		.375	720.1
4	4	4.00	952.80	.035	.770	91.0	85.0	4.3	135.0		.375	690.6
4	5	4.00	954.90	.045	.970	92.0	85.0	4.5	132.0		.375	781.0
4	6	4.00	957.08	.048	1.030	92.0	85.0	4.7	137.0	71.0	.375	810.1
4	7	4.00	959.18	.043	.925	95.0	86.0	4.4	137.0		.375	766.7
4	8	4.00	961.25	.037	.805	95.0	86.0	4.3	139.0		.375	712.4

APPENDIX B

SO_2 GASEOUS DATA AND RESULTS[a/]

Continuous monitoring of sulfur dioxide was conducted during the testing program by EPA/OAP on the No. 1 outlet stack using an electrochemical reaction sensing analyzer. Emissions data recorded during this time is presented in Table I (for additional details see Appendix E).

a/ As provided by EPA/OAP.

TABLE B-I

Sulfur Dioxide Data by Dynascience

Continuous Monitoring Instrument

(All values are SO_2, ppm by volume (70°F)

Date	Time	% Scale	SO_2, ppm
5/16/72	8:55	9.5	375
Run 1	10:00	12.	470
	10:10	11	425
	10:30	5	200
	10:35	7	275
	10:47	11	425
	11:20	10.5	410
	12:00	10.	400
	12:18	9.5	375
			Average 372
5/16/72	15:58	10.	400
Run 2	16:28	9.	350
	16:50	9.5	375
	17:00	9.5	375
	17:24	9.5	375
	17:48	9.	350
	18:03	9	350
	18:15	8	300
			Average 359
5/17/72			
Run 3	13:10	12	470
	13:29	14	550
	13:31	15	575
	13:35	14.5	560
	13:40	12	470
	13:45	12	470
	13:50	13.5	525
	13:55	14	550
	14:00	14	550
	14:05	13	500
	14:10	12.5	475
	14:15	12	470
	14:20	11.5	450
	14:25	16	625
	14:30	15	575
	14:35	12	470
	14:40	12	470
	14:45	11.5	450
	14:50	15.5	600
	14:55	11.5	450
	15:00	10.0	400

Date	Time	% Scale	SO_2, ppm
5/17/72	15:05	9.5	375
	15:10	9	350
	15:15	10.	400
	15:20	10.	400
	15:25	10.5	410
	15:30	13.5	525
	15:35	14.	550
	15:40	10.	400
	15:44	7.5	300
			Average 479

1. Calibration curve based on 25% of scale reading; calibrated instrument with 985 ppm SO_2.

APPENDIX C[a/]

PROCESS OPERATION LOG

This Appendix presents an explaination of process operations during testing. A detailed log of control room readings is also included. Runs 1 and 2 were performed on May 16, 1972 and Run 3 was performed on May 17, 1972.

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a/ This entire Appendix was supplied by EPA/OAP.

Complete Operation Results

The exhaust gas flow rates and volumes varied appreciably between each of the three tests. This could be attributed to several reasons: (1) the operational variations of temperature, draft and process, (2) the cleaning of compartments, (3) the dilution damper, (4) the gas conditioning water sprays, or (5) blockages within the fan blades. Orsat analyses were not conducted for each separate exhaust stack, therefore, no variation is noted, however, the percent water vapor and gas temperature from the different stacks showed only minor variations between runs.

Process operations during testing program

5/15/72 Monday	a.	Checked lime addition @ 13:55 - 143.9 gm/min Stack opacities range between 5 and 10% (not certified readings).
5/16/72 Tuesday	a.	Furnace feed is 14 tons of sinter, 2500 pounds of coke, and 200 pounds of iron; Lime check @ 8:10 - 173 gm/min; Run started @ 09:05;
Run No. 1		Furnace was pulled back @ 0909; Run was stopped @ 09:10; Furnace operation back to normal @ 09:20; Run resumed @ 09:25. Tempering air valve opened @ 09:46; Cleaning cycle for stack No. 1 @ 10:00 - 10:05; Water sprays at No. 1 bank on @ 10:04; Lead tap @ 10:27; Cleaning cycle for stack No. 2 @ 11:02-11:07; Tempering valve opened @ 11:07; Run completed @ 12:15.
	b.	Dynamite charge placed in furnace @ 12:30.
Run No. 2	c.	Furnace feed rate same as indicated above; Run started @ 15:55; 1st bank of water sprays on @ 16:02; Tempering valve closed @ 16:29; Tempering valve reopened @ 16:35; Cleaning cycle for stack No. 3 @ 16:46-16:51; Checked lime rate @ 17:00 - 165.4 gms/min; Cleaning cycle for stack No. 1 @ 17:28-17:35; Cleaning cycle for stack No. 2 @ 17:36-17:41; 200 to 500 pounds of iron plus 400 pounds of litharge added; Run completed @ 18:30.

5/17/72 Wednesday Run No. 3	a.	Furnace feed rate same as indicated on 5/16/72; Tapping lead @ 13:10, Run started @ 13:10; Lime check @ 13:10 - 150 gm/min; Tempering valve opened @ 13:16, Cleaning cycle for stack No. 1 @ 13:18-13:23; Compartment No. 1 remained closed due to control room personnel leaving switch in manual positions. This was corrected @ 13:24; Water sprays for No. 1 bank on @ 13:21; Cleaning cycle for stack No. 2 @ 13:30 - 13:35; Tuyeres cleaned @ 14:17; Cleaning cycle for stack No. 3 @ 14:29-14:34; Cleaning cycle for stack No. 1 @ 15:05-15:12; Run completed @ 15:40.

The following tables present a detailed log of control room readings taken during the testing programs.

Test No. I - Test Log
Type - Particulate, Date 5-16-72

Time	Temperature: Blast Furnace Flue Temp. °F	Temperature: Baghouse Temp. °F	Baghouse Press. "H_2O	H_2O Sprays: Off	H_2O Sprays: On	H_2O Sprays: No. Banks	Shaking Compartment: I	Shaking Compartment: II	Shaking Compartment: III	Furnace Feed	CFM to Furnace	Lead Tap: Start	Lead Tap: Stop	Remarks
8:55A			1.7					X			8800			
9:04										X	8800			FURNACE [illegible] shut-off and [illegible] some [illegible] started.
9:05														1. TEST STARTED.
9:09														1. FURNACE [illegible] back, 2. TEST stopped until normal operations regained
9:20											9000			1. Test restarted 2. CF [illegible] from recorder.
9:27														1. TEST stopped 2. blower [illegible]
9:34														1. TEST RESTARTED
9:46														TEMPERING AIR valve opened.
9:47			2.5											
9:52			2.6											TEST stopped. "Mixup in communication."
9:55			2.9		X				X					1. TEST RESTARTED 2. SHAKING CYCLE started

Test No. I (Continued)

Time	Temperature: Blast Furnace Flue Temp. °F	Temperature: Baghouse Temp. °F	Baghouse Press. "H_2O	H_2O Sprays: Off	H_2O Sprays: On	H_2O Sprays: No. Banks	Shaking Compartment: I	Shaking Compartment: II	Shaking Compartment: III	Furnace Feed	CFM to Furnace	Lead Tap: Start	Lead Tap: Stop	Remarks
10:04			2.9		X		X							1. WATER spray initiate at 150°F 2. 1 BANK of spray 5.65 gal/min
10:05			1.4		X									cleaning cycle complete
10:09			1.7		X						8800			
10:24			2.3		X				X					
10:37					X								X	Lead tapped continuously until stopped. EACH POT contains 9 TONS Pb
10:39	C-5		2.2		X							X		
10:51				X							8800			
10:55					X	2								
10:59					X	1/2								
11:04			3.5		X			X					X	
11:07			1.2		X				X	X		X		TEMPERING VALVE opened.

Test No. I (Continued)

Time	Temperature: Blast Furnace Flue Temp. °F	Temperature: Baghouse Temp. °F	Baghouse Press. "H_2O	H_2O Sprays: Off	H_2O Sprays: On	H_2O Sprays: No. Banks	Shaking Compartment: I	Shaking Compartment: II	Shaking Compartment: III	Furnace Feed	CFM to Furnace	Lead Tap: Start	Lead Tap: Stop	Remarks
11:12				X							8800			
11:57					X	4							X	
11:51					X	4						X		
11:58					X	4					8800			
12:11				X		1/2								
12:12			2.9		X									
12:17					X					X				
12:20	5/16/72				X									TEST RAID. OF FIRMS 6918690
12:25	5/16/72				X									
12:31					X								X	
12:31			3.5		X	1/2			X					
12:32					X		X							

Test No. I (Concluded)

Time	Temperature: Blast Furnace Flue Temp. °F	Temperature: Baghouse Temp. °F	Baghouse Press. "H_2O	H_2O Sprays: Off	H_2O Sprays: On	H_2O Sprays: No. Banks	Shaking Compartment: I	Shaking Compartment: II	Shaking Compartment: III	Furnace Feed	CFM to Furnace	Lead Tap: Start	Lead Tap: Stop	Remarks
12:50			1.5		X									LOG END GE CEILING 6918752

Test No. II - Test Log
Type - Particulate, Date 5-16-72

Time	Temperature: Blast Furnace Flue Temp. °F	Temperature: Baghouse Temp. °F	Baghouse Press. "H_2O	H_2O Sprays: Off	H_2O Sprays: On	H_2O Sprays: No. Banks	Shaking Compartment: I	Shaking Compartment: II	Shaking Compartment: III	Furnace Feed	CFM to Furnace	Lead Tap: Start	Lead Tap: Stop	Remarks
3:55	220		2.35		X	4					8800			TEST START
[illegible]					X	2							X	1. water spray initiate at 150°F 2. 1 BANK of spray 5.55 [illegible]
[illegible]				X								X		
[illegible]	190		2.5	X										
[illegible]			2.5	X							8600			
[illegible]	190		2.70		X	2				X				
[illegible]					X	4								
[illegible]	250				X									
[illegible]			2.9		X									Tempering valve closed.
4:35					X									Tempering valve opened.
4:45	200		1.5	X					X				X	

Test No. II (Continued)

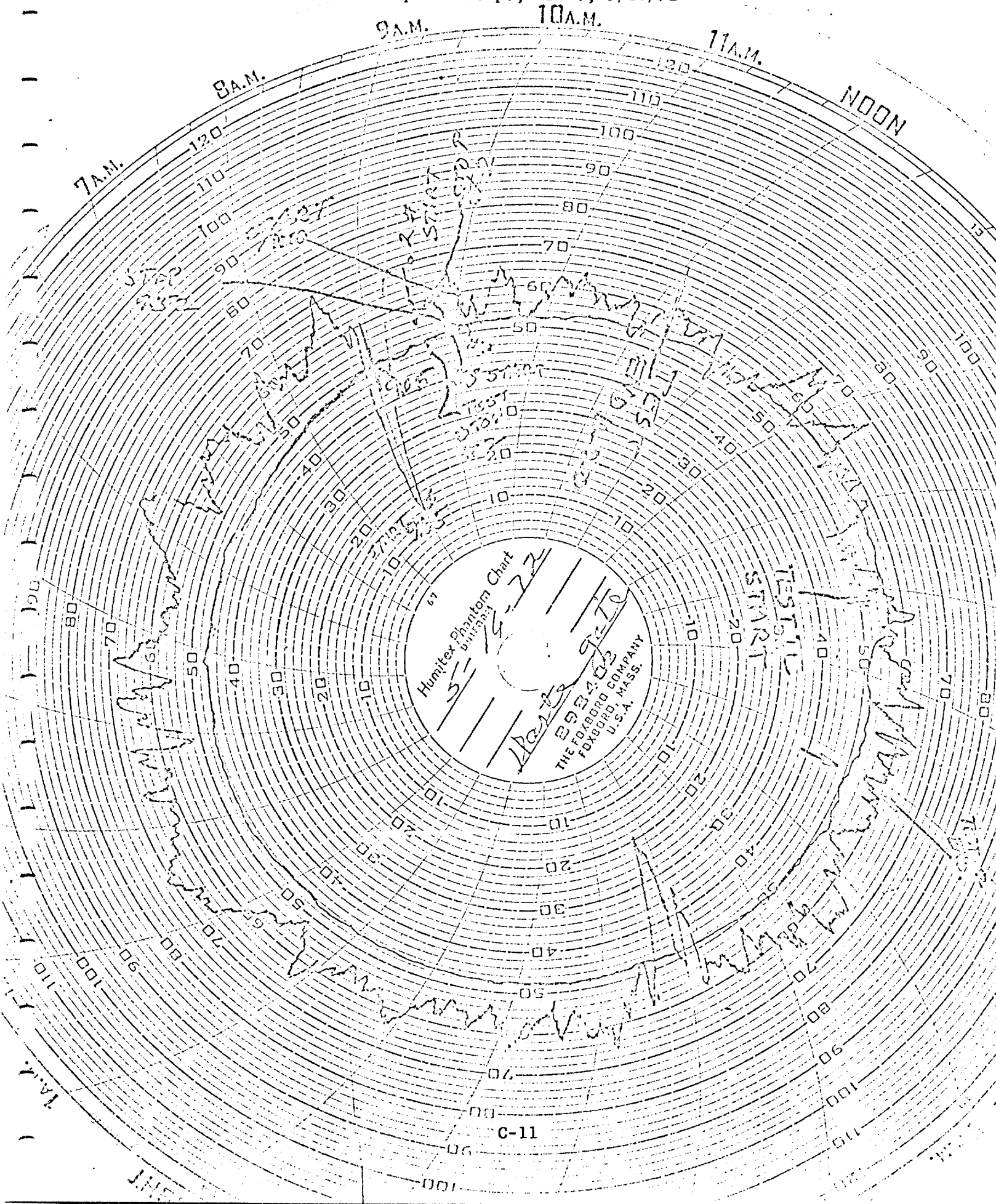
Time	Temperature: Blast Furnace Flue Temp. °F	Temperature: Baghouse Temp. °F	Baghouse Press. "H_2O	H_2O Sprays: Off	H_2O Sprays: On	H_2O Sprays: No. Banks	Shaking Compartment: I	Shaking Compartment: II	Shaking Compartment: III	Furnace Feed	CFM to Furnace	Lead Tap: Start	Lead Tap: Stop	Remarks
4:56	200			X						X		X		
4:57	200		2.5		X	3								
4:58	200		2.5		X	3 1/2								CF 6920716-5
5:06					X					X	8800			
5:15	350		2.6		X	4					8800			
5:27	380		2.9		X	3				X				
5:30	400		3.5		X	4					8200			
5:31					X				X					Comparison with dust side temperature of shaking cycle could not be [illegible]
5:33					X					X				
5:45	305		1.5	X							8800			
5:47				X						X				
5:57	230		2.0	X							8800			

Test No. II (Concluded)

Time	Temperature: Blast Furnace Flue Temp. °F	Temperature: Baghouse Temp. °F	Baghouse Press. "H_2O	H_2O Sprays: Off	H_2O Sprays: On	H_2O Sprays: No. Banks	Shaking Compartment: I	Shaking Compartment: II	Shaking Compartment: III	Furnace Feed	CFM to Furnace	Lead Tap: Start	Lead Tap: Stop	Remarks
1105	220		2.0	X							8800			
1112	—				X	4								
1117	220		2.5		X	3							X	
1122	220		25	X						X		X		200 to 300 Pounds of Iron Plus 100 lbs of Litharge Added.
1130	220		2.5	X						X				TEST END.
1135	220		2.9		X	4								
	5/16/72													

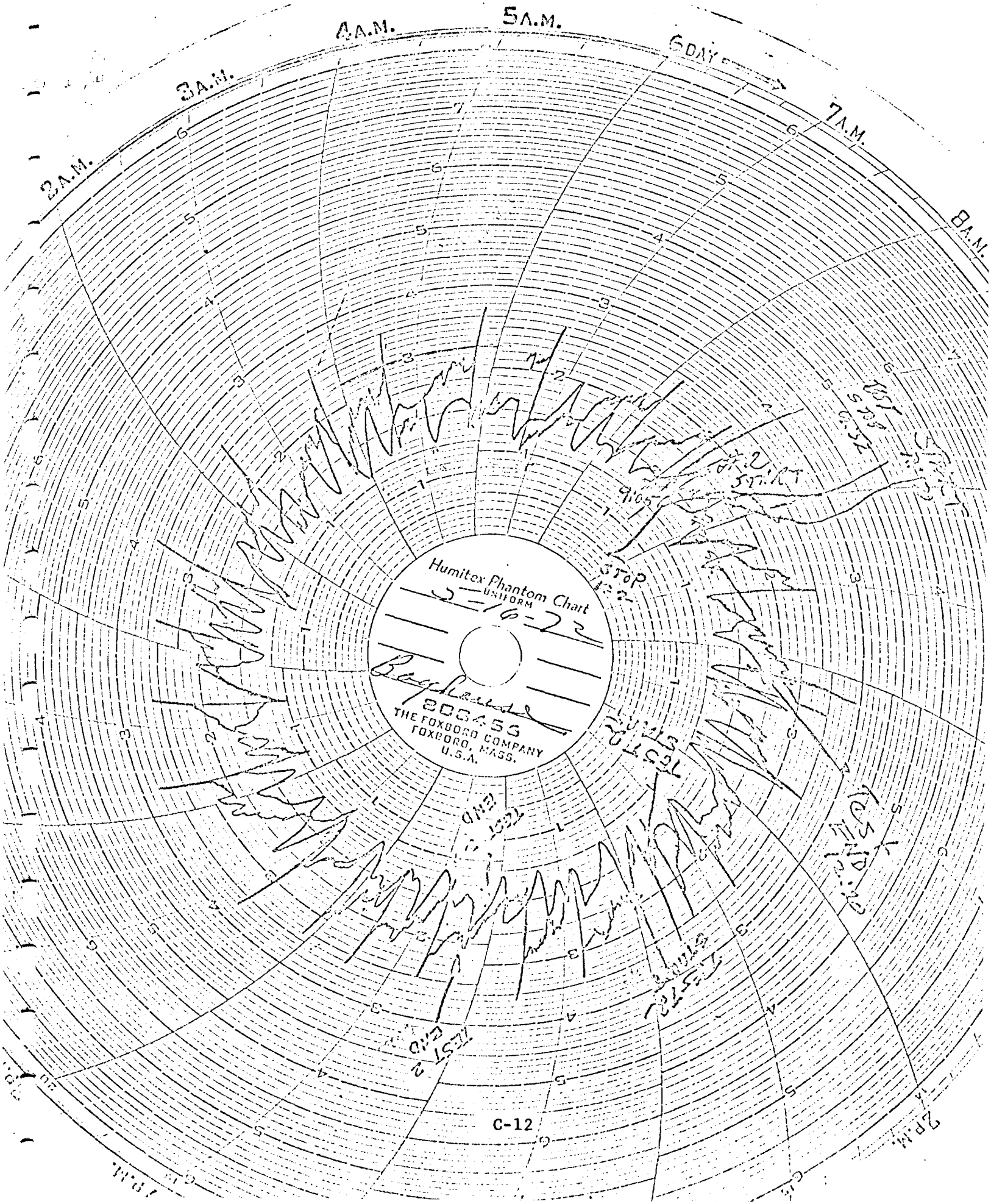
Tests I, II

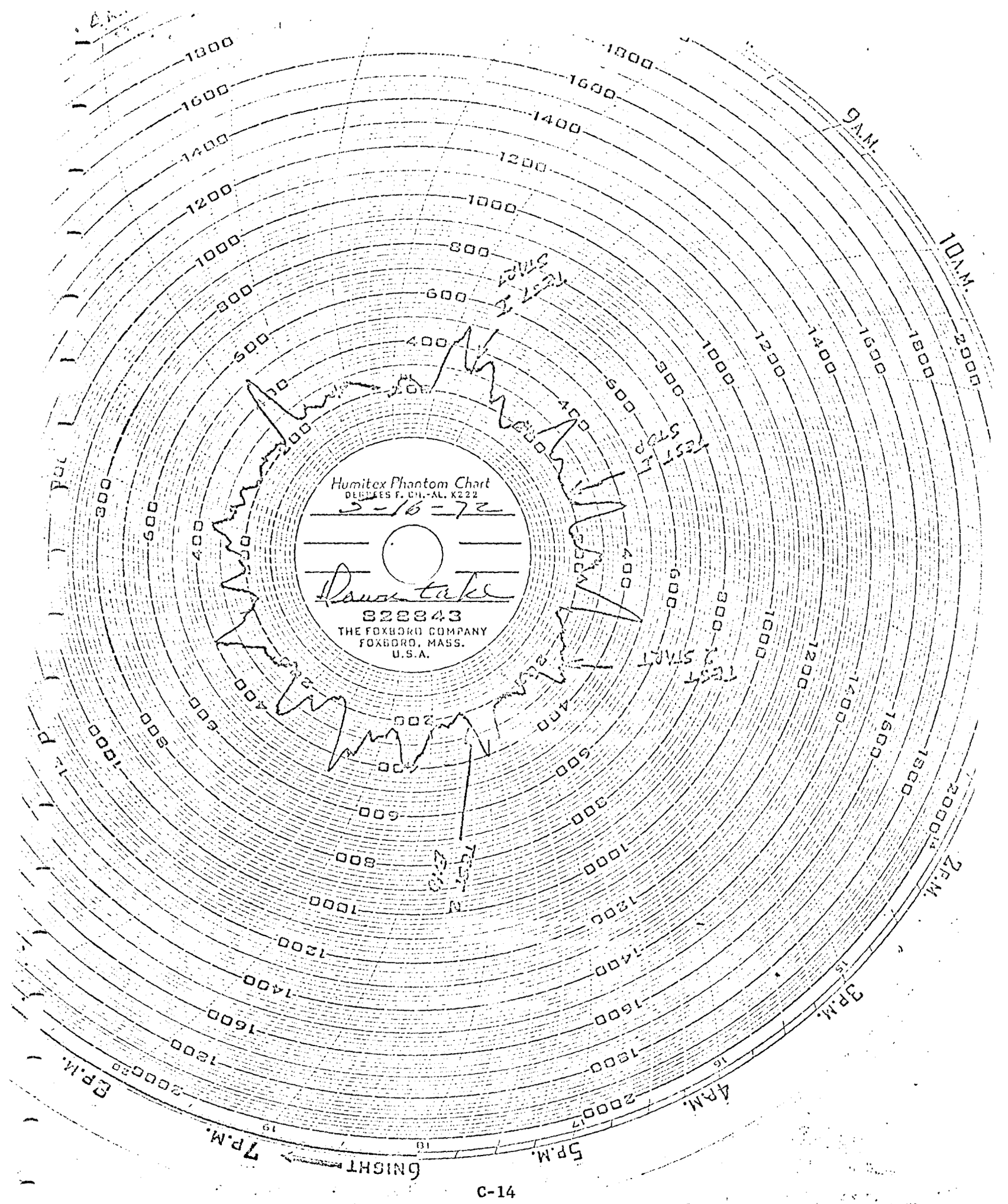
Dump Gas Temp., Pres., 5/16/72



Shaking begins when pressure passes 3 in. H_2O

Baghouse pressure read on 1-8, Scale - pounds H_2O
Outlet flue gas temperature read on 1-6, scale 100°F





C-14

Blast Furnace Flue Temp.

taken as gas exits furnace

Test No. III - Test Log
Type - Particulate, Date 5-17-72

Time	Temperature: Blast Furnace Flue Temp. °F	Temperature: Baghouse Temp. °F	Baghouse Press. "H_2O	H_2O Sprays: Off	H_2O Sprays: On	H_2O Sprays: No. Banks	Shaking Compartment: I	Shaking Compartment: II	Shaking Compartment: III	Furnace Feed	CFM to Furnace	Lead Tap: Start	Lead Tap: Stop	Remarks
1115	280		2.6	X							9000	X		Chart was being flipped at beginning of test. 2. TEST STARTED
[illegible]	270		2.75	X							9000			TEMPERING CHAMB COOL 1. WATER SHUT inlets at 150°F 2. 1 CHAM of spray [illegible]
1121	250		3.4	X			X							
[illegible]			1.5	X				X			9000			
1124	250		1.5	X						X	8800			1. #1 coal [illegible] open [illegible] because Tech. used [illegible] switch. 2. Shaking [illegible] added
1130	250		1.7		X	½								
1131	250				X	1½								
[illegible]	250	120°			X	4								
1137	270	135	1.9		X						8800			
[illegible]	270	120	2.0		X	3½					8800			
1145	270	125	2.0		X	2					8500			

Test No. III (Continued)

Time	Temperature: Blast Furnace Flue Temp. °F	Temperature: Baghouse Temp. °F	Baghouse Press. "H_2O	H_2O Sprays: Off	H_2O Sprays: On	H_2O Sprays: No. Banks	Shaking Compartment: I	Shaking Compartment: II	Shaking Compartment: III	Furnace Feed	CFM to Furnace	Lead Tap: Start	Lead Tap: Stop	Remarks
1146	290	125	2.0		X	1.5					8900			
1147	290	125	2.0		X	1					8800			
1148	290	140	2.1		X	1/2					8800			
1149	290	140	2.1	X							8800			
1151	290	190	2.3		X	1/2				X	8900		X	
1157	290	190			X	2					8900			
1159 30	290	190	2.5		X	3								
1200	280	190	2.5		X	3 1/2					8900	X		
1201	300	170	2.5		X	4					8900			
1202	300	150	2.5		X	4					8800			
1204	300	155	2.7		X	4					8900			
[illegible]	300	140			X	3								

Test No. III (Continued)

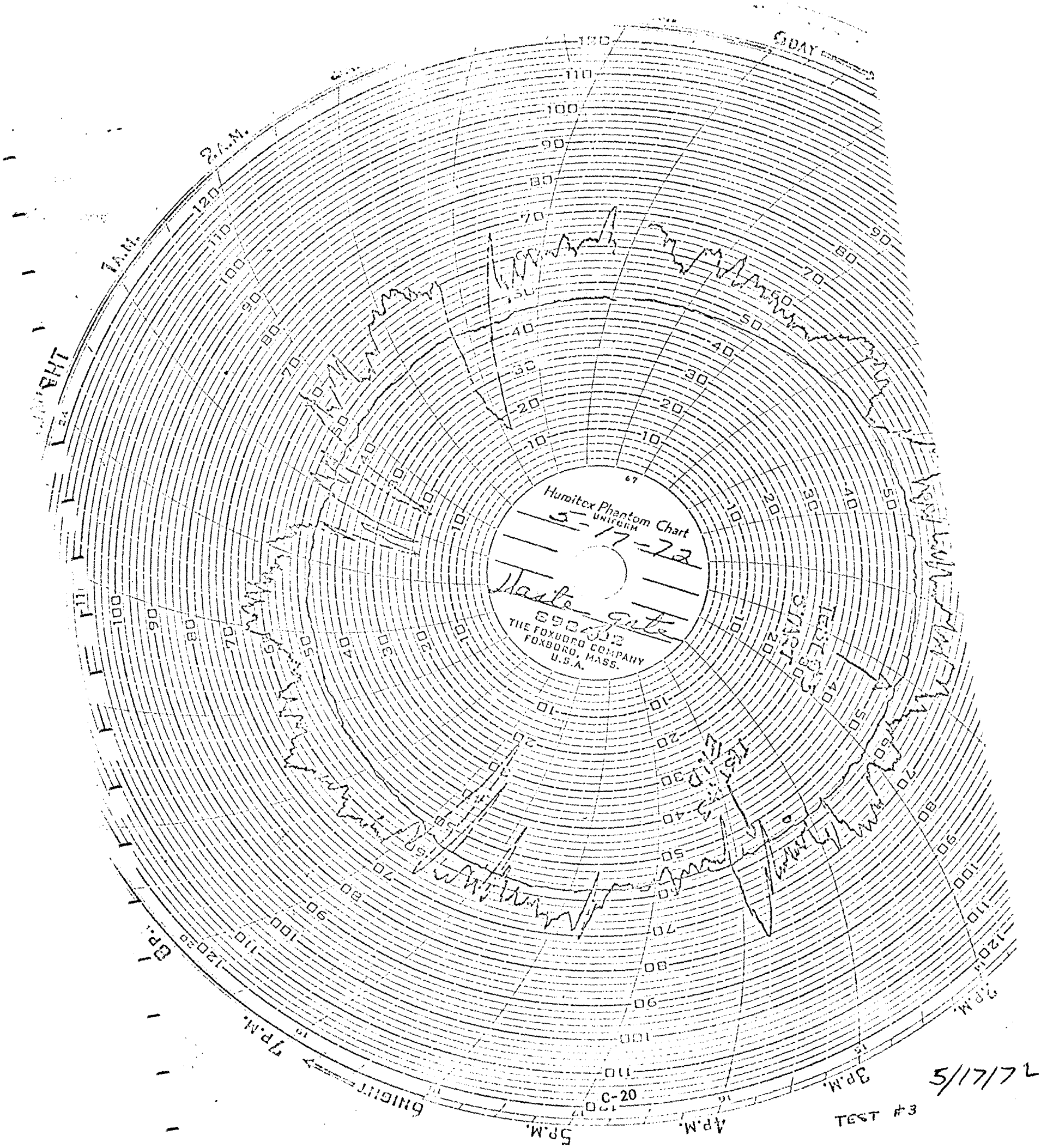
Time	Temperature: Blast Furnace Flue Temp. °F	Temperature: Baghouse Temp. °F	Baghouse Press. "H_2O	H_2O Sprays: Off	H_2O Sprays: On	H_2O Sprays: No. Banks	Shaking Compartment: I	Shaking Compartment: II	Shaking Compartment: III	Furnace Feed	CFM to Furnace	Lead Tap: Start	Lead Tap: Stop	Remarks
2:17	320	140	2.8		X	2				X	7600			Tuyers cleaned.
[illegible]		130	2.9		X	1/2					8800			
[illegible]	320	130	2.5	X							8800			
[illegible]	300	175	2.6	X							8600			
[illegible]	300	185	2.7		X	1/2					8800			
[illegible]	300	185	2.7		X	1 1/2					8800			
2:28	300	170	2.8		X	3					8800			
[illegible]	300	160	1.5		X	4			X		8600			
[illegible]					X	4								
[illegible]	300	135	2.0		X	4			X		8400			
[illegible]					X						8800		X	

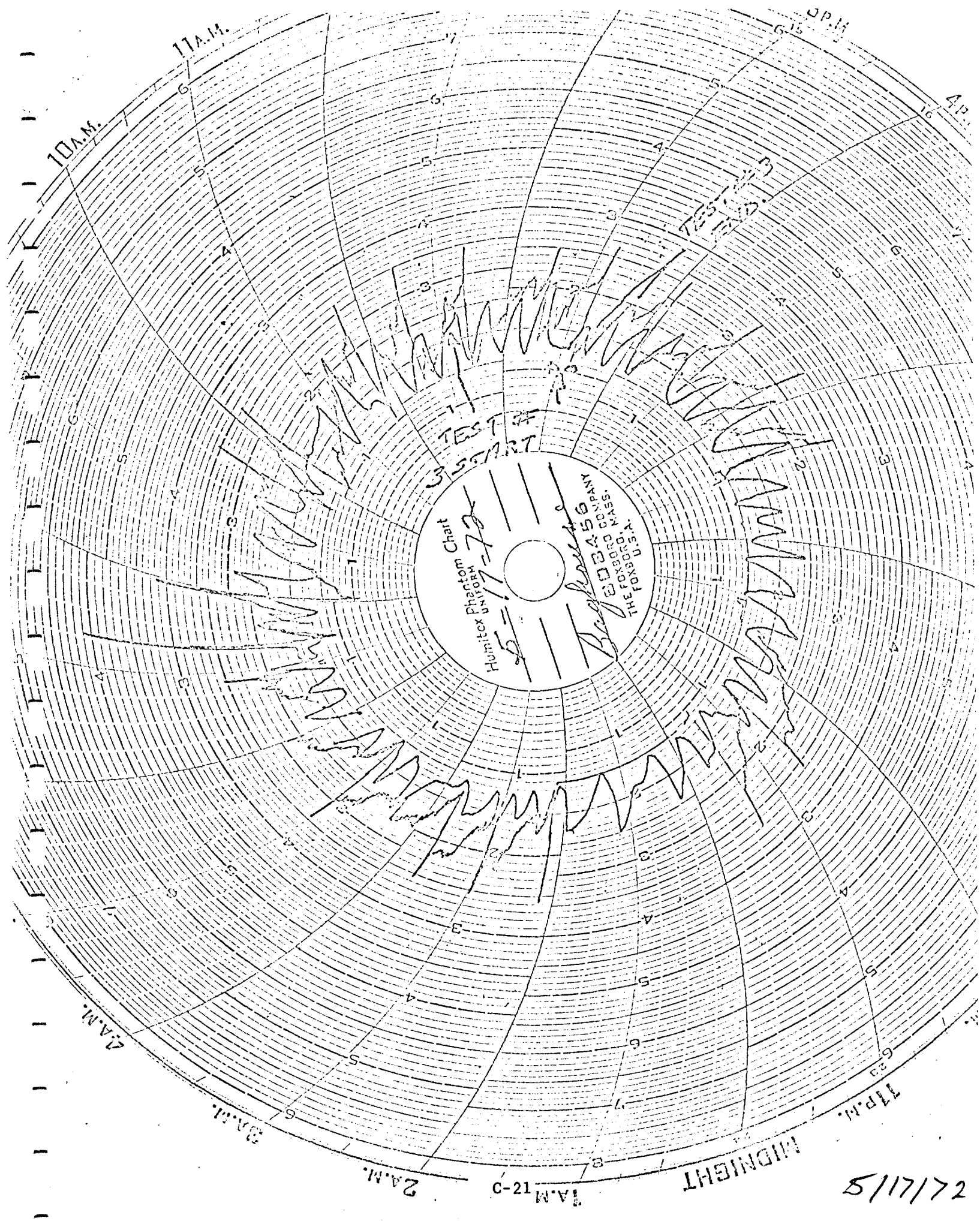
Test No. III (Continued)

Time	Temperature: Blast Furnace Flue Temp. °F	Temperature: Baghouse Temp. °F	Baghouse Press. "H_2O	H_2O Sprays: Off	H_2O Sprays: On	H_2O Sprays: No. Banks	Shaking Compartment: I	Shaking Compartment: II	Shaking Compartment: III	Furnace Feed	CFM to Furnace	Lead Tap: Start	Lead Tap: Stop	Remarks
2140		130			X	3					8800	X		
2145	300	120	2.5		X	1					8800			
2149	300	120	2.2	X							8800			
2177	350	200	2.35		X	4				X	8800			CF 6930
2200	400	140	2.7		X	4					8800			
2209					X	4	X							
2210	320	130	1.7		X						8600			
2215					X	4							X	
2220	300	130	2.0		X	4					8800	X		
2224	300	130	2.1		X	3½				X	8700			
2230	300	140	2.2		X	2					9000			
2235	300	150	2.5		X	3½					8900			

Test No. III (Concluded)

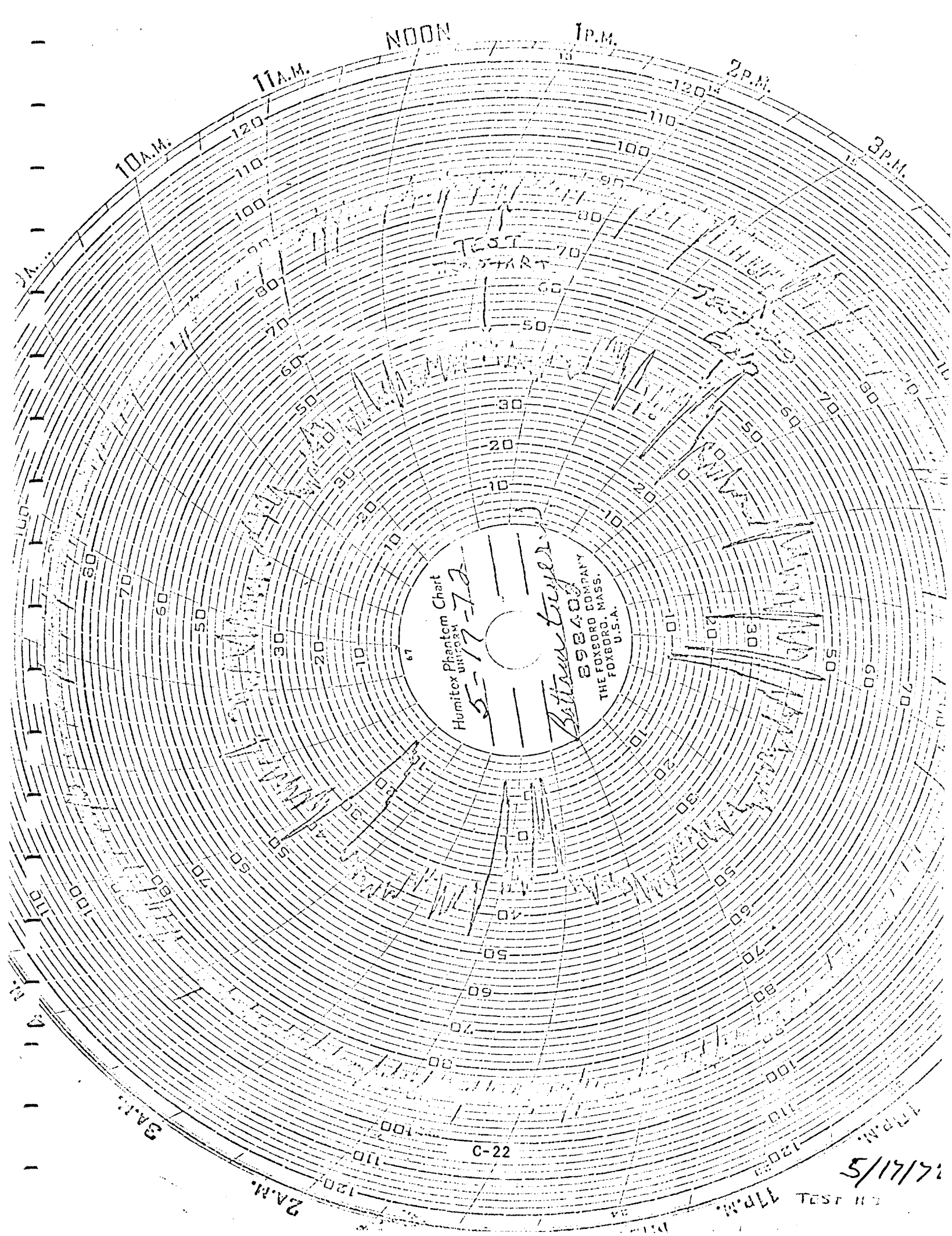
Time	Temperature: Blast Furnace Flue Temp. °F	Temperature: Baghouse Temp. °F	Baghouse Press. "H_2O	H_2O Sprays: Off	H_2O Sprays: On	H_2O Sprays: No. Banks	Shaking Compartment: I	Shaking Compartment: II	Shaking Compartment: III	Furnace Feed	CFM to Furnace	Lead Tap: Start	Lead Tap: Stop	Remarks
3:40	380	130	2.7		X	3					9400			Test [illegible] Pressure dropped and leaverfe incomplete work on furnace
3:45					X									
3:50	240	170	2.6	X							9100			Put V notch in furnace.
	5/17/72													

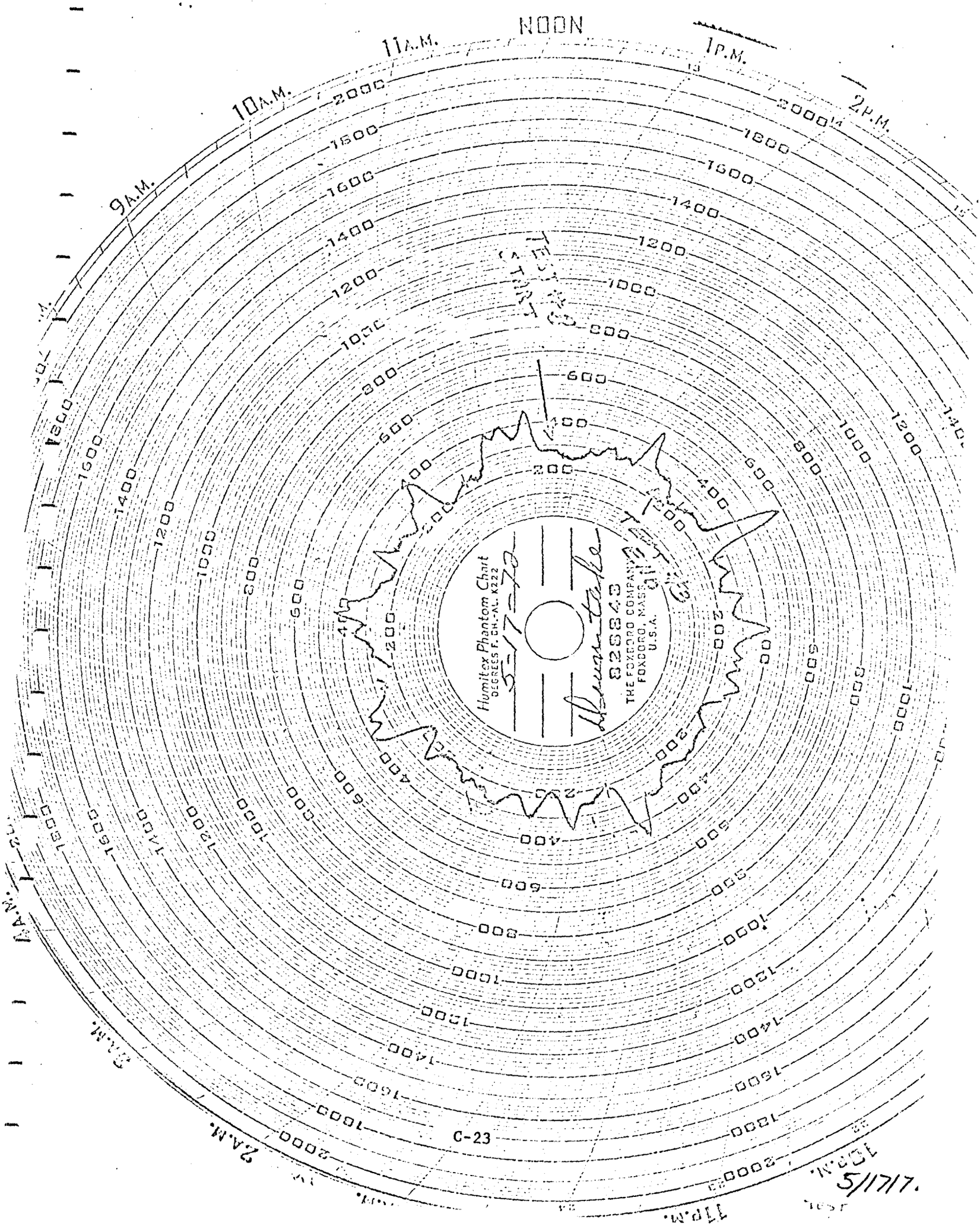

Humitex Phantom Chart
UNIFORM
5-17-72
Master Gate
890002
THE FOXBORO COMPANY
FOXBORO, MASS.
U.S.A.
6 DAY
TEST #3
5/17/72
C-20


10A.M.
11A.M.
12 NOON
1P.M.
2P.M.
3P.M.
4P.M.
5P.M.
6P.M.
7P.M.
8P.M.
9P.M.
10P.M.
11P.M.
MIDNIGHT
1A.M.
2A.M.
3A.M.
4A.M.
5A.M.
6A.M.
7A.M.
8A.M.
9A.M.
TEST #3 START
TEST #3 END
Humitex Phantom Chart
UNIFORM
THE FOXBORO COMPANY
FOXBORO, MASS.
U.S.A.

5/17/72

TEST #3


NOON
1P.M.
2P.M.
3P.M.
11A.M.
10A.M.
TEST
Humitex Phantom Chart
UNIFORM
89840
THE FOXBORO COMPANY
FOXBORO, MASS.
U.S.A.
5/17/72


NOON
11A.M.
1P.M.
10A.M.
2P.M.
9A.M.
Humitex Phantom Chart
DEGREES F. CH. NO. K222
THE FOXBORO COMPANY
FOXBORO, MASS.
U.S.A.
5/17/79

APPENDIX D

FIELD SAMPLING DATA

MIDWEST RESEARCH INSTITUTE

PARTICULATE EMISSION TEST - DATA FORM P

RUN 1-1

MRI Project Number 3585-C11
Field Dates 5/15-18/72
Plant ASARCO
Sampling Location Blast F. Baghouse
Sampling Date 5-15-72
16

FIELD CREW

Project Chief R C Tossey

Testing Engineer
3 E Trompeter
2 R Conkling
1 ~~G Kelso~~ R Stultz

Engr. Technician
1 E Cartwright
3 ~~R Stultz~~ G Kelso
2 H Maloney

Lab Technician
1 R Flippin
2
3

Process Engineer
1 ~~R Flippin~~ EPA only
2

Other
1
2

Form	Date Out	Name	Date In	Checked
P1 - Stack Geometry				
P2 - Traverse Points				
P3 - Preliminary Traverse Data				
P4 - Preliminary Moisture Determination				
P5 - Nomograph Settings				
P6 - Carrier Gas Sampling (Orsat)				
P7 - Carrier Gas Analysis (Orsat)				
P8 - Sampling Train Specifications				
P9 - Particulate Sampling				
P10 - Particulate Analysis				

5-15-72 Trompeter

MRI - Form PO (3/72)

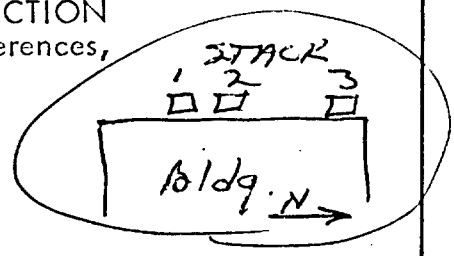
MIDWEST RESEARCH INSTITUTE

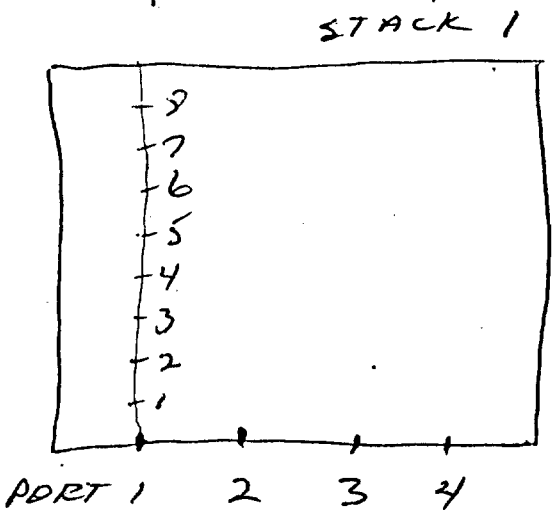
Run Number 1-1
Date 5-15-72

STACK GEOMETRY

Recorded by RCT

SKETCH OF FLOW PROFILE AND CROSS-SECTION
(Illustrate port-point configuration, flow interferences, platform dimensions)





NOTE: If previously illustrated - See Run No. 1-3

A. Distance from inside far wall to outside of port 83 1/4 in.

B. Port length 1/4 in.

STACK DIAMETER: (A-B) 83 in.

STACK AREA: _____ in.^{2}

Sampling cross-section is:

No. of Duct Diameters		Type of Flow Obstruction
4 1/2	diameters downstream of	breeching
2	diameters upstream of	ambient

MRI - Form P1 (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 1-1

TRAVERSE POINTS

Recorded by RCY Date 5-12

Checked by G Riley 5-12

Point	PERCENT OF DIAMETER FROM INSIDE PORT TO POINT No. of Traverse Points on a Diameter 83" inside square												Distance from Inside Port (in.)	Distance from Outside Port (in.)	Use (in.)
	2	4	6	8	10	12	14	16	18	20	22	24			
1	14.6	6.7	4.4	3.3	2.5	2.1	1.8	1.6	1.4	1.3	1.1	1.1	5.19	1 1/4	5 1/2
2	85.4	25.0	14.7	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2	15.56	"	15 3/4
3		75.0	29.5	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5	25.94	"	25 1/4
4		93.3	70.5	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9	36.32	"	36 1/2
5			85.3	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5	46.69	"	46 3/4
6			95.6	80.6	65.8	35.5	26.9	22.0	18.8	16.5	14.6	13.2	57.06	"	57 1/4
7				89.5	77.4	64.5	36.6	28.3	23.6	20.4	18.0	16.1	67.44	"	67 3/4
8				96.7	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4	77.82	"	78
9					91.8	82.3	73.1	62.5	38.2	30.6	26.1	23.0			
10					97.5	88.2	79.9	71.7	61.8	38.8	31.5	27.2			
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3			
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8			
13							94.3	87.5	81.2	75.0	68.5	60.2			
14							98.2	91.5	85.4	79.6	73.9	67.7			
15								95.1	89.1	83.5	78.2	72.8			
16								98.4	92.5	87.1	82.0	77.0			
17									95.6	90.3	85.4	80.6			
18		NOTE: If previously determined see Run No. ____							98.6	93.3	88.4	83.9			
19										96.1	91.3	86.8			
20										98.7	94.0	89.5			
21											96.5	92.1			
22											98.9	94.5			
23												96.8			
24												98.9			

MRI - Form P2 (3/72)

MIDWEST RESEARCH INSTITUTE

Run No. 1-1
Date 5-15-72

PRELIMINARY TRAVERSE DATA

Recorded by R. Stultz
Assisted by EC

Port-Point	Clock Time	Velocity Head Δ P (in. H_2O)	Stk. Temp (°F)	Port-Point	Clock Time	Velocity Head Δ P (in. H_2O)	Stk. Temp (°F)
1-1				3-1			
2	1525	.130	118	2	1531	.090	122
3		*		3			
4	1527	.155	120	4	1532	.100	125
5				5			
6	1528	.190	122	6	1532	.050	122
7				7			
8	1529	.165	118	8	1542	.050	126
2-1				4-1			
2				2	1544	.093	120
3				3			
4				4	1545	.094	124
5				5			
6				6	1546	.110	120
7				7			
8				8	1547	.120	115
Approx. Average				Approx. Average			

stuff

	Velocity	Temperature	Pressure
Sensor	☒ "S": No. PROBE # Sequence: Impact ___ Static ___	☒ Thermocouple ☐ Other ___	☒ "S": No. 7' Sequence: Impact ___ Static ~~.035~~
Reading Device	☐ Conventional: No ___ ☒ Console (0-6 in. H_2O) ☒ High Sensitivity (0-0.25) ☐ Other ___	☒ Potentiometer ☐ Other ___	☐ Conventional: No. ___ ☐ Console (0-6 in. H_2O) ☒ High Sensitivity (0-0.25) ☐ Other

Stack Pressure + ( ) (in. H_2O) = (.037)

MRI Form P3 (3/72)

MIDWEST RESEARCH INSTITUTE

PRELIMINARY

MOISTURE DETERMINATION

Run Number 1-1

Date 5-15-72

Recorded by RCV

Assisted by _____

NOTE: Same as Run No. _____

A. Condensor and/or Silica Gel Method

Barometric Pressure, P_B = _____ in. Hg

☐ Barometer Location _____

Reading Time _____ by _____

☐ Elevation _____

	Clock Time	Dry Gas Meter Reading(cf)	Flowmeter Setting	Dry Gas Meter Temp (°F)	Impinger Water Volume (ml)
Final					
Initial					
Difference		Vm =			Wc =

Tube No.	Weight (Grams)		
	Final	Initial	Difference
Total Moisture Adsorbed:			Wa =

Run 1-1 Result

Meter Pressure, $P_B \approx Pm$ = Vm = 29.03 in. Hg

Average Meter Temperature, Tm = 110 °F

Total Weight of Moisture Collected, Wc + Wa = Wm = 68.6 gm

Moisture Content = $\frac{100}{1 + 375 \frac{Pm\,Vm}{(Tm+460)\,Wm}}$ = 3.8 % by Volume

596.735
504.53
92.205 = Vm

B. Wet/Dry Bulb Method

Dry Bulb Temperature = _____ °F

Wet Bulb Temperature = _____ °F

Moisture Content (from Ref. Table) = _____ % by Volume

C. Predetermined Value

% Moisture 4 Basis Dragesin - Pressure

MRI - Form P4 (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 1-1
Date 5-15-72
16

NOMOGRAPH SETTINGS

Recorded by R. Stultz
Checked by G Riley 5-16-
RCD

NOTE: Same as Run No. _____

Ta	-	Ambient Temperature	=	65	°F
Pb	-	Barometric Pressure	=	~~28.98~~ 29.03	in. Hg 0800 5/16/
Δ H@	-	Reference ΔH	=	1.84	in. H_2O
Tm	-	Avg. Meter Temperature, (Ta + 20 °F)	=	85	°F
%H_2O	-	Moisture Content	=	4	% by Vol.
P_o	-	Static (Gauge) Pressure in Stack	=	-.035	in.H_2O
		x 0.073	=	-.0026	in.Hg
Ps	-	Absolute Pressure in Stack, Pb + Po	=	~~28.98~~ 29.03	in. Hg
Pm	-	Meter Pressure (≈ Pb)	=	~~28.98~~ 29.03	in. Hg
Ps/Pm	-	= 1.0			
C	-	Correction Factor = 1.03			
Ts	-	Stack Temperature	=	120	°F
Δ P	-	Average Stack Velocity Head	=	.112	in. Hg
Δ P max	-	Maximum Stack Velocity Head	=	.190	in. Hg
D	-	Probe Tip Diameter	=	3/8	in.

Ts						
ΔP_{ref}						

MRI - Form P5 (3/72)

MIDWEST RESEARCH INSTITUTE
SAMPLING TRAIN
SPECIFICATIONS

Run Number 1-1
Date 5-15-72

Recorded by _____

Unit No.
8-3
~~8-2~~

PROBE

Length =	Lining Material	Initial Tip Diameter	Pitot Tube Coefficient	Pitot Tube Sequence
8 ft.	☐ S. Steel	☐ 1/8" ☐ 1/4"	~~☐ .85~~	☐ Impact
	☒ Pyrex	☒ 3/8" ☐ 1/2"	☐ _____	☐ Static
		Changed _____		

OTHER: cyclone bypass used

SAMPLING CASE

11 Filter Holder Type

☒ RAC 2-1/2"

☐ GI 3-1/2"

☐ _____

Filter No.:
~~1095~~
EPA 72-000-802 ↗ _____
1098

Impinger Content				
Number	Normal		Use	
	Material	Amount	Material	Amount
1	DDW	100 ml	H_2O	100
2	DDW	100 ml	H_2O	100
3	DRY	-	dry	dry
4	Adsorbent*	~200 gm		≈200

Container weight = _____ gm

Container + Adsorbent Weight = 588.8 gm

* ☒ Silica Gel ☐ Drierite ☐ _____

UMBILICAL CORD

50-6

Length = 50 ft (Console)
Length = _____ ft (Sample Box)

Connector No. _____

CONTROL CONSOLE

5 Manometer Type

☐ Console (0-6 in.H_2O)

☒ High Sensitivity (0-.25 in.H_2O)

☐ Other _____

Leak Check

At a vacuum of 15 in.Hg.

.005 CFM

(≤ 0.02 is acceptable) 5/16/72

By _____ Clock Time 6:50

MRI - Form P8 (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 1-1
Date 5-~~15~~ 16-72

PARTICULATE SAMPLING

Recorded by RCS

Port Point	Samp. Time (Min)	Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
1-1	4	0905	504.53 / 506.602	.046	.89	81	81	115	3.6 /	
2		0923	508.87	.060	1.17	88	84	124	4.0 /	1-2
3		0944	511.21	.075	1.46	91	85	120	4.8 /	
4			513.745	.100	1.94	90	85	128	4.8 /	
5		START 1000	516.710	.093	1.81	95	86	138	5.2 /	3
6		1011	521.240	.260	5.00	104	87	143	12.0 /	4
7		~~1019~~	525.985	.255	4.90	115	90	140	12.1 / 73	
8		1019	529.702	.200	2.85	124	94	134	7.4 /	
2-1		1029	533.010	.120	2.31	~~[illegible]~~	96	120	6.1 /	
2		~~[illegible]~~	536.315	.130	2.50	119	98	126	6.5 /	
3		1037	539.865	.140	2.70	124	100	135	7.0 /	
4		1042	543.675	.165	3.20	127	101	141	7.8 / 73	
5		1046	547.453	.160	3.10	128	102	152	7.7 /	
6			551.750	.200	3.90	128	102	155	9.0 / 72	
7			556.185	.240	4.60	127	102	136	10.9 /	
8			560.163	.180	3.50	132	102	125	8.0 /	
3-1		1106	562.347	.08	1.60	112	102	133	4.2 /	
2		1110	564.420	.039	.76	111	102	135	3.2 /	5
3		~~1114~~ 1114	566.721	.060	1.19	118	103	138	4.0 /	
4		1118	569.100	.060	1.19	123	104	139	4.0 /	
5		1122	571.545	.065	1.25	127	105	140	4.0 / 72	
6		1126	574.196	.075	1.48	128	106	140	4.5 /	
7		1130	576.888	.075	1.48	131	108	141	4.6 /	
8		1134	579.605	.075	1.48	136	109	146	4.6 /	

Comments:

1. Test stopped for 13 m Because of Blast Furnace
2. Power failure for 2' min
3. Blown Bag 7m off
4. Switched to high range manom.
5. Switched to low range manom.
6.
7.
8.
9.
10.
11.

MRI-Form P9 (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 1-1
Date 5-~~15~~-72
16

PARTICULATE SAMPLING

Recorded by RCS

Port Point	Samp. Time (Min)	Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
4-1	4	1141	579.605 / 581.371	.030	.59	128	109	149	3.0 /	
2		1145	583.304	.043	.84	126	110	150	3.5 /	
3		1149	585.385	.040	.78	125	111	151	3.5 /	
4		1153	587.500	.045	.88	126	111	151	3.5 /	
5		1157	589.690	.043	.84	130	112	151	3.5 /	
6		1201	592.050	.060	1.15	130	112	149	4.0 / 76	
7		1205	594.416	.060	1.15	129	112	140	4.0 /	
8		1209	596.735	.058	1.12	132	112	132	4.0 /	

Comments:

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.

Run 1 Dtect 1

MIDWEST RESEARCH INSTITUTE

RCT & RF in field

Run Number 1-1

Analysis Dates _____

PARTICULATE CLEAN-UP AND ANALYSIS

Recorded by _____

Impinger Sequence	1	2	3	4	5	6
Impinger Type*	M	S	M	M		
Final Volume**				567.4		
Initial Volume **	100	100	dry	~~538.8 gm~~		
Difference	138	108	5	585		

* S = Greenburg-Smith standard, M = modified, O = Other _____

** Indicate value and units (ml or gm)

EPA

	Sample No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By
12 000 809	0608		1	85.55814	85.54731	.1083	MH
810	0609		2	84.15485	84.09554	382.[illegible]	MH
811	0610		3	84.60194	84.59487	143.[illegible]7	MH
	—		4				
807	0606		5	83.92859	83.79364	555	MH
808	0607	1098	6	.20938	.20547		MH
			6				
			6				
			7	82.36541	82.36540	200	RCT 1
			8	86.11134	86.11132	200	RCT 1
854	0655		9	81.74379	81.74359	175	MH 6
853	0654		10	82.34117	82.34117	150	MH
812	0611	21122	see - discarded in field				
			Acetone	82.36541	82.36540	200	MH
			Chloroform	86.11134	86.11132	200	MH

MRI 2 & 8

one sample of each for 3 runs

Comments:

Codes:

1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MIDWEST RESEARCH INSTITUTE

PARTICULATE EMISSION TEST - DATA FORM P

RUN 1-2

MRI Project Number 3585-C11
Field Dates 5/15-18/72
Plant ASARCO
Sampling Location Blast F. Baghouse
Sampling Date May 16, 1972

FIELD CREW

Project Chief R Clussey

Testing Engineer ~~1~~ 3 E Trompeter
2 R Conkling
~~1~~ ~~G Kelso~~ R. Stultz

Engr. Technician 1 E Cartwright
~~3~~ 3 ~~R Stultz~~ G Kelso
~~2~~ 2 H Moloney

Lab Technician 1 R Flippin
2
3

Process Engineer 1 ~~R Flippin~~ EPA only
2

Other 1
2

Form	Date Out	Name	Date In	Checked
P1 - Stack Geometry				
P2 - Traverse Points				
P3 - Preliminary Traverse Data	5-16-72	Conkling		
P4 - Preliminary Moisture Determination				
P5 - Nomograph Settings				
P6 - Carrier Gas Sampling (Orsat)				
P7 - Carrier Gas Analysis (Orsat)				
P8 - Sampling Train Specifications				
P9 - Particulate Sampling				
P10 - Particulate Analysis				

MRI - Form PO (3/72)

MIDWEST RESEARCH INSTITUTE

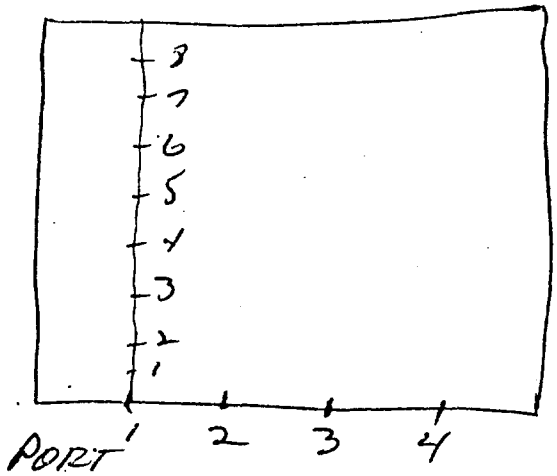
Run Number 1-2
Date 5-15-72

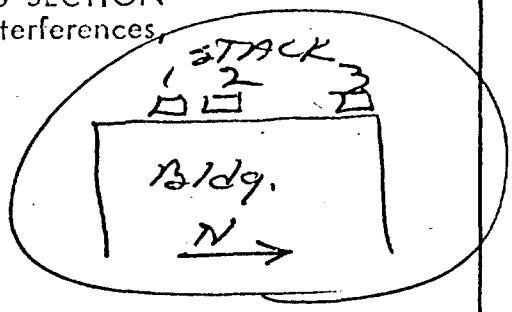
STACK GEOMETRY

Recorded by RCJ

SKETCH OF FLOW PROFILE AND CROSS-SECTION
(Illustrate port-point configuration, flow interferences, platform dimensions)

STACK 2





NOTE: If previously illustrated - See Run No. 1-3

A. Distance from inside far wall to outside of port 83 1/4 in.

B. Port length 1/4 in.

STACK DIAMETER: (A-B) 83 in.

STACK AREA: _____ in.^{2}

Sampling cross-section is:

No. of Duct Diameters		Type of Flow Obstruction
4 1/2	diameters downstream of	breeching
2	diameters upstream of	ambient

MRI - Form PI (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 1-2

TRAVERSE POINTS

Recorded by RCT Date 5-12

Checked by G Riley 5-12

Point	PERCENT OF DIAMETER FROM INSIDE PORT TO POINT No. of Traverse Points on a Diameter 83" inside square												Distance from Inside Port (in.)	Distance from Outside Port (in.)	Use (in.)
	2	4	6	8	10	12	14	16	18	20	22	24			
1	14.6	6.7	4.4	3.3	2.5	2.1	1.8	1.6	1.4	1.3	1.1	1.1			5 1/2
2	85.4	25.0	14.7	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2			15 3/4
3		75.0	29.5	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5			25 1/4
4		93.3	70.5	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9			
5			85.3	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5			
6			95.6	80.6	65.8	35.5	26.9	22.0	18.8	16.5	14.6	13.2			
7				89.5	77.4	64.5	36.6	28.3	23.6	20.4	18.0	16.1			
8				96.7	85.4	65.0	63.4	37.5	29.6	25.0	21.8	19.4			
9					91.8	82.3	73.1	62.5	38.2	30.6	26.1	23.0			
10					97.5	88.2	79.9	71.7	61.8	38.8	31.5	27.2			
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3			
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8			
13							94.3	87.5	81.2	75.0	68.5	60.2			
14							98.2	91.5	85.4	79.6	73.9	67.7			
15								95.1	89.1	83.5	78.2	72.8			
16								98.4	92.5	87.1	82.0	77.0			
17									95.6	90.3	85.4	80.6			
18		NOTE: If previously determined see Run No. 1-3							98.6	93.3	88.4	83.9			
19										96.1	91.3	86.8			
20										98.7	94.0	89.5			
21											96.5	92.1			
22											98.9	94.5			
23												96.8			
24												98.9			

MRI - Form P2 (3/72)

MIDWEST RESEARCH INSTITUTE

Run No. 1-2
Date 5-15-72

PRELIMINARY TRAVERSE DATA

Recorded by RSC.
Assisted by H. Malaney + Cochrane

Port-Point	Clock Time	Velocity Head Δ P (in. H_2O)	Stk. Temp (°F)	Port-Point	Clock Time	Velocity Head Δ P (in. H_2O)	Stk. Temp (°F)
1-1				3-1			
2	1725	.045	120	2	1721	.053	125
3				3			
4	1726	.045	125	4	1722	.061	125
5				5			
6	172630	.055	125	6	172230	.062	125
7				7			
8	1727	.054	125	8	1723	.052	125
2-1				4-1			
2	1717	.052	120	2			
3				3			
4	1718	.048	125	4			
5			1	5			
6	1719	.045	125	6			
7				7			
8	1720	.046	125	8			
9							
Approx. Average				Approx. Average			

	Velocity	Temperature	Pressure
Sensor	☒ "S": No. ~~Probe~~ 3' Pitox Sequence: Impact ____ Static ____	☒ Thermocouple ☐ Other ____	☒ "S": No. ~~Probe~~ 3' Pitox Sequence: Impact ____ Static ____
Reading Device	☐ Conventional: No ____ ☐ Console (0-6 in. H_2O) ☒ High Sensitivity (0-0.25) ☐ Other ____	☒ Potentiometer ☐ Other ____	☐ Conventional: No. ____ ☐ Console (0-6 in. H_2O) ☒ High Sensitivity (0-0.25) ☐ Other Stack Pressure + ( ) (in. H_2O) = (.02)

MRI Form P3 (3/72) P3A.

.105 .23

MIDWEST RESEARCH INSTITUTE

Run No. 1-2
Date 5-15-72

PRELIMINARY TRAVERSE DATA

Recorded by R.S.C.
Assisted by H. Malone + Carlw

Port-Point	Clock Time	Velocity Head Δ P (in. H_2O)	Stk. Temp (°F)	Port-Point	Clock Time	Velocity Head Δ P (in. H_2O)	Stk. Temp (°F)
1-1	~~1500~~	~~.105~~	~~120~~	3-1	1509	.205	130
2	1500	.105 (.07)	120	2			
3				3			~~135~~
4	1501	.11 (.05)	120	4	1512	.230	135
5				5			
6	1504	.125 (.067)	120	6	1513	.220	135
7				7			
8	1505	.17 (.075)	120	8	1515	.200	130
2-1				4-1	1519	.145	135
2				2			
3				3			
4				4	1520	.170	137
5				5			
6				6	1521	.175	133
7				7			
8				8	1522	~~.175~~ .130 RSC.	133
Approx. Average				Approx. Average			

Removed balls from Pitot line. See Page 15A.

	Velocity	Temperature	Pressure
Sensor	☒ "S": No. ~~PROBE~~ 7' Pitot Sequence: Impact ____ Static ____	☒ Thermocouple ☐ Other ____	☒ "S": No. 7' Pitot Sequence: Impact ____ Static ____
Reading Device	☐ Conventional: No ____ ☐ Console (0-6 in. H_2O) ☒ High Sensitivity (0-0.25) ☐ Other ____	☒ Potentiometer ☐ Other ____	☐ Conventional: No. ____ ☐ Console (0-6 in. H_2O) ☒ High Sensitivity (0-0.25) ☐ Other

Stack Pressure + ( ) (in. H_2O) = (.23) .02 RSC.

MRI Form P3 (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 1-2 / 16

Date 5-15-72

NOMOGRAPH SETTINGS

Recorded by RL

Checked by RC / RCR 5-16-

NOTE: Same as Run No. _____

Ta	-	Ambient Temperature	=	65	°F
Pb	-	Barometric Pressure	=	~~28.98~~ 29.03 (0800 5-16-72)	in. Hg
Δ HΘ	-	Reference ΔH	=	1.84	in. H_2O
Tm	-	Avg. Meter Temperature, (Ta + 20 °F)	=	85	°F
%H_2O	-	Moisture Content	=	4	% by Vol.
P_o	-	Static (Gauge) Pressure in Stack	=	-.23	in. H_2O
		.073 × .23 = .219 / .016 79	x 0.073 =	.01679	in. Hg
Ps	-	Absolute Pressure in Stack, Pb + Po	28.98 =		in. Hg
Pm	-	Meter Pressure (≈ Pb)	=		in. Hg
Ps/Pm	-	= 1			
C	-	Correction Factor = ~~1.05~~ 1.03 RSC			
Ts	-	Stack Temperature	=	~~[illegible]~~ 125 RSC	°F
Δ P	-	Average Stack Velocity Head	.053 RSC =	~~RSC .235~~ ~~.047~~	in. Hg
Δ P max	-	Maximum Stack Velocity Head	=	~~.23~~ ~~RSC~~ .062	in. Hg
D	-	Probe Tip Diameter	=	.375	in.

Ts						
ΔPref						

MRI - Form P5 (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 1-2
Date 5-15-72

CARRIER GAS
SAMPLING (ORSAT)

Recorded by _____
Assisted by _____

Barometric Pressure _____ in. Hg
Stack (Gauge) Pressure _____ in. Hg

Ambient Temperature _____ °F
Stack Temperature _____ °F

See Run 1-3

A. Grab Sample (Evacuated Bulb)

Sampling Train Description:
Bulb Material and Volume _____ ml
Probe Material and Length _____ in.
Prefilter Material _____

Sampling Location:
Port _____
Point or Distance from Inside of Port _____

Comments: _____

Bulb No.	Initial Bulb Vacuum (in. Hg)	Vacuum Measurement Time (min)	Clock Time

B. Integrated Sample (Tedlar Bag - MRI Train)

Sampling Unit Number _____

Sampling Location:
Port _____
Point or Distance from Inside of Port _____

	Clock Time	Valve Setting	Flowmeter Reading	Box Vacuum (in. H_2O)
Start				
Stop				

MRI - Form P6 (3/72)

MIDWEST RESEARCH INSTITUTE

CARRIER GAS ANALYSIS (ORSAT)

Run Number 1-2

Analysis Date 5-15-72

Recorded by _____

Analysis Location: _____

Clock Time: From: _____ To: _____

Orsat Unit Number: _____

Sample identification	CO_2 Reading 1	Reading 2	O_2 (2-1)	Reading 3	CO (3-1)
	Avg =		Avg =		Avg =
	Avg =		Avg =		Avg =
	Avg =		Avg =		Avg =
	Avg =		Avg =		Avg =

Comments:

see Run 1-3

MRI - Form P7 (3/72)

MIDWEST RESEARCH INSTITUTE
SAMPLING TRAIN
SPECIFICATIONS

Run Number 1-2
Date 5-~~15~~ 16-72

Recorded by RC

Unit No.

8-2
~~8-3~~

PROBE

Length =	Lining Material	Initial Tip Diameter	Pitot Tube Coefficient	Pitot Tube Sequence
8 ft.	☐ S. Steel	☐ 1/8" ☐ 1/4"	☒ .85	☐ Impact
	☒ Pyrex	☒ 3/8" ☐ 1/2"	☐ _____	☐ Static
		Changed _____		

OTHER: cyclone bypass used

SAMPLING CASE

~~#1~~ Filter Holder Type

☒ RAC 2-1/2"

☐ GI 3-1/2"

☐ _____

Filter No.: 1095

Impinger Content				
Number	Normal		Use	
	Material	Amount	Material	Amount
1	DDW	100 ml	H_2O	100
2	DDW	100 ml	H_2O	100
3	DRY	-	dry	dry
4	Adsorbent*	~200 gm		≈ 200 gm

Container weight = _____ gm

Container + Adsorbent Weight = 567.4 gm

* ☒ Silica Gel ☐ Drierite ☐ _____

UMBILICAL CORD

50-7

Length = 50 ft (Console)

Length = _____ ft (Sample Box)

Connector No. _____

CONTROL CONSOLE

8 Manometer Type

☐ Console (0-6 in.H_2O)

☒ High Sensitivity (0-.25 in.H_2O)

☐ Other _____

Leak Check

At a vacuum of 15 in.Hg.

0 CFM

($\leq$ 0.02 is acceptable)

By RC Clock Time 1614

MRI - Form P8 (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 1-2
Date ~~5-15-72~~ 5-16-72

PARTICULATE SAMPLING

Recorded by RSC.

Port Point	Samp. Time (Min)	Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
1-1	4	0905	~~19.822~~ 22.01	.05	.960	80	80	125	3.5 /	
2		0923	24.45	.075	1.~~3~~47	84	80	135	4.5 /	(1) 22.5
3		0944	27.04	.06 .075	1.41	84	83	142	4.5 /	(2), (3) 24.
4			29.55	.065	1.21	85	83	135	4.2 /	(4) 29.
5		Start 10:00	32.20	.1/.06	1.84/1.21	89	84	150	5.5 / 275	
6			34.21	.03/.035	.570/.65	96	85	155	3.0 /	
7		10:08	36.41	.05	.93	99	86	147	4.0 /	
8		10:12	38.62	.047	.888	103	87	150	3.7 /	
2-1		10:24	~~38.74~~ 40.95	.047	.888	98	89	128	5.7 /	
2		10:28	43.17	.05/.045	.894/.77	103	90	125	4.0 /	
3		10:32	45.29	.045/.04*	.84/.75*	106	91	120	3.5 /	5
4		10:36	47.45	.04/	.75/	108	93	126	3.2 /	
5		10:40	49.47	.042/	.84/	110	94	131	3.5 /	
6		10:44	51.95	.055/	1.05/	110	95	132	4.0 / 85	
7		10:48	54.13	.05/.065	.945/1.05	110	95	130	3.7 /	
8		10:52	56.77	.08/	1.42/	110	96	122	4.5 /	
3-1		10:58	~~56.99~~ 59.08	.05/.04	.945/.751	108	96	128	3.7 /	
2		11:02	~~61.22~~ 61.47	.055/	1.05/	108	97	120	4.0 /	6
3		11:12	65.29	.26/	4.31/	108	96	124	12 /	
4		1116	70.22	.25/.29	4.6/5.35	121	97	120	14 /	
5		1120	75.22	.26/.23	4.8/4.25	130	99	138	11 /	
6		1124	79.81	.23/.25	4.25/4.65	130	101	125	9.2 /	
7		1130	84.56	.25/	4.65/	130	105	127	9.8 /	
8		1134	89.11	.2/.24	3.75/4.5	134	103	126	8.2 /	

Comments:

1. off for (13 min) Blast furnace problems.
2. Power off for 32 min.
3. Reset Nomo for 150° Stack 1= ΔP
4. off for (9 min 22 sec)
5. Reset Nomo for 130° Stack. ΔP = .097*
6. off for Cleaning (5 min + 3 sec)
7.
8.
9.
10.
11.

Check nozzle to the pitot tube, it is thin.

MIDWEST RESEARCH INSTITUTE

Run Number 1-2

Date 5-~~15~~ 16-72 RSC

PARTICULATE SAMPLING

Recorded by RSC.

Port Point	Samp. Time (Min)	Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
4-1	4	1140	~~89.11~~ 92.96	.15	2.81	123	104	156	6.1 /	
2		1144	96.90	.19/.17	3.56/3.20	124	104	151	7.5 /	
3		1148	100.93	.18/	3.35/	125	104	159	7.1 /	
4		1152	105.31	.23/.22*	4.2/4.0	126	105	160 *	8.8 /	1
5		1156	109.73	.22/	4.0/	130	106	151	8.8 /	
6		1200	114.07	.20/	3.7/	134	107	150	8.1 /	
7		1204	118.28	.18/.22	3.32/4.00	130	107	142	7.5 /	
8		1208	122.45	.18/	3.32/	132	107	129	7.5 /	

Comments:

1. Reset nozzle to 140°
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.

MRI-Form P9 (3/72)

Run 1 Stack 2

MIDWEST RESEARCH INSTITUTE

RCT & RF in field

Run Number 1-2

Analysis Dates _____

PARTICULATE CLEAN-UP AND ANALYSIS

Recorded by _____

Impinger Sequence	1	2	3	4	5	6
Impinger Type*	M	S	M	M		
Final Volume**				588.8		
Initial Volume **	100	100	dry	~~567.4 gm~~		
Difference	132	114	5	611		

* S = Greenburg-Smith standard, M = modified, O = Other _____

** Indicate value and units (ml or gm)

EPA	Sample No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By
803	0602		1	80.71279	80.70218		
804	0603		2	80.96238	80.91136	338	MH
805	0604		3	84.34886	84.38982	84	MH
	—		4				
801	0600		5	67.02415	66.98616	386	MH
802	0601	1095	6	.20716	.20247		MH
	~~0601~~		6				
			6				
			7	82.36541	82.36540	200	RCT
			8	86.11134	86.11132	200	RCT
856	0655		9	81.74379	81.74359	175	MH
855	0654		10	87.34116	87.34116	150	MH
806	0605	silica gel	— discarded in field				

Comments:

Codes:

1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MIDWEST RESEARCH INSTITUTE

PARTICULATE EMISSION TEST - DATA FORM P

RUN 1-3

MRI Project Number 3585-C11
Field Dates 5/15-18/72
Plant ASARCO
Sampling Location Blast F. Baghouse
Sampling Date 5-16-72

FIELD CREW

Project Chief R C Tossey

Testing Engineer 02 R Conkling
03 E Trompeter
01 ~~G Kelso~~ R Stultz

Engr. Technician 03 ~~R Stultz~~ Kelso
01 E Cartwright
02 H Moloney

Lab Technician 1 R Flippin
2
3

Process Engineer 1 ~~R Flippin~~ EPA only
2

Other 1
2

Form	Date Out	Name	Date In	Checked
P1 - Stack Geometry				
P2 - Traverse Points				
P3 - Preliminary Traverse Data	5-15-72	[illegible]		
P4 - Preliminary Moisture Determination				
P5 - Nomograph Settings				
P6 - Carrier Gas Sampling (Orsat)				
P7 - Carrier Gas Analysis (Orsat)				
P8 - Sampling Train Specifications				
P9 - Particulate Sampling				
P10 - Particulate Analysis				

MRI - Form PO (3/72)

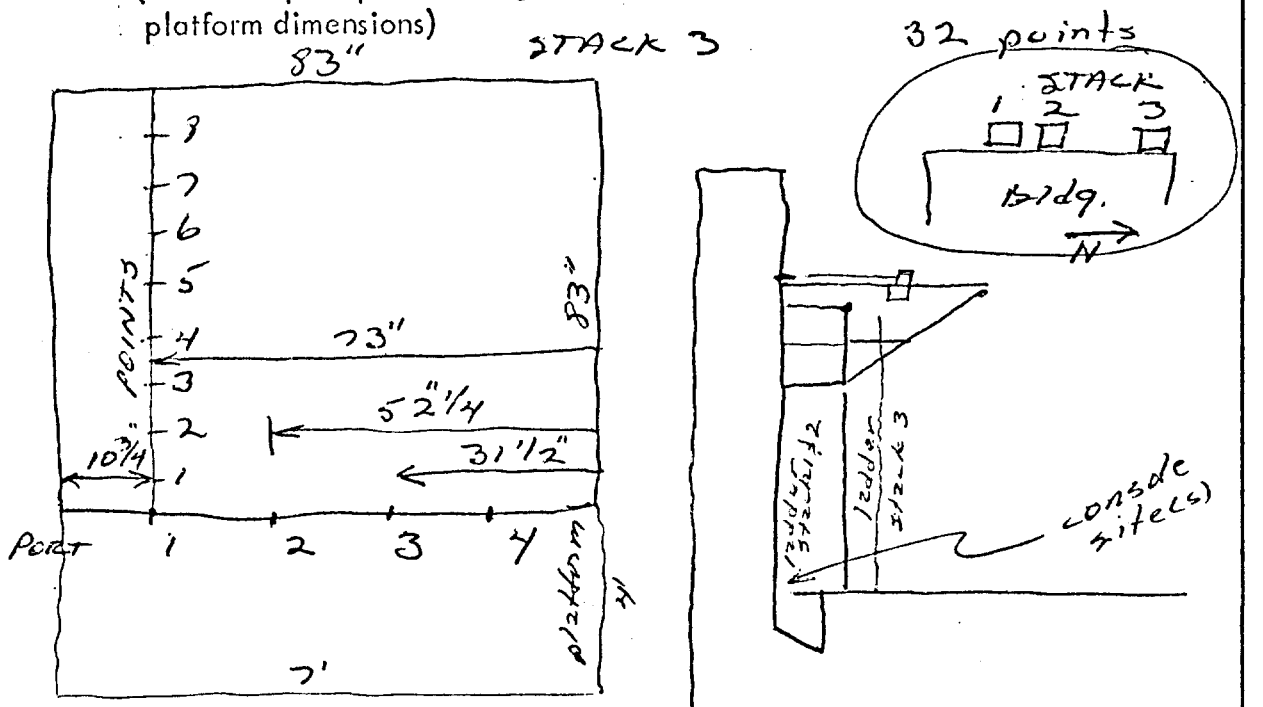
MIDWEST RESEARCH INSTITUTE

Run Number 1-3
Date 5-15

STACK GEOMETRY

Recorded by RCT

SKETCH OF FLOW PROFILE AND CROSS-SECTION
(Illustrate port-point configuration, flow interferences, platform dimensions)



NOTE: If previously illustrated - See Run No. ☐

A. Distance from inside far wall to outside of port: 83 1/4 in.

B. Port length: 1/4 in.

STACK DIAMETER: equivalent (A-B): 83" in.

STACK AREA: _____ in.^{2}

Sampling cross-section is:

No. of Duct Diameters		Type of Flow Obstruction
4 1/2	diameters downstream of	breeching
2	diameters upstream of	ambient

MIDWEST RESEARCH INSTITUTE

Run Number 1-3

TRAVERSE POINTS

Recorded by RCT Date 5-12

Checked by G Riley 5-12

PERCENT OF DIAMETER FROM INSIDE PORT TO POINT

No. of Traverse Points on a Diameter 83" square

Point	2	4	6	8	10	12	14	16	18	20	22	24	Distance from Inside Port (in.)	Distance from Outside Port (in.)	Use (in.)
1	14.6	6.7	4.4	3.3	2.5	2.1	1.8	1.6	1.4	1.3	1.1	1.1	5.19	+ 1/4	5 1/2
2	85.4	25.0	14.7	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2	15.56	"	15 3/4
3		75.0	29.5	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5	25.94	"	25 1/4
4		93.3	70.5	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9	36.32	"	36 1/2
5			85.3	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5	46.69	"	46 3/4
6			95.6	80.6	65.8	35.5	26.9	22.0	18.8	16.5	14.6	13.2	57.06	"	57 1/4
7				89.5	77.4	64.5	36.6	28.3	23.6	20.4	18.0	16.1	67.44	"	67 3/4
8				96.7	85.4	65.0	63.4	37.5	29.6	25.0	21.8	19.4	77.82	"	78
9					91.8	82.3	73.1	62.5	38.2	30.6	26.1	23.0			
10					97.5	88.2	79.9	71.7	61.8	38.8	31.5	27.2			
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3			
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8			
13							94.3	87.5	81.2	75.0	68.5	60.2			
14							98.2	91.5	85.4	79.6	73.9	67.7			
15								95.1	89.1	83.5	78.2	72.8			
16								98.4	92.5	87.1	82.0	77.0			
17									95.6	90.3	85.4	80.6			
18		NOTE: If previously determined see Run No. ____							98.6	93.3	88.4	83.9			
19										96.1	91.3	86.8			
20										98.7	94.0	89.5			
21											96.5	92.1			
22											98.9	94.5			
23												96.8			
24												98.9			

MRI - Form P2 (3/72)

MIDWEST RESEARCH INSTITUTE

Run No. 1-3
Date 5-15

PRELIMINARY TRAVERSE DATA

Recorded by F.T.
Assisted by C. K. [illegible]

Port-Point	Clock Time	Velocity Head Δ P (in. H_2O)	Stk. Temp (°F)	Port-Point	Clock Time	Velocity Head Δ P (in. H_2O)	Stk. Temp (°F)
1-1				3-1			
2	16:04	.069	121	2	16:12	.048	130
3				3			
4	16:06	.093	128	4	16:14	.050	130
5				5			
6	16:07	.099	128	6	16:15	.055	130 ← S.P.
7				7			
8	16:08	.073	128	8	16:18	.067	128
2-1				4-1			
2				2	16:20	.042	124
3				3			
4				4	16:22	.043	125
5				5			
6				6	16:23	.041	125
7				7			
8				8	16:25	.050	125
Approx. Average				Approx. Average			

	Velocity	Temperature	Pressure
Sensor	☒ "S": No. PROBE # Sequence: Impact ___ Static ___	☒ Thermocouple ☐ Other ___	☐ "S": No. 7 ft ~~[illegible]~~ Sequence: Impact ___ Static ___
Reading Device	☐ Conventional: No ___ ☒ Console (0-6 in. H_2O) ☒ High Sensitivity (0-0.25) ☐ Other ___	☒ Potentiometer ☐ Other ___	☐ Conventional: No. ___ ☐ Console (0-6 in. H_2O) ☒ High Sensitivity (0-0.25) ☐ Other

Stack Pressure + (~~[illegible]~~) (in. H_2O) = (.085)

MRI Form P3 (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 1-3

Date 5-~~18~~-72 16

NOMOGRAPH SETTINGS

Recorded by ET

Checked by [illegible] 5-16-

NOTE: Same as Run No. _____

Ta	-	Ambient Temperature	=	65	°F
Pb	-	Barometric Pressure	=	~~29.93~~ 29.03	in. Hg 0800 5-16-72
Δ HΘ	-	Reference ΔH	=	1.84	in. H_2O
Tm	-	Avg. Meter Temperature, (Ta + 20 °F)	=	85	°F
$\%H_2O$	-	Moisture Content	=	4	% by Vol.
P_o	-	Static (Gauge) Pressure in Stack	=	− ~~.051~~ .085	in. H_2O
		x 0.073	=	.0037	in. Hg
Ps	-	Absolute Pressure in Stack, Pb + Po	=	28.98	in. Hg
Pm	-	Meter Pressure (≈ Pb)	=	28.9	in. Hg
Ps/Pm	-	= 1.0			
C	-	Correction Factor = 1.03			
Ts	-	Stack Temperature	=	128	°F
Δ P	-	Average Stack Velocity Head	=	.060	in. Hg
Δ P max	-	Maximum Stack Velocity Head	=	.099	in. Hg
D	-	Probe Tip Diameter	=	.375	in.

Ts						
ΔPref						

MRI - Form P5 (3/72)

MIDWEST RESEARCH INSTITUTE

CARRIER GAS SAMPLING (ORSAT)

Run Number 1-3
Date 5-~~15~~-72 16

Recorded by RF
Assisted by

Barometric Pressure ~~28.93~~ 29.03 in. Hg (9:20 AM 8:00 AM)
Stack (Gauge) Pressure _____ in. Hg

Ambient Temperature 65 °F
Stack Temperature 128 °F

A. Grab Sample (Evacuated Bulb)

Sampling Train Description:
Bulb Material and Volume _____ ml
Probe Material and Length _____ in.
Prefilter Material _____

Sampling Location:
Port _____
Point or Distance from Inside of Port _____

Comments: _____

Bulb No.	Initial Bulb Vacuum (in. Hg)	Vacuum Measurement Time (min)	Clock Time

B. Integrated Sample (Tedlar Bag - MRI Train)

Sampling Unit Number no number

Sampling Location:
Port Gas Port located ≈ 1D above breaching top inlet near console level
Point or Distance from Inside of Port ≈ 2'
comments: ≈ 2 ft³ sample

	Clock Time	Valve Setting	Flowmeter Reading	Box Vacuum (in. H_2O)
Start	0915	open wide to bag	1.5	not connected
		other valve	steel ball	
Stop	1030	50	1.5	

Matheson 620 PB W603

MRI - Form P6 (3/72)

MIDWEST RESEARCH INSTITUTE

CARRIER GAS ANALYSIS (ORSAT)

Run Number 1-3

Analysis Date 5-16-72

Recorded by RF

Analysis Location: ASARCO - Truck Izb

Clock Time: From: ~~0915~~ 1130 To: ~~1030~~ 1200

Orsat Unit Number: 0-3

Sample Identification	CO2 Reading 1	Reading 2	O2 (2-1)	Reading 3	CO (3-1)
Run 1-3 Blast furnace bashouse gas port	1.2	20.2	19.0	20.8	1.8
	1.6	20.6	19.0	21.6	2.6
	1.6	20.6	19.0	21.4	2.4
	Avg = 1.46		Avg = 19.0		Avg = 2.26
	Avg =		Avg =		Avg =
	Avg =		Avg =		Avg =
	Avg =		Avg =		Avg =

Comments:

MRI - Form P7 (3/72)

MIDWEST RESEARCH INSTITUTE
SAMPLING TRAIN
SPECIFICATIONS

Run Number 1-3
Date 5-15-72
Recorded by ET

Unit No.

PROBE

Unit No.	Length	Lining Material	Initial Tip Diameter	Pitot Tube Coefficient	Pitot Tube Sequence
8-1	8 ft.	☐ S. Steel ☒ Pyrex	☐ 1/8" ☐ 1/4" ☒ 3/8" ☐ 1/2" Changed ____	☒ .85 ☐ ____	☐ Impact ☐ Static

OTHER: cyclone bypass used

SAMPLING CASE

7 Filter Holder Type

☒ RAC 2-1/2"

☐ GI 3-1/2"

☐ ____

Filter No.: 1097

Impinger Content				
Number	Normal		Use	
	Material	Amount	Material	Amount
1	DDW	100 ml	H_2O	100
2	DDW	100 ml	H_2O	100
3	DRY	-	dry	dry
4	Adsorbent*	~200 gm		≈ 200

Container weight = ____ gm

Container + Adsorbent Weight = 527.4 gm

* ☒ Silica Gel ☐ Drierite ☐ ____

UMBILICAL CORD

50-4

Length = 50 ft (Console)

Length = ____ ft (Sample Box)

Connector No. none

CONTROL CONSOLE

7 Manometer Type

☐ Console (0-6 in.H_2O)

☒ High Sensitivity (0-.25 in.H_2O)

☐ Other ____

Leak Check

At a vacuum of 15 in.Hg.

.00 CFM

($\leq$ 0.02 is acceptable)

By ET Clock Time 1710

MRI - Form P8 (3/72)

Run 1 Stack 3

MIDWEST RESEARCH INSTITUTE

Run Number 1-3
Date 5-16-72

PARTICULATE SAMPLING

Recorded by ET

Port Point	Samp. Time (Min)	Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
1-1	4	09:05	~~707.717~~ ~~710.175~~	~~.099~~ ~~.049~~	~~1.790~~ ~~.945~~	73	74	127	5.8	
2		09:23	713.210	.125	2.430	81	77	~~124~~	8.5	1
3		09:44	716.433	.115	2.210	80	79	128	8.0	2 ~~3~~
4		10:00	719.62	.120	2.300	82	79	125	8.0	3
5		10:04:45	722.670	.080	1.580	84	80	143	6.1	4
6		10:08:45	726.215	.140	2.700	92	81	142	4.5 / 65	
7		10:12:45	729.380	.113	2.200	100	82	141	8.0	
8		10:16:45	732.348	.095	1.850	103	84	142	7.0	
2-1		1028	~~732.348~~ ~~734.420~~	.073	1.420	94	86	128	6.0	5
2		1032	~~734.900~~ ~~737.600~~	.082	1.600	98	87	127	6.0	
3		1036	~~737.600~~ ~~740.460~~	.092	1.790	102	88	132	6.7	
4		10:40	~~740.460~~ ~~743.130~~	.098	1.900	106	89	137	7.0	
5		10:44	746.370	.095	1.850	108	90	143	7.0 / 65	
6		10:48	749.40	.095	1.850	107	91	148	7.0	
7		10:52	752.760	.120	2.300	107	92	142	8.0	
8		10.56	755.934	.100	1.930	110	92	132	7.0	
3-1		1105	~~755.934~~ 758.180	.070	1.370	94	90	122	5.8	
2		1109	760.045	.035	.690	97	90	121	4.0	
3		1113	762.040	.043	.830	102	91	128	4.3	
4		1117	764.050	.043	.830	102	92	130	4.5	
5		1121	765.950	.035	.690	104	92	132	4.0 / 70	
6		1125	767.930	.038	.740	102	93	132	4.2	
7		1129	769.990	.043	.830	103	93	135	4.4	
8		1133	772.145	.049	.945	107	94	140	4.4	

Comments:

1. Stopped at ~~15 min~~ 13 min delay Blower Furnace Prob. 09:09:45
2. 32 min shutdown power failure
3. Mix up
4. Stopped 10:03:20 sec
5. Meter Volume should be moved back one for first 4 readings
6. 1
7.
8.
9.
10.
11.

MRI-Form P9 (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number ~~3-4~~ 1-3
Date 5-16-72

PARTICULATE SAMPLING

Recorded by ET

Port Point	Samp. Time (Min)	Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
4-1	4	1146	772.45 / 773.720	.018	.358	96	94	142	3.2	
2		1150	775.350	.029	.573	98	94	152	3.3	1
3		1154	777.220	.033	.649	100	94	152	4.0	
4		1158	779.110	.035	.685	104	95	153	4.0	
5		1202	781.000	.034	.670	105	95	152	4.0	
6		1206	782.950	.037	.730	105	96	143	4.2 / 70	
7		1210	784.933	.038	.740	108	96	140	4.2	
8		1214	787.050	.043	.833	109	97	138	4.5	

Comments:

1. Changed nomograph to 140°F
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.

Run 1 Stack 3 — questions on impinger — missapied run 1-1 instead of 1-3 RCT 1-26-73

MIDWEST RESEARCH INSTITUTE

Run Number ~~3-1~~ 1-3

Analysis Dates _____

PARTICULATE CLEAN-UP AND ANALYSIS

RCT & RF in field

Recorded by _____

Impinger Sequence	1	2	3	4	5	6
Impinger Type*	m	s	m	m		
Final Volume**	RCT					
Initial Volume **	100	100	dry	577.4		
Difference	~~135~~ 123	~~108~~ 116	~~5~~ 3	593		

593
577
15
12
2
5

* S = Greenburg-Smith standard, M = modified, O = Other _____

** Indicate value and units (ml or gm)

EPA	Sample No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By
815	0614		1	81.25066	81.24200	-	MH
816	0615		2	78.69240	78.66634	370	MH
817	0616		3	81.09671	81.08900	80	MH
	—		4				
813	0612		5	82.89765	82.88149	426	MH
814	~~0613~~	1097	6	.20012	.19903		
			6				
			6				
			7	82.36541	82.36540	200	RCT
			8	86.11134	86.11132	200	RCT
856	0655		9	81.74379	81.74359	175	MH
855	0654		10	82.34117	82.34117	150	MH
818	0617	filter set — discarded in field					

Comments:
Sample removed 5-16-72 RF

Codes:
1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MIDWEST RESEARCH INSTITUTE

PARTICULATE EMISSION TEST - DATA FORM P

RUN 2-1

MRI Project Number 3585-C11
Field Dates 5/15-19/72
Plant ASARCO
Sampling Location STACK 1
Sampling Date 5-16-72

FIELD CREW

Project Chief R C Tussey

Testing Engineer
1 R Shultz
2 R Conkling
3 E Trompeter

Engr. Technician
1 E Cartwright
2 H Moloney
3 G Relso

Lab Technician
1 R Flippin
2
3

Process Engineer
1 R Flippin
2

Other
1
2

Form	Date Out	Name	Date In	Checked
P1 - Stack Geometry				
P2 - Traverse Points				
P3 - Preliminary Traverse Data	5-16-72	R Shultz		
P4 - Preliminary Moisture Determination				
P5 - Nomograph Settings				
P6 - Carrier Gas Sampling (Orsat)				
P7 - Carrier Gas Analysis (Orsat)				
P8 - Sampling Train Specifications				
P9 - Particulate Sampling				
P10 - Particulate Analysis				

MRI - Form PO (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 2-1
Date 5-16-72

NOMOGRAPH SETTINGS

Recorded by RCS
Checked by RCT

NOTE: Same as Run No. 2

Ta	-	Ambient Temperature	=	90	°F
Pb	-	Barometric Pressure	=	29.00 at 1520	in. Hg
Δ H@	-	Reference ΔH	=		in. H_2O
Tm	-	Avg. Meter Temperature, (Ta + 20 °F)	=	110	°F
%H_2O	-	Moisture Content	=	4	% by Vol.
P_o	-	Static (Gauge) Pressure in Stack	=	-.035	in.H_2O
		x 0.073	=	-.0026	in.Hg
Ps	-	Absolute Pressure in Stack, Pb + Po	=	29.00	in. Hg
Pm	-	Meter Pressure (≈ Pb)	=	29.00	in. Hg
Ps/Pm	-	= 1.0			
C	-	Correction Factor = 1.1			
Ts	-	Stack Temperature	=	140	°F
Δ P	-	Average Stack Velocity Head	=	.100	in. Hg
Δ P max	-	Maximum Stack Velocity Head	=	.260	in. Hg
D	-	Probe Tip Diameter	=	3/8	in.

Ts						
ΔP_{ref}						

MRI - Form P5 (3/72)

Run Number 2-1
Date 5-16-72

MIDWEST RESEARCH INSTITUTE
SAMPLING TRAIN
SPECIFICATIONS

Recorded by RCS

Unit No.

PROBE

Unit No.	Length =	Lining Material	Initial Tip Diameter	Pitot Tube Coefficient	Pitot Tube Sequence
8-3	8 ft.	☐ S. Steel	☐ 1/8" ☐ 1/4"	☑ .85	☐ Impact
		☒ Pyrex	☒ 3/8" ☐ 1/2"	☐ _____	☐ Static
			Changed _____		

SAMPLING CASE

11 Filter Holder Type

☒ RAC 2-1/2"

☐ GI 3-1/2"

☐ _____

Filter No.: 1099

Impinger Content				
Number	Normal		Use	
	Material	Amount	Material	Amount
1	DDW	100 ml	H_2O	100
2	DDW	100 ml	H_2O	100
3	DRY	-	dry	dry
4	Adsorbent*	~200 gm		≈200

Container weight = _____ gm

Container + Adsorbent Weight = 563 gm

* ☒ Silica Gel ☐ Drierite ☐ _____

UMBILICAL CORD

50-6 Length = 50 ft (Console)

Length = _____ ft (Sample Box)

Connector No. _____

CONTROL CONSOLE

5 Manometer Type

☒ Console (0-6 in.H_2O)

☒ High Sensitivity (0-.25 in.H_2O)

☐ Other _____

Leak Check

At a vacuum of 15 in.Hg.

.02 CFM

($\leq$ 0.02 is acceptable) 5/16/72

By RCS Clock Time 1530

MRI - Form P8 (3/72)

Run 2 Stack 1

MIDWEST RESEARCH INSTITUTE

Run Number 2-1
Date 5-16-72

PARTICULATE SAMPLING

Recorded by RCS

Port Point	Samp. Time (Min)	Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
4-1	4	1555	596.834 / 597.010	.05	1.0	85	89	149	3.9	
2		1559	601.621	.07	1.40	89	88	146	4.9	
3		1603	604.3[illegible]	.075	1.56	94	88	138	[illegible]	
4		1607	606.965	.075	1.50	[illegible]	88	130	4.5	
5		1611	609.578	.070	1.40	107	88	141	4.5	
6		1615	612.250	.075	1.50	114	88	152	4.8	
7		1619	615.000	.080	1.61	119	89	165	5.0 / 68	
8		1623	617.916	.092	1.82	123	90	150	5.5	
3-1		1631	620.540	.073	1.45	113	92	138	4.5	
2		1635	623.410	.090	1.80	116	92	132	5.2	
3		1639	626.320	.085	1.72	120	93	131	5.2	
4		1643	629.270	.092	1.85	119	94	136	5.5	
5		1647	631.615	.075	1.50	121	94	140	4.8	
6		1651	633.850	.050	1.00	116	94	137	4.0 / 63	
7		1655	636.134	.052	1.01	115	94	139	4.9	
8		1659	638.706	.067	1.32	115	94	142	4.5	
2-1		1708	640.961	.055	1.10	104	93	104	4.0	
2		1712	643.355	.063	1.25	107	93	103	4.3	
3		1716	646.100	.078	1.55	111	93	105	4.8	
4		1720	649.105	.098	1.95	114	93	102	5.7	
5		1724	652.060	.097	1.92	118	93	102	5.6 / 61	
6		1728	654.940	.088	1.75	122	93	110	5.4	1
7		1736	659.610	.420	8.50	120	93	105	16.9	2-3
8		1745	664.843	.32	6.10	117	94	98	10.7	

Comments:

1. Shut down for Cleanout start at ~~1736~~ 1728
2. Shut down at 1738
3. Shutdown for 6.5m
4.
5.
6.
7.
8.
9.
10.
11.

MRI-Form P9 (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 2-1
Date 5-16-72

PARTICULATE SAMPLING

Recorded by RCS

Port Point	Samp. Time (Min)	Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
1-1	4	1753	664.843 / 668.953	.19	3.8	114	94	145	6.7 /	
2		1757	673.550	.230	4.5	123	94	150	7.7 /	
3		1801	678.430	.265	5.15	127	94	153	8.5 /	
4		1805	683.542	.30	5.9	130	95	159	10.4 /	
5		1809	688.780	.295	5.8	130	96	158	9.6 /	
6		1813	694.110	.310	6.3	137	97	145	10.6 / 60	
7		1817	699.285	.300	5.9	142	98	130	10.2 /	
8		1821	703.710	.220	4.3	137	100	129	7.5 /	
									/	
									/	
									/	
									/	
									/	
									/	
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									/	
									/	
									/	

Comments:

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.

MIDWEST RESEARCH INSTITUTE

Run Number 2-1 + filter cleaning 5-16 - remainder of box 5-17

Analysis Dates mode PARTICULATE CLEAN-UP AND ANALYSIS Recorded by

	1	2	3	4	5	6
Impinger Sequence						
Impinger Type*	M	S	M	M		
Final Volume**						
Initial Volume **	100	100	dry	563		
Difference	153	114	5	582		

* S = Greenburg-Smith standard, M = modified, O = Other

** Indicate value and units (ml or gm)

	Sample No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By
00 824	0620		1	88.58458	88.57666		MH
822	0621		2	82.62108	82.55322	366	MH
823	0622		3	82.30450	82.30019	93	MH
	—		4				
819	0618		5	86.99154	86.95163	330	MH
820	0619	1099	6	.21309	.20335		MH
			6				
			6				
			7	82.36541	82.36540	200	RCT
			8	86.11134	86.11132	200	RCT
856	0655		9	81.74379	81.74359	175	MH
855	0654		10	82.34117	82.34117	150	MH
824	0623	silica sel		discarded in field			

Comments:

Codes:

1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MIDWEST RESEARCH INSTITUTE

PARTICULATE EMISSION TEST - DATA FORM P

RUN 2-2

MRI Project Number 3585-C11
Field Dates 5/15-19/72
Plant ASARCO
Sampling Location STACK 2
Sampling Date 5-16-72

FIELD CREW

Project Chief R C Tossey

Testing Engineer
1 R Stultz
2 R Conkling
3 E Trompeter

Engr. Technician
1 E Cartwright
2 H Moloney
3 G Kelso

Lab Technician
1 R Flippin
2
3

Process Engineer
1 R Flippin
2

Other
1
2

Form	Date Out	Name	Date In	Checked
P1 - Stack Geometry				
P2 - Traverse Points	5-16-72	Conkling		
P3 - Preliminary Traverse Data				
P4 - Preliminary Moisture Determination				
P5 - Nomograph Settings				
P6 - Carrier Gas Sampling (Orsat)				
P7 - Carrier Gas Analysis (Orsat)				
P8 - Sampling Train Specifications				
P9 - Particulate Sampling				
P10 - Particulate Analysis				

MRI - Form PO (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 2-2
Date May 16, 1972

NOMOGRAPH SETTINGS

Recorded by R.S.C.
Checked by RCF 5-16-72

NOTE: Same as Run No. _____

Ta	-	Ambient Temperature	=	85	°F
Pb	-	Barometric Pressure	=	29.00	in. Hg (1520)
Δ HO	-	Reference ΔH	=	1.84	in. H_2O
Tm	-	Avg. Meter Temperature, (Ta + 20 °F)	=	105	°F
%H_2O	-	Moisture Content	=	4	% by Vol.
P_o	-	Static (Gauge) Pressure in Stack	=		in. H_2O
		x 0.073	=		in. Hg
Ps	-	Absolute Pressure in Stack, Pb + Po	=		in. Hg
Pm	-	Meter Pressure (≈ Pb)	=		in. Hg
Ps/Pm	-	= 1			
C	-	Correction Factor = 1.05			
Ts	-	Stack Temperature	=	140	°F
Δ P	-	Average Stack Velocity Head	=	.053	in. Hg
Δ P max	-	Maximum Stack Velocity Head	=	.062	in. Hg
D	-	Probe Tip Diameter	=	.375	in.

Ts						
ΔP_{ref}						

MRI - Form P5 (3/72)

MIDWEST RESEARCH INSTITUTE
SAMPLING TRAIN
SPECIFICATIONS

Run Number 2-2
Date May 16, 1972

Recorded by RSC

Unit No.

PROBE

Unit No.	Length	Lining Material	Initial Tip Diameter	Pitot Tube Coefficient	Pitot Tube Sequence
8-2	8 ft.	☐ S. Steel ☒ Pyrex	☐ 1/8" ☐ 1/4" ☒ 3/8" ☐ 1/2" Changed _____	☒ .85 ☐ _____	☐ Impact ☐ Static

SAMPLING CASE

Filter Holder Type: 1

☒ RAC 2-1/2"
☐ GI 3-1/2"
☐ _____

Filter No.: 1100

Impinger Content				
Number	Normal		Use	
	Material	Amount	Material	Amount
1	DDW	100 ml	water	100 ml
2	DDW	100 ml	"	"
3	DRY	-	DRY	DRY
4	Adsorbent*	~200 gm		

Container weight = _____ gm
Container + Adsorbent Weight = 560 gm

* ☒ Silica Gel ☐ Drierite ☐ _____

UMBILICAL CORD

50-7

Length = 50 ft (Console)
Length = _____ ft (Sample Box)

Connector No. _____

CONTROL CONSOLE

8

Manometer Type

☒ Console (0-6 in.H_2O)
☒ High Sensitivity (0-.25 in.H_2O)
☐ Other _____

Leak Check

At a vacuum of 15 in.Hg.

.002 CFM

($\leq$ 0.02 is acceptable)

By RSC Clock Time 1525

MRI - Form P8 (3/72)

Run Start
2 2

MIDWEST RESEARCH INSTITUTE

Run Number 2-2
Date May 16, 1972

PARTICULATE SAMPLING

Recorded by RSC.

Port Point	Samp. Time (Min)	Point start time Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
Y-1	4	1555	122.59 / 125.06	.05 / .095 / .01	.95 / 1.42 / 1.12	84	84	150°	4.5	
2		1559	127.72	.075 / .085	1.42 / 1.6	88	83	142	5	
3		1603	130.59	.095	1.84	94	84	130	6	
4		1607	133.62	.125	1.97	100	84	132	6.5	
5		1611	136.70	.125	1.97	104	84	144	6.2	
6		1615	139.89	.11 / .095	2.1 / 1.67	112	86	160	6	
7		1619	142.89	.11	1.94	116	88	160	6.2	
8		1623	145.93	.095 / .115	1.82 / 2.2	117	89	150	6.0	
3-1		1631	148.50	.04	1.15	113	92	136	4.2	
2		1635	151.25	.08	1.57	115	93	134	5.2	
3		1639	154.09	.085	1.65	118	94	135	5.5	
4		1643	156.99	.095 / .085	1.82 / 1.65	120	95	141	5.2	
5		1647	159.80	.11 / .07 / .095	1.95 / 1.37 / .95	121	96	149	7	
6		1651	161.94	.045	.865	116	97	141	3.7	
7		1655	164.08	.045	.865	113	97	145	3.9	
8		1659	166.33	.043 / .055 / .05	.850 / 1.13 / 1.05	110	96	143	3.9	
2-1		1708	168.30	.0355	.685	100	93	136	3.3	
2		1712	170.23	.0355	.685	102	93	140	3.2	
3		1716	172.31	.04 / .047	.761 / .885	102	92	142	3.5	
4		1720	174.49	.047	.889	104	92	138	4.0	
5		1724	176.65	.045	.865	106	92	135	4.0	
6		1728	178.71	.047	.761	109	92	139	3.8	
7		1732	180.62	.04 / .03	.761 / .595	110	92	142	3.2	
8		1736	182.42	.025	.495	108	92	135	3.2	1

Comments:

1. Down 4 min + 30 sec.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.

MIDWEST RESEARCH INSTITUTE

Run Number 2-2
Date May 16, 1972

PARTICULATE SAMPLING

Recorded by RSC.

Port Point	Samp. Time (Min)	Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
1-1	4	1749	182.42 / 183.61	.01	.19	98	90	122	2.1	
2		1753	184.86	.015	.29	98	91	131	2.5	
3		1757	186.26	.017 .02	.321 .389	99	90	136	2.5	
4		1801	187.78	.02	.389	101	90	141	2.7	
5		1805	189.42	.029 .026	.555 (.389)	102	90	141	3.1	1
6		1809	191.19	.032	.612	100	90	143	3.5	
7		1813	193.06	.045 .025	.845 .792	102	89	140	4.0	
8		1817	194.60	.02	.385	103	91	129	3.0	

Comments:

1. All should read .389
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.

MRI-Form P9 (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 2-2 closed 5-16-72 PARTICULATE

Analysis Dates none CLEAN-UP AND ANALYSIS Recorded by _____

Impinger Sequence	1	2	3	4	5	6
Impinger Type*	M	S	M	M		
Final Volume**						
Initial Volume **	100	100	dry	500		
Difference	141	110	5	576.5		

* S = Greenburg-Smith standard, M = modified, O = Other _____

** Indicate value and units (ml or gm)

EPA	Sample No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By
.000 827	0626		1	78.39390	78.38621		MH
828	0627		2	82.09344	82.05985	356	MH
829	0628		3	79.29626	79.29410	90	MH
	—		4				
825	0624		5	78.59244	78.56575	289	MH
826	0625	1100	6	.21257	.20629		MH
			6				
			7	82.36541	82.36540	200	RCT
			8	86.11134	86.11132	200	RCT
			8				
856	0655	~~0655~~	9	81.74379	81.74359	175	MH
855	0654	~~0654~~	10	82.34117	82.34117	150	MH
830	0629	silica gel	discarded in field				

Comments:

Codes:

1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MIDWEST RESEARCH INSTITUTE

PARTICULATE EMISSION TEST - DATA FORM P

RUN 2-3

MRI Project Number 3585-C11
Field Dates 5/15-19/72
Plant ASARCO
Sampling Location STACK 3
Sampling Date 5-16-72

FIELD CREW

Project Chief R C Tussey

Testing Engineer
1 R Stultz
2 R Conkling
3 E Trompeter

Engr. Technician
1 E Cartwright
2 H Maloney
3 G Kelso

Lab Technician
1 R Flippin
2
3

Process Engineer
1 R Flippin
2

Other
1
2

Form	Date Out	Name	Date In	Checked
P1 - Stack Geometry				
P2 - Traverse Points				
P3 - Preliminary Traverse Data	5-16-72	Trompeter		
P4 - Preliminary Moisture Determination				
P5 - Nomograph Settings				
P6 - Carrier Gas Sampling (Orsat)				
P7 - Carrier Gas Analysis (Orsat)				
P8 - Sampling Train Specifications				
P9 - Particulate Sampling				
P10 - Particulate Analysis				

MRI - Form PO (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 2-3
Date 5/16/72

NOMOGRAPH SETTINGS

Recorded by ET
Checked by

NOTE: Same as Run No. _____

Ta	-	Ambient Temperature	=	85	°F
Pb	-	Barometric Pressure	=	29.00	in. Hg
Δ H⊙	-	Reference ΔH	=	1.84	in. H_2O
Tm	-	Avg. Meter Temperature, (Ta + 20 °F)	=	90	°F
%H_2O	-	Moisture Content	=	4	% by Vol.
P_o	-	Static (Gauge) Pressure in Stack	=		in. H_2O
		x 0.073	=		in. Hg
Ps	-	Absolute Pressure in Stack, Pb + Po	=		in. Hg
Pm	-	Meter Pressure (≈ Pb)	=		in. Hg
Ps/Pm	-	= 1.0			
C	-	Correction Factor = 1.04			
Ts	-	Stack Temperature	=	135	°F
Δ P	-	Average Stack Velocity Head	=	.100	in. Hg
Δ P max	-	Maximum Stack Velocity Head	=	.140	in. Hg
D	-	Probe Tip Diameter	=	.375	in.

Ts						
ΔP_{ref}						

MRI - Form P5 (3/72)

MIDWEST RESEARCH INSTITUTE

CARRIER GAS SAMPLING (ORSAT)

Run Number 2-3

Date

RF sampled

Recorded by RCT

Assisted by

Barometric Pressure 29.00 in. Hg

Stack (Gauge) Pressure in. Hg

Ambient Temperature 85 °F

Stack Temperature 150 °F

A. Grab Sample (Evacuated Bulb)

Sampling Train Description:

Bulb Material and Volume ≈ 250 ml glass bulb ml

Probe Material and Length 3 ft tygon in.

Prefilter Material glass wool

Sampling Location:

Port glass port - stack 3

Point or Distance from Inside of Port ≈ 2' SS

Comments: evacuated several times - then pulled with pump for ≈ 10 min.

Bulb No.	Initial Bulb Vacuum (in. Hg)	Vacuum Measurement Time (min)	Clock Time

B. Integrated Sample (Tedlar Bag - MRI Train)

Sampling Unit Number

Sampling Location:

Port

Point or Distance from Inside of Port

	Clock Time	Valve Setting	Flowmeter Reading	Box Vacuum (in. H_2O)
Start				
Stop				

MRI - Form P6 (3/72)

MIDWEST RESEARCH INSTITUTE

CARRIER GAS ANALYSIS (ORSAT)

Run Number 2-3

Analysis Date 5-16-72

RF analysis

Recorded by RCF

Analysis Location: Field 12b

Clock Time: ~~From:~~ ≈ 1800 ~~To:~~

Orsat Unit Number: 0-3

Sample Identification	CO2 Reading 1	Reading 2	O2 (2-1)	Reading 3	CO (3-1)
Run 2-3 stack 3 S2> port	1.4	20.4	19.0	21.4	2.4
	1.6	19.8	18.2	20.2	2.0 ← drop
new O2 solution	1.4	20.6	19.2	21.6	2.4
	Avg = 1.4		Avg = 19.1		Avg = 2.4
	Avg =		Avg =		Avg =
	Avg =		Avg =		Avg =
	Avg =		Avg =		Avg =

Comments:

MRI - Form P7 (3/72)

Run Number 2-3
Date 5/16/72

MIDWEST RESEARCH INSTITUTE
SAMPLING TRAIN
SPECIFICATIONS

Recorded by ET

Unit No.

PROBE

8-1

Length = 8 ft.

Lining Material	Initial Tip Diameter	Pitot Tube Coefficient	Pitot Tube Sequence
☐ S. Steel	☐ 1/8" ☐ 1/4"	☒ .85	☐ Impact
☒ Pyrex	☒ 3/8" ☐ 1/2" Changed ____	☐ ____	☐ Static

SAMPLING CASE

7

Filter Holder Type

☒ RAC 2-1/2"

☐ GI 3-1/2"

☐ ____

Filter No.: 1101

Impinger Content				
Number	Normal		Use	
	Material	Amount	Material	Amount
1	DDW	100 ml	H_2O	100
2	DDW	100 ml	H_2O	100
3	DRY	-	dry	dry
4	Adsorbent*	~200 gm		

Container weight = ____ gm

Container + Adsorbent Weight = 565.5 gm

* ☒ Silica Gel ☐ Drierite ☐ ____

UMBILICAL CORD

50-4

Length = 50 ft (Console)

Length = ____ ft (Sample Box)

Connector No. ____

CONTROL CONSOLE

7

Manometer Type

☐ Console (0-6 in.H_2O)

☒ High Sensitivity (0-.25 in.H_2O)

☐ Other ____

Leak Check

At a vacuum of 15 in.Hg.

.003 Thru probe tip CFM

($\leq$ 0.02 is acceptable)

By ET GK Clock Time 1530

MRI - Form P8 (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 2-3
Date 5/16/72

PARTICULATE SAMPLING

Recorded by ET

Port Point	Samp. Time (Min)	Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
4-1	4	1555	787.140 / 789.155	.018	.375	81	83	141	3.0 /	
4-2		1559	790.82	.027	.550	83	83	142	3.7 /	
3		1603	792.64	.033	.665	88	83	129	4.0 /	
4		1607	794.420	.030	.620	93	84	122	4.0 /	
5		1611	796.210	.037	.750	96	84	128	4.1 /	
6		1615	798.030	.031	.630	100	84	132	4.0 / 65	
7		1619	800.290	.065	1.290	104	85	141	5.5 /	
8		1623	802.378	.040	.800	109	86	135	4.5 /	
3-1		1636	804.410	.040	.800	96	86	127	4.3 /	
2		1640	806.550	.052	.950	101	88	127	4.7 /	
3		1644 / 1645	808.790	.053	1.060	106	88	131	4.9 /	1
4			812.880	.240	4.650	108	91	135	15.0 /	
5			817.070	.195	3.800	113	90	138	13.0 /	
6			821.350	.210	4.000	118	90	143	13.0 / 65	
7			825.78	.230	4.400	123	91	129	15.0 /	
8			830.098	.215	4.100	125	92	121	14.0 /	
2-1		1720	833.24	.110	2.130	101	90	133	7.5 /	
2		1724	836.64	.130	2.580	106	90	128	9.0 /	
3		1728	840.140	.130	2.580	115	90	136	9.0 /	
4		1732	843.580	.165	3.230	121	91	150	11.0 /	
5	stack up →	1736 / 1743	846.370	.090	1.610	121	92	140	6.5 /	2
6			849.240	.085	1.700	108	92	129	6.8 /	
7			852.040	.080	1.610	110	92	130	6.5 /	
8			854.400	.055	1.100	112	91	132	5.0 / 60	

Comments:

1. 1647:15 sec stopped for previous clamp
2. 1734:40 sec Fouled up
3.
4.
5.
6.
7.
8.
9.
10.
11.

MRI-Form P9 (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 2-3
Date 5/16/72

PARTICULATE SAMPLING

Recorded by ET

Port Point	Samp. Time (Min)	Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
1-1	4	1800	~~854.400~~ 856.400	.043	.860	105	92	142	4.5	
2		1804	85[illegible]	.059	1.180	104	92	145	5.5	
3		1808	861.[illegible]	.076	1.530	102	91	147	6.0	
4		1812	864.550	.095	1.890	104	90	145	7.2	
5		1816	867.870	.115	2.300	109	89	142	8.3	
6		1820	871.270	.123	2.460	114	90	132	8.5	
7		1824	874.380	.097	1.950	108	89	128	7.2	60
8		1828	876.925	.067	1.330	102	87	130	5.0	

Comments:

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.

MRI-Form P9 (3/72)

Run 2 Stack 3

MIDWEST RESEARCH INSTITUTE

Run Number 2-3
Analysis Dates _____

PARTICULATE
CLEAN-UP AND ANALYSIS

Recorded by _____

	1	2	3	4	5	6
Impinger Sequence						
Impinger Type*	M	S	M	M		
Final Volume**						
Initial Volume **	100 ml	100 ml	dry	565.5		
Difference	138	118	5	585.5		

* S = Greenburg-Smith standard, M = modified, O = Other _____
** Indicate value and units (ml or gm)

EPA	Sample No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By
1000 833	0632		1	89.61393	89.60743		MH
834	0633		2	81.27026	81.21521	372	MH
835	0634		3	79.28939	79.26800	102	MH
	—		4				
831	0630		5	77.17285	77.09470	308	MH
832	0631	1101	6	.19646	.19306		MH
			6				
			6				
			7	82.36541	82.36540	200	RCT
			8	86.11131	86.11132	200	RCT
856	0655		9	81.74379	81.74359	175	MH
855	0654		10	82.34117	82.34117	150	MH
836	0635	1101	2	1 discarded in field			

Comments:

Codes:

1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MIDWEST RESEARCH INSTITUTE

PARTICULATE EMISSION TEST - DATA FORM P

RUN 3-1

MRI Project Number 3585-C11
Field Dates 5/15-18/72
Plant ASARCO
Sampling Location Stack 1 Blast Furnace Baghouse
Sampling Date 5-17-72

FIELD CREW

Project Chief R L Dossey

Testing Engineer
1 R Stultz
2 R Conkling
3 E Trompeter

Engr. Technician
1 E Cardwright
2 H Moloney
3 G Kelso

Lab Technician
1 R Flippin
2
3

Process Engineer
1
2

Other
1
2

Form	Date Out	Name	Date In	Checked
P1 - Stack Geometry				
P2 - Traverse Points				
P3 - Preliminary Traverse Data	5-17-72	R Stultz		
P4 - Preliminary Moisture Determination				
P5 - Nomograph Settings				
P6 - Carrier Gas Sampling (Orsat)				
P7 - Carrier Gas Analysis (Orsat)				
P8 - Sampling Train Specifications				
P9 - Particulate Sampling				
P10 - Particulate Analysis				

MRI - Form PO (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 3-1
Date 5-17-72

NOMOGRAPH SETTINGS

Recorded by RCS
Checked by RCT 5-17-72

NOTE: Same as Run No. _____

Ta	-	Ambient Temperature	=	90	°F
Pb	-	Barometric Pressure	=	29.13	in. Hg
Δ H@	-	Reference ΔH @ ΔH = 2.0 avg. use 1.85	=	1.85 RCT	in. H_2O
Tm	-	Avg. Meter Temperature, (Ta + 20 °F)	=	110	°F
$\%H_2O$	-	Moisture Content	=	4	% by Vol.
P_o	-	Static (Gauge) Pressure in Stack	=	-.035	in. H_2O
		x 0.073	=		in. Hg
Ps	-	Absolute Pressure in Stack, Pb + Po	=	29.13	in. Hg
Pm	-	Meter Pressure (≈ Pb)	=	29.13	in. Hg
Ps/Pm	-	= 1.0			
C	-	Correction Factor = 1.10			
Ts	-	Stack Temperature	=	140	°F
Δ P	-	Average Stack Velocity Head	=		in. Hg
Δ P max	-	Maximum Stack Velocity Head	=		in. Hg
D	-	Probe Tip Diameter	=	3/8	in.

Ts						
ΔP_{ref}						

MRI - Form P5 (3/72)

Run Number 3-1
Date 5-17-72

MIDWEST RESEARCH INSTITUTE
SAMPLING TRAIN
SPECIFICATIONS

Recorded by RCS

Unit No.

PROBE

8-3

Length = 8 ft.

Lining Material	Initial Tip Diameter	Pitot Tube Coefficient	Sequence
☐ S. Steel	☐ 1/8" ☐ 1/4"	☒ .85	☐ Impact
☒ Pyrex	☒ 3/8" ☐ 1/2"	☐ _____	☐ Static
	Changed _____		

SAMPLING CASE

11

Filter Holder Type

☒ RAC 2-1/2"

☐ GI 3-1/2"

☐ _____

Filter No.: 1102

Impinger Content

Number	Normal		Use	
	Material	Amount	Material	Amount
1	DDW	100 ml	H_2O	100
2	DDW	100 ml	H_2O	100
3	DRY	-	dry	dry
4	Adsorbent*	~200 gm		≈ 200

Container weight = _____ gm

Container + Adsorbent Weight = 561.1 gm

* ☒ Silica Gel ☐ Drierite ☐ _____

UMBILICAL CORD

50-6

Length = 50 ft (Console)

Length = _____ ft (Sample Box)

Connector No. _____

CONTROL CONSOLE

5

Manometer Type

☒ Console (0-6 in.H_2O)

☒ High Sensitivity (0-.25 in.H_2O)

☐ Other _____

Leak Check

At a vacuum of 15 in.Hg.

.006 CFM*

($\leq$ 0.02 is acceptable)

By RCS Clock Time 1045

MRI - Form P8 (3/72)

* Silicone grease on all fittings.

MIDWEST RESEARCH INSTITUTE

Run Number 3-1
Date 5-17-72

PARTICULATE SAMPLING

Recorded by RCS

Port Point	Samp. Time (Min)	Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
1-1	4	1310	703.811 / 705.910	.043	.86	84	84	141	3.0 /	
2		1314	708.275	.055	1.12	92	85	148	3.5 /	
3		1318	710.788	.080	1.64	97	85	160	3.8 /	1
4		1326	713.115	.053	1.10	96	86	160	3.5 /	
5		1330	715.616	.062	1.25	98	86	160	3.7 / 72	
6		1334	718.541	.080	1.62	102	86	160	5.0 /	
7		1338	721.558	.095	1.92	106	87	153	5.0 /	
8		1342	724.309	.080	1.65	110	88	148	4.5 /	
2-1		1352	726.580	.050	1.01	100	89	153	3.5 /	
2		1356	728.835	.053	1.07	100	90	160	3.4 /	
3		1400	731.314	.063	1.29	102	90	166	3.7 /	
4		1404	734.184	.087	1.78	110	91	163	4.7 /	
5		1408	737.095	.090	1.83	117	94	160	4.7 / 73	
6		1412	740.115	.098	1.98	115	94	152	4.9 /	
7		1416	743.090	.090	1.85	112	95	145	4.9 /	
8		1420	745.536	.065	1.31	108	96	140	4.0 /	
3-1		1428	747.431	.040	.82	96	93	155	3.3 /	
2		1432	748.995	.020	.41	96	93	155	2.0 /	
3		1436	750.810	.030	.62	101	94	150	2.5 /	
4		1440	752.738	.035	.71	101	94	142	3.0 /	
5		1444	754.513	.033	.68	101	94	140	2.5 / 69	
6		1448	756.411	.035	.71	100	94	152	3.0 /	
7		1452	758.594	.043	.87	101	94	163	3.0 /	
8		1456	760.727	.048	.97	102	94	152	3.1 /	

Comments:

1. Shutdown for Clean cycle for 4½ m.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.

MRI-Form P9 (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 3-1
Date 5-17-72

PARTICULATE SAMPLING

Recorded by RCS

Port Point	Samp. Time (Min)	Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
4-1	4	1505	760.727 / 762.437	.018	.37	96	92	140	2.0 /	1
2		1515	765.852	.115	2.34	94	92	130	5.5 /	
3		1520	769.247	.115	2.34	103	92	130	5.8 /	
4		1523	772.515	.118	2.39	110	92	131	5.6 /	
5		1527	775.555	.100	2.02	116	92	139	5.0 / 65	
6		1531	778.531	.090	1.83	117	94	145	4.6 /	
7		1535	781.760	.115	2.39	114	94	143	5.4 /	
8		1540	784.971	.110	2.25	113	95	135	5.5 /	

Comments:

1. Shutdown for clean cycle for 6½m
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.

MRI-Form P9 (3/72)

Run 3 Sec. 1

MIDWEST RESEARCH INSTITUTE

Run Number 3-1

Analysis Dates _____

PARTICULATE
CLEAN-UP AND ANALYSIS

RCT & RE field

Recorded by _____

Impinger Sequence	1	2	3	4	5	6
Impinger Type*	M	S	M	M		
Final Volume**						
Initial Volume **	100	100	dry	561.1		
Difference	152	104	5	576.0		

* S = Greenburg-Smith standard, M = modified, O = Other _____

** Indicate value and units (ml or gm)

EPA	Sample No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By
1000 839	0633		1	78.90109	78.88981		MH
840	0639		2	86.07170	85.97273	384	MH
841	0640		3	81.99807	81.99581	116	MH
	—		4				
837	0636		5	81.80909	81.79188	386	MH
838	0637	1102	6	.20000	.19347		MH
			6				
			6				
			7	82.36541	82.36540	200	RCT
			8	86.11134	86.11132	200	RCT
856	0655		9	81.74379	81.74359	175	MH
855	0654		10	82.34117	82.34117	150	MH
842	0641	71/102	gel discarded in field				

Comments:

Codes:

1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MIDWEST RESEARCH INSTITUTE

PARTICULATE EMISSION TEST - DATA FORM P

RUN 3-2

MRI Project Number 3585-C11
Field Dates 5/15-18/72
Plant ASARCO
Sampling Location Stack 2 Blast Furnace Baghouse
Sampling Date 5-17-72

FIELD CREW

Project Chief: RC Dossey

Testing Engineer: 1 R Stultz; 2 R Conkling; 3 E Trompeter

Engr. Technician: 1 E Cartwright; 2 H Moloney; 3 G Kelso

Lab Technician: 1 R Flippin; 2; 3

Process Engineer: 1; 2

Other: 1; 2

NOTE: Glass insert broken. Noticed after cleaning. Back check through tip indicates ok prior to testing. Joe B. (EPA) said he thought that he may have broken it while helping clean it. RCT 5-17-72

Form	Date Out	Name	Date In	Checked
P1 - Stack Geometry	5-17-72	R Conkling		
P2 - Traverse Points				
P3 - Preliminary Traverse Data				
P4 - Preliminary Moisture Determination				
P5 - Nomograph Settings				
P6 - Carrier Gas Sampling (Orsat)				
P7 - Carrier Gas Analysis (Orsat)				
P8 - Sampling Train Specifications				
P9 - Particulate Sampling				
P10 - Particulate Analysis				

MRI - Form PO (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 3-2
Date 5-17-72

NOMOGRAPH SETTINGS

Recorded by RSC.
Checked by RCT 5-17-72

NOTE: Same as Run No. _____

Ta	-	Ambient Temperature	=	90	°F
Pb	-	Barometric Pressure	=	29.13	in. Hg
Δ HΘ	-	Reference ΔH use 1.90 avg. for estimated ΔH values.	=	1.90 RCT	in. H_2O
Tm	-	Avg. Meter Temperature, (Ta + 20 °F)	=	110	°F
$\%H_2O$	-	Moisture Content	=	4	% by Vol.
P_o	-	Static (Gauge) Pressure in Stack	=		in. H_2O
		x 0.073	=		in. Hg
Ps	-	Absolute Pressure in Stack, Pb + Po	=		in. Hg
Pm	-	Meter Pressure (≈ Pb)	=		in. Hg
Ps/Pm	-	= 1			
C	-	Correction Factor = 1.11			
Ts	-	Stack Temperature	=	150	°F
Δ P	-	Average Stack Velocity Head	=		in. Hg
Δ P max	-	Maximum Stack Velocity Head	=		in. Hg
D	-	Probe Tip Diameter	=	.375	in.

Ts						
ΔP_{ref}						

MRI - Form P5 (3/72)

MIDWEST RESEARCH INSTITUTE

CARRIER GAS SAMPLING (ORSAT)

Run Number 3-2
Date 5-17-72

Recorded by RC
Assisted by RCT

@ 1000 @ 0900

Barometric Pressure 29.13 in. Hg
Stack (Gauge) Pressure _____ in. Hg

Ambient Temperature 70 °F
Stack Temperature ≈ 150 °F

A. Grab Sample (Evacuated Bulb)

Sampling Train Description:
Bulb Material and Volume 250 ml Blub #1 ml
Probe Material and Length 2 ft in Stack Stainless Steel in.
Prefilter Material glass wool

Sampling Location:
Port gas Port.
Point or Distance from Inside of Port 2 ft. (24 in)

Comments: bulb evacuated several times then sampled through for ≈ 5 minutes

Bulb No.	Initial Bulb Vacuum (in. Hg)	Vacuum Measurement Time (min)	Clock Time sample
1			1522

B. Integrated Sample (Tedlar Bag - MRI Train)

Sampling Unit Number _____

Sampling Location:
Port _____
Point or Distance from Inside of Port _____

	Clock Time	Valve Setting	Flowmeter Reading	Box Vacuum (in. H_2O)
Start				
Stop				

MRI - Form P6 (3/72)

MIDWEST RESEARCH INSTITUTE

CARRIER GAS ANALYSIS (ORSAT)

Run Number 3-2

Analysis Date 5-12-72

Analysis by RF

Recorded by RCT

Analysis Location: Field lab Rental truck

Clock Time: From: 1520 To: 1600

Orsat Unit Number: 0-7

Sample Identification	CO2 Reading 1	Reading 2	O2 (2-1)	Reading 3	CO (3-1)
stack 2 sas port	1.6	21.0	19.4	21.6	2.2
	1.6	20.8	19.2	21.6	2.4
	Avg = 1.6		Avg = 19.3		Avg = 2.3
	Avg =		Avg =		Avg =
	Avg =		Avg =		Avg =
	Avg =		Avg =		Avg =

Comments:

MRI - Form P7 (3/72)

Run Number 3-2
Date 5-17-72

MIDWEST RESEARCH INSTITUTE
SAMPLING TRAIN
SPECIFICATIONS

Recorded by _____

Unit No.

PROBE

Unit No.	Length	Lining Material	Initial Tip Diameter	Pitot Tube Coefficient	Pitot Tube Sequence
8-2	8 ft.	☐ S. Steel ☒ Pyrex	☐ 1/8" ☐ 1/4" ☒ 3/8" ☐ 1/2" Changed _____	☒ .85 ☐ _____	☐ Impact ☐ Static

SAMPLING CASE

Filter Holder Type: 1

☒ RAC 2-1/2"
☐ GI 3-1/2"
☐ _____

Filter No.: 1103

Impinger Content				
Number	Normal		Use	
	Material	Amount	Material	Amount
1	DDW	100 ml	H_2O	100
2	DDW	100 ml	H_2O	100
3	DRY	-	dry	dry
4	Adsorbent*	~200 gm		~200

Container weight = _____ gm
Container + Adsorbent Weight = 588.3 gm

* ☒ Silica Gel ☐ Drierite ☐ _____

UMBILICAL CORD

50-7

Length = 50 ft (Console)
Length = _____ ft (Sample Box)

Connector No. _____

CONTROL CONSOLE

8

Manometer Type

☒ Console (0-6 in.H_2O)
☒ High Sensitivity (0-.25 in.H_2O)
☐ Other _____

Leak Check

At a vacuum of 15 in.Hg.
.01 CFM
($\leq$ 0.02 is acceptable)

By RSC Clock Time 1117

MRI - Form P8 (3/72)

MIDWEST RESEARCH INSTITUTE

29.07 —
82 —

Run Number 3-2
Date 5-12-72

PARTICULATE SAMPLING

Recorded by [illegible]

Port Point	Samp. Time (Min)	Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
1-1	4	1310	196.21 / 198.03	.03 / .025	.6 / .45	82	82	140	1.9 /	
2		1314	200.06	.04	.785	87	82	139	2.0 /	
3		1318	202.13	.04	.785	90	82	140	2.0 /	
4		1322	205.06	.12 .105	2.35 .205	91	83	150	4.1 /	1x
5		1330	208.17	.10	1.93	96	83	156	3.7 /	
6		1334	211.44	.11 .12	2.11 2.35	101	84	156	4.0 /	
7		1338	215.10	.16 .14	3.09 2.7	106	85	136	4.9 /	
8		1342	218.73	.13 .135 .145	2.52 2.62 2.82	110	86	125	5 /	
2-1		1350	221.82	.11 .10 .09	2.15 1.95 1.75	100	88	137	3.3 /	
2		1354	225.14	.12	2.32	102	88	149	4.1 /	
3		1358	228.56	.12 .135	2.32 2.61	104	89	156	4.1 /	
4		1402	232.06	.13 .12	2.55 2.35	106	90	155	4.5 /	
5		1406	235.55	.13	2.55	115	91	145	4.5 / 70	
6		1410	239.07	.13	2.55	115	92	136	4.5 /	
7		1414	242.78	.15 .10	2.71 3.1	112	92	131	5 /	
8		1418	246.17	.1 .12 .135	1.95 2.34 2.61	106	92	131	4.3 /	
3-1		1427	249.27	.1 .08 .125	1.95 1.60 2.42	90	87	156	3.7 /	
2		1431	251.81	.065	1.26	94	87	145	2.8 /	
3		1435	254.49	.072	1.47	98	87	140	3.0 /	
4		1439	257.32	.017 .09	1.59 1.81	101	88	136	3.0 /	
5		1443	260.05	.07 .09	1.31 1.43 1.81	104	88	130	3.0 / 7	
6		1447	262.58	.06 .065	1.22 1.31	99	88	155	3.0 / 75	
7		1451	265.29	.07 .035	1.42 1.72	98	88	166	3.0 /	
8		1455	268.25	.035 .075	1.71 1.95	98	88	149	3.5 /	

Comments:

1. off for (Bad) cleaning stack
2. "
3.
4.
5.
6.
7.
8.
9.
10.
11.

MRI-Form P9 (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 3-2
Date May 17, 1972

PARTICULATE SAMPLING

Recorded by RSC

Port Point	Samp. Time (Min)	Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
4-1	4	1505	268.25 / 270.70	.05	1.1	92	86	135	2.5 /	
2		1509	273.28	.08 / .035	1.42 / .72	95	86	155	3.0 /	
3		1513	275.03	~~.07~~ .045 / .035	.91 / .72	94	86	137	2.2 /	
4		1517	277.40	.05	1.1	96	86	136	2.5 /	
5		1521	279.83	.06	1.19	96	86	134	2.7 /	
6		1525	282.40	.065	1.31	100	86	140	3.0 /	
7		1529	284.86	.06	1.2	104	88	139	2.9 / 75	
8		1533	287.25	.05	1.1	104	89	139	2.5 /	

.045

Comments:

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.

MRI-Form P9 (3/72)

Run 3 Run 2 wrong

MIDWEST RESEARCH INSTITUTE

Run Number 3-2

Analysis Dates _____

PARTICULATE
CLEAN-UP AND ANALYSIS

RCT & RF field

Recorded by _____

Impinger Sequence	1	2	3	4	5	6
Impinger Type*	M	S	M	M		
Final Volume**						
Initial Volume **	100	100	dry	588.3		
Difference	154	112	5	610.3		

* S = Greenburg-Smith standard, M = modified, O = Other _____

** Indicate value and units (ml or gm)

EPA	Sample No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By
845	0644		1	87.28730	87.27589		MH
846	0645		2	89.48526	89.42842	372	MH
847	0646		3	80.10277	80.09769	98	MH
	—		4				
843	0642		5	77.06502	77.04437	232	MH
844	0643	1103	6	.20493	.21343		MH
			6				
			6				
			7	82.36541	82.36540	200	RCT
			8	86.11134	86.11132	200	RCT
856	0655		9	81.74379	81.74359	175	MH
855	0654		10	82.34117	82.34117	150	MH
848	0647	5	Filter	set discarded in	field		

Comments:

Codes:

1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MIDWEST RESEARCH INSTITUTE

PARTICULATE EMISSION TEST - DATA FORM P

RUN 3-3

MRI Project Number 3585-C11
Field Dates 5/15-18/72
Plant PSPRCO
Sampling Location Stack 3 Blast Furnace Baghouse
Sampling Date 5-17-72

FIELD CREW

Project Chief R C Tussey

Testing Engineer
1 R Stoltz
2 R Conkling
3 E Trompeter

Engr. Technician
1 E Cartwright
2 H Maloney
3 G Kelso

Lab Technician
1 R Flippin
2
3

Process Engineer
1
2

Other
1
2

Form	Date Out	Name	Date In	Checked
P1 - Stack Geometry				
P2 - Traverse Points				
P3 - Preliminary Traverse Data	5-17-72	E Trompeter		
P4 - Preliminary Moisture Determination				
P5 - Nomograph Settings				
P6 - Carrier Gas Sampling (Orsat)				
P7 - Carrier Gas Analysis (Orsat)				
P8 - Sampling Train Specifications				
P9 - Particulate Sampling				
P10 - Particulate Analysis				

MRI - Form PO (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 3-3
Date 5-17-72

NOMOGRAPH SETTINGS

Recorded by ET
Checked by RCY 5-17-72

NOTE: Same as Run No. _____

Ta	-	Ambient Temperature	=	85	°F
Pb	-	Barometric Pressure	=	29.13 @ 1000	in. Hg
Δ H@	-	Reference ΔH using calibration curve data — expected ΔH values	=	2.0 RCY	in. H_2O
Tm	-	Avg. Meter Temperature, (Ta + 20 °F)	=	105	°F
$\%H_2O$	-	Moisture Content	=	4	% by Vol.
P_o	-	Static (Gauge) Pressure in Stack	=		in. H_2O
		x 0.073	=		in. Hg
Ps	-	Absolute Pressure in Stack, Pb + Po	=		in. Hg
Pm	-	Meter Pressure (≈ Pb)	=		in. Hg
Ps/Pm	-	= 1.0			
C	-	Correction Factor = 1.18 ~~1.07~~			
Ts	-	Stack Temperature	=	130	°F
Δ P	-	Average Stack Velocity Head	=	1.5	in. Hg
Δ P max	-	Maximum Stack Velocity Head	=	4.5	in. Hg
D	-	Probe Tip Diameter	=	.375	in.

Ts						
ΔP_{ref}						

MIDWEST RESEARCH INSTITUTE

CARRIER GAS
SAMPLING (ORSAT)

Run Number 3-3
Date 5-17-73

Recorded by _____
Assisted by _____

Barometric Pressure @ 1000 29.13 in. Hg
Stack (Gauge) Pressure _____ in. Hg

Ambient Temperature @ 0900 70 °F
Stack Temperature _____ °F

A. Grab Sample (Evacuated Bulb)

Sampling Train Description:
Bulb Material and Volume glass 250 ml
Probe Material and Length ~~SS~~ ¼ tyson ≈ 2' into stack
Prefilter Material glass fiber

Sampling Location:
Port _____
Point or Distance from Inside of Port ≈ 2'

Comments: bulb evacuated several times then sampled through for ≈ 5 minutes

Bulb No.	Initial Bulb Vacuum (in. Hg)	Vacuum Measurement Time (min)	Clock Time ~~sample time~~
1			1347

B. Integrated Sample (Tedlar Bag - MRI Train)

Sampling Unit Number _____

Sampling Location:
Port _____
Point or Distance from Inside of Port _____

	Clock Time	Valve Setting	Flowmeter Reading	Box Vacuum (in. H_2O)
Start				
Stop				

MRI - Form P6 (3/72)

MIDWEST RESEARCH INSTITUTE

CARRIER GAS ANALYSIS (ORSAT)

Run Number 3-3

Analysis Date 5-17-72

Analysis by RF

Recorded by RCP

Analysis Location: Truck 22b

Clock Time: From: 1400 To: 1430

Orsat Unit Number: 0-3

Sample Identification	CO2 Reading 1	Reading 2	O2 (2-1)	Reading 3	CO (3-1)
Stack 3 Run 3-3 gas port	1.4	20.4	19.0	21.2	2.2
	1.4	20.2	18.8	21.0	2.2
	1.5	20.3	18.8	21.2	2.4
	Avg = 1.43		Avg = 18.86		Avg = 2.26
~~Stack 2 Run 3-2 gas port~~					
	Avg =		Avg =		Avg =
	Avg =		Avg =		Avg =
	Avg =		Avg =		Avg =

Comments:

MRI - Form P7 (3/72)

MIDWEST RESEARCH INSTITUTE
SAMPLING TRAIN
SPECIFICATIONS

Run Number 3-3
Date 5-17-72

Recorded by RCJ & ET

Unit No.

PROBE

Unit No.	Length	Lining Material	Initial Tip Diameter	Pitot Tube Coefficient	Pitot Tube Sequence
8-1	8 ft.	☐ S. Steel ☒ Pyrex	☐ 1/8" ☐ 1/4" ☒ 3/8" ☐ 1/2" Changed ____	☒ .85 ☐ ____	☐ Impact ☐ Static

SAMPLING CASE

Filter Holder Type: 2

☒ RAC 2-1/2"
☐ GI 3-1/2"
☐ ____

Filter No.: 1104

Impinger Content				
Number	Normal		Use	
	Material	Amount	Material	Amount
1	DDW	100 ml	H_2O	100
2	DDW	100 ml	H_2O	100
3	DRY	-	dry	dry
4	Adsorbent*	~200 gm		≈200

Container weight = ____ gm
Container + Adsorbent Weight = 572.2 gm

* ☒ Silica Gel ☐ Drierite ☐ ____

UMBILICAL CORD

50-4

Length = 50 ft (Console)
Length = ____ ft (Sample Box)

Connector No. ____

CONTROL CONSOLE

7

Manometer Type

☒ Console (0-6 in.H_2O)
☒ High Sensitivity (0-.25 in.H_2O)
☐ Other ____

Leak Check

At a vacuum of 15 in.Hg.
.004 CFM
($\leq$ 0.02 is acceptable)

By ET Clock Time 1100

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MIDWEST RESEARCH INSTITUTE

Run Number 3-3
Date 5-17-72

PARTICULATE SAMPLING

Recorded by ET

Port Point	Samp. Time (Min)	Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
1-1	4	~~1310~~ 1310	~~877.080~~ 879.260	.0478	1.030	78	79	137	4.6	
2		~~1314~~ 1314	882.033	.069	1.530	86	80	142	6.0	~~1~~
3		1318	885.190	.090	1.980	94	81	151	6.8	1
4		1322	888.150	.120	2.570	102	82	154	6.0	
5		1326	890.600	.065	1.390	104	84	158	5.2	
6		1330	893.090	.060	1.290	100	85	158	5.0	
7		1334	895.634	.060	1.290	102	86	155	5.0	
8		1338	898.236	.070	1.520	102	87	148	5.5 / 75	
~~24~~		1347	~~898.236~~ 900.330	.045	.960	95	87	141	4.5	
2		1351	902.690	.062	1.320	97	88	144	5.1	
3		1355	905.240	.070	1.520	100	89	148	5.5	
4		1359	907.880	.065	1.390	101	89	153	5.5	
5		1403	910.740	.080	1.740	104	89	158	6.0	
6		1407	913.570	.080	1.740	112	91	153	6.0 / 77	
7		1411	916.330	.075	1.610	111	93	149	5.8	
8		1415	918.480	.037	.800	113	93	142	4.4	
3-1		1423	~~918.480~~ 920.255	.025	.548	87	88	143	3.7	
2		1433	922.830	.034	.740	88	88	151	4.2	2
3		1437	926.310	.130	2.780	93	86	132	8.0	
4		1441	929.960	.140	2.980	100	87	126	8.3 / 73	
5		1445	933.610	.150	3.200	106	87	132	9.0	
6		1449	936.870	.100	2.120	100	87	158	6.8	
7		1453	940.150	.100	2.120	96	87	167	7.0	3
8		1457	943.803	.130	2.800	97	87	152	8.2	

Comments:

1. Changed nomograph to 140°F
2. Stopped at 14:29 for process
3. Changed nomograph to 150°F
4.
5.
6.
7.
8.
9.
10.
11.

MRI-Form P9 (3/72)

MIDWEST RESEARCH INSTITUTE

Run Number 3-3
Date 5-17-72

PARTICULATE SAMPLING

Recorded by CT

Port Point	Samp. Time (Min)	Clock Time	Meter Volume (DCF)	Δ P Velocity Head (in. H_2O)	Δ H Orifice (in. H_2O)	Meter Temp In Left (°F)	Meter Temp Out Right (°F)	Stack Temp (°F)	Tr. Vac (In. Hg) / Box Temp (°F)	Comment No.
4-1	4	15:03	943.803 / 946.340	.050	1.080	92	84	138	5.0	
2		1507	948.700	.065	1.400	93	85	137	5.2	
3		1511	950.735	.038	.830	91	85	136	4.3	
4		1515	952.800	.035	.770	91	85	135	4.3	
5		1519	954.900	.045	.970	92	85	132	4.5	
6		1523	957.080	.048	1.030	92	85	137	4.7 / 71	
7		1527	959.150	.043	.925	95	86	137	4.4	
8		1531	961.248	.037	.805	95	86	139	4.3	

Comments:

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.

MIDWEST RESEARCH INSTITUTE

Run Number 3-3
Analysis Dates _____

PARTICULATE
CLEAN-UP AND ANALYSIS

RCT & RE field
Recorded by _____

Impinger Sequence	1	2	3	4	5	6
Impinger Type*	M	S	M	M		
Final Volume**						
Initial Volume **	100	100	dry	572.2		
Difference	142	112	3	585.0		

* S = Greenburg-Smith standard, M = modified, O = Other _____
** Indicate value and units (ml or gm)

EPA	Sample No.	Filter No.	Code	Final Weight (gm)	Tare Weight (gm)	Sample Volume (ml)	Performed By
851	0650		1	80.77148	80.76190		MIt
852	0651		2	82.44776	82.41056	382	MIt
853	0652		3	77.39512	77.38000	164	MIt
	—		4				
849	0648		5	83.66871	83.65221	318	MIt
850	0649	1104	6	.20319	.20100		MIt
			6				
			6				
			7	82.36541	82.36540	200	RCT
			8	86.11134	86.11132	200	RCT
856	0655		9	81.74379	81.74359	175	MIt
855	0654		10	82.34117	82.34117	150	MIt
854	0653	1112		Sol discarded in field			

Comments:

Codes:

1. Ether-chloroform extraction of impinger water
2. Impinger water residue
3. Impingers and back half of filter, acetone wash
4. Dry probe and cyclone catch (generally no data)
5. Probe, cyclone, flask and front half of filter, acetone wash
6. Filter
7. Ether blank
8. Chloroform blank
9. Water blank
10. Acetone blank

MIDWEST RESEARCH INSTITUTE

CARRIER GAS

ANALYSIS (ORSAT)

Run Number 1

Analysis Date 5-16-72

Recorded by Flippin

Analysis Location: ASARCO - Glover Plant - Stack #3 Gas Port

Clock Time: From: 0915 To: 1030 Integrated Sample

Orsat Unit Number: 0-3

Sample Identification	CO2 Reading 1	Reading 2	O2 (2-1)	Reading 3	CO (3-2)
Run #1 Stack #3 Gas Port	1.2	20.2	20.2 - 1.2 = 19.0	20.8	20.6 - 19.6 = 1.0
	1.6	20.6	20.6 - 1.6 = 19.0	21.6	21.6 - 19.0 = 2.0
	1.6	20.6	20.6 - 1.6 = 19.0	21.4	21.4 - 19.4 = 2.0
	Avg = 1.46		Avg = 19.0		Avg = 2.26
Run 2-3 Stack 3 Gas Port	1.4	20.4	19.0	21.4	2.4
	~~1.6~~	~~19.8~~	~~18.2~~	~~20.2~~	~~2.0~~
	1.4	20.6	19.2	21.6	2.4
	Avg = 1.4		Avg = 19.1		Avg = 2.4
Run #3 Stack 3 Gas Port 2 ft inside stack Sampled @ 1317	1.4	20.4	[illegible]	21.2	2.2
	1.4	20.2	18.8	21.6	2.2
	1.5	20.3	[illegible] 18.8	21.2	2.4
	Avg = 1.42		Avg = 18.86		Avg = 2.26
Run #3 Stack 2 Gas Port 2 ft inside stack Sampled at 1522	1.6	21.0	19.4	21.6	2.2
	1.6	20.8	19.2	21.6	2.4
	Avg = 1.6		Avg = 19.3		Avg = 2.3

Comments: Compressor completed on Run #1 @ 1200 (noon) 5-16-72 RS
" " " Run #2 @ 1700 5-16-72 RS
" " " Run #3 @

MRI - Form P7 (3/72)

APPENDIX E

GENERAL ANALYTICAL PROCEDURES

Laboratory analysis was performed purusant to the procedures presented on the following pages with these exceptions:

1. Beakers are not routinely precleaned with nitric acid unless we are advised of planned metals analysis (we were not so advised),

2. Filters were stored in glycene envelopes,

3. A covered steam table under an operating laboratory hood was used to evaporate water washings, and

4. Silica gel was weighed and discarded in the field.

These deviations were previously reviewed and designated acceptable by EPA/OAP.

LABORATORY ANALYSIS PROCEDURE FOR DETERMINATION OF PARTICULATE EMISSIONS FROM STATIONARY SOURCES

The following is a detailed outline of the laboratory procedure used in determining the weights of particulate and water collected in the various containers resulting from sample recovery from field collection trains.

All glassware used for evaporation and residue determinations in the following steps was first soaked in 40% nitric acid for several hours. The beakers were then washed and rinsed with distilled water followed by oven-drying. After drying the beakers were descicated to constant weight and kept in a descicator until used. Beakers were weighed to ±0.1 mg.

A. Container No. 1 (Filter)

1.) Preparation

The filters are oven-dried @ 105°C for a minimum of four hours, and then descicated to constant weight. Filters are weighed to ±.0001 grams. After weighing the filters are placed in plastic petri dishes until used.

2.) Particulate weight determination

Filter and any loose particulate matter are transferred to a tared glass weighing dish, and descicated to constant weight. The weight gain is then recorded.

B. Container No. 2 (Acetone washings prior to filter)

1.) These acetone washings are received in glass bottles, are measured and transferred to the tared beakers prepared as described above.

2.) The acetone washings are then allowed to evaporate to dryness at ambient temperature and pressure. The beakers are covered with ribbed cover glasses to facilitate evaporation without allowing dust or other foreign matter into the beakers. When dry, the beakers are descicated to constant weight. Beakers are weighed to nearest 0.1 mg.

3.) A blank of the acetone (measured amount) is evaporated also as described above. Any residue resulting from this blank is used to correct for the amount of acetone used in the washings. The net weight is the required particulate residue.

C. Container No. 3 (Impinger water plus water rinsings)

1.) The volume of impinger water has been measured at the recovery station and recorded. Our laboratory measures the final volumes in these containers which allows us to determine the volume of washings used and to correct for this water using a blank.

2.) After measuring the volume of water, the solution is transferred to a separatory funnel. The organic particulate is then extracted using three 25 ml portions of chloroform, followed by three 25 ml portions of ethyl ether. The organic solvents are then combined and washed once with 100 ml of distilled water. The combined solvents are transferred to a tared beaker (prepared as above) and evaporated at 70°F until dry. The samples are then descicated to constant weight.

A blank of the distilled water used in the impingers and washings is also extracted with the chloroform and ether. The organic extract is then used as a blank for the organic particulate and the water phase as a blank for the impinger water and washings. The water phase is evaporated at 212°F until dry. The residue is descicated to constant weight and corrected for any blank found.

D. Container No. 4 (Acetone washings-back)

1.) Acetone washings are first measured and then transferred to tared beakers (prepared as above) and allowed to evaporate to dryness at ambient temperature and pressure. Upon drying, the beakers are descicated to constant weight. A blank of the acetone used is also evaporated and any corrections due to the acetone are made if necessary. Beakers are weighed to nearest 0.1 mg.

E. Container No. 5 (Silica gel)

1.) Preparation

The silica is placed in a wide mouth plastic bottle and capped. The silica gel is then weighed to ±0.1 gm.

2.) After sampling, the used silica gel is weighed to nearest 0.1 gm and weight of water collected is determined.

Special Note

All samples are dried in 250 ml beakers to a constant weight.

APPENDIX F

SAMPLE HANDLING LOG

This appendix presents a table containing information identifying the chain of custody and handling of collected samples.

MIDWEST RESEARCH INSTITUTE

SAMPLE HANDLING LOG

MRI Task No. 3585-C11 PLANT: ASARCO - Blast F. Baghouse Recorded by RCTossey

Run No.	Sample No.	Activity	1972 Date	Time	Personnel	Remarks
1-1		collection	5-16	0905-1213	R Stultz E Cartwright	
1-1		transfere to Field Lab	5-16	1230	crew	
1-1	0611	probe cleaning	"	1300	RCT, Joe B. Lore Riley	EPA help during lunch
1-1		sample box cleaning	"	≈1330	RF	
1-1		field storage	"	≈1400	RF Rental Truck	locked at night & lunch
1-1		transport to MRI	5-18	1200	G Kelso	personal car
1-1	0611	silica gel discarded	5-16	≈1330	RF	
1-1		transport from truck to MRI lab.	5-19	0900	G Kelso	
1-1		MRI lab. storage	5-19	0900	F Bergman	locked
1-1		analysis	6-7	—	M Hammons	analysis completed
1-1		storage	6-7	—	M Hammons	plastic covered in beakers
1-1		residue transport to EPA-G Riley	6-13	—	M Hammons	in beakers registered air mail

Comments

MIDWEST RESEARCH INSTITUTE

SAMPLE HANDLING LOG

MRI Task No. 3555-C11 PLANT: ASARCO Blast F. Baghouse Recorded by RCT

Run No.	Sample No.	Activity	Date (1972)	Time	Personnel	Remarks
1-2		collection	5-16	0905-1213	R Conkling H Molnely	
1-2	001	transfer to field lab	5-16	1230	crew	
1-2	002	probe cleaning	5-16	1300	RCT, Gene R. Joe D	EPA help during lunch
1-2	003	sample box cleaning	5-16	≈1330	RF	
1-2	004	field storage	5-16	≈1400	RF Rental truck	locked at night ~~lunch~~ Rental truck lab
1-2		transport to MRI	5-18	1200	G Kelso	personal car
1-2	0605	silica gel divided	5-16	≈1330	R Flippin	
1-2		storage at MRI	5-19	0900	F. Benzinger	locked
1-2		analysis	6-7	–	M Hammons	analysis completed
1-2		storage	6-7	–	M Hammons	beakers plastic covered
1-2		residue transport to EPA - G. Riley	6-13	–	M Hammons	registered in beakers in mail

Comments

MIDWEST RESEARCH INSTITUTE

SAMPLE HANDLING LOG

MRI Task No. 3585-C11 PLANT: Blast F. Baghouse ASARCO Recorded by RCT

Run No.	Sample No.	Activity	Date (1972)	Time	Personnel	Remarks
1-		collection	5-16	0905-1215	E Trompeter G Kelso	
1-3		transfere to field lab	5-16	1230	crew	
1-3		probe cleaning	5-16	1300	RCT Gene R. Joe B.	EPA help during lunch
1-3		sample box cleaning	5-16	≈1330	RF	
1-3		field storage	5-16	≈1400	RF Rental Truck	locked at night ~~& lunch~~
1-3		transport to MRI	5-18	≈1200	G Kelso	personal car
1-3	0617	silica gel discarded	5-16	≈1330	RF	
1-3		storage at MRI	5-19	0900	F. Bergman	locked
1-3		analysis	6-7	—	M. Hammons	completed
1-3		storage	6-7	—	"	beakers - plastic covers
1-3		residue transported to EPA - G. Riley	6-13	—	M Hammons	in beakers resistored air mail

Comments

5/0/70

MIDWEST RESEARCH INSTITUTE

SAMPLE HANDLING LOG

MRI Task No. 3585-C11 PLANT: ASARCO Blast F. Baghouse Recorded by R C Tossey

Run No.	Sample No.	Activity	1972 Date	Time	Personnel	Remarks
2-1		collection	5-16	1515 - 1825	R. Stulte E. Cartwright	
2-1		transfere to field lab	5-16	1900	crew	
2-1		probe cleaning	5-16	1930	ET Joe B. G Riley RS	EPA help
2-1		sample box thimble filter cleaning	5-16	1930	RF	
2-1		field storage	5-17	1000	RF Rental Truck	locked at night
2-1		transport to MRI	5-18	1200	G Kelso	personal car
2-1	0623	silical gel discarded	5-17	1000	RF	
2-1		sample box after filter cleaning	5-17	0930	RF & RC	
2-1		storage at MRI	5-19	0900	F. Bergman	locked
2-1		analysis	6-7	—	M. Hammons	completed
2-1		storage	6-7	—	"	beakers-plastic cover
2-1		residue transported to EPA - G. Riley	6-13	—	"	in beakers registered air mail

Comments

5/2/72

MIDWEST RESEARCH INSTITUTE

SAMPLE HANDLING LOG

MRI Task No. 3555-C11. PLANT: ASARCO Blast F. Baghouse Recorded by RCK

Run No.	Sample No.	Activity	1972 Date	Time	Personnel	Remarks
2-2		collection	5-16	1515-1521	R Conkling H Moloney	
2-2		transferred to field lab	5-16	1900	crew	
2-2	1 A	probe cleaning	5-16	1930	RS JeB Lower	EPA help
2-2	1 B	sample box thru filter cleaning	5-16	1930	RF	
2-2	0028	field storage	5-17	1000	RF Rental Truck	locked at night
2-2	0028	transport to MRI ~~by truck~~	5-15	1200	G Kelso	personal car
2-2	0029	silica gel discarded	5-17	1000	RF	
2-2		sample box after filter cleaning	5-17	0930	RF JRC	
2-2		storage at MRI	5-19	0900	F. Bergman	locked
2-2		analysis	6-7	—	M. Hammons	completed
2-2		storage	6-7	—	"	beakers-plastic cover
2-2		residue transport to EPA - G Riley	6-13	—	"	in beakers registered air mail

Comments

5/3/72

MIDWEST RESEARCH INSTITUTE

SAMPLE HANDLING LOG

MRI Task No. 3585-C11 PLANT: ASARCO Blast F. Beehouse Recorded by RCT

Run No.	Sample No.	Activity	1972 Date	Time	Personnel	Remarks
2-3		collection	5-16	1515-1532	E Trompeter G Kelso	
2-3		transfere to field lab	5-16	1900.	crew	
2-3	1	probe cleaning	5-16	1930	RS ET Joe B. Gener	EPA help
2-3	8	sample box thru filter cleaning	5-16	1930	RF	
2-3	M	field storage	5-17	1000	RF Rental Truck	locked at night
2-3	0	transport to MRI	5-18	1200	G Kelso	personal car
2-3	0635	silica gel discarded	5-17	1000	RF	
2-3		sample box after filter cleaning	5-17	0930	RF & RC	
2-3		storage at MRI	5-19	0900	F. Borgman	locked
2-3		analysis	6-7	—	M. Hammons	~~covered~~ completed
2-3		storage	6-7	—	"	Baskets—plastic covers
2-3		residue transport to EPA—G Riley	6-13	—	"	in baskets registered air mail

Comments

MIDWEST RESEARCH INSTITUTE

SAMPLE HANDLING LOG

MRI Task No. 3585-C11 PLANT: ASARCO Blast F. Baghouse Recorded by RCT

Run No.	Sample No.	Activity	1972 Date	Time	Personnel	Remarks
3-1		collection	5-17	1310-1544	R Stuhr E Cartwright	
3-1	0641	transfere to field lab	5-17	1630	crew	
3-1		probe cleaning	5-17	1700	JB - EPA RCT, ET, GK-MRI	
3-1	0642	sample box cleaning	5-17	1700	RF	
3-1	0643	field storage	5-17	1730	RF Rental Truck	locked at night
3-1		~~silica gel discarded~~	5-17	1730	RF	
3-1		transport to MRI	5-15	1200	G Kelso personal car	
3-1	0644	silica gel discarded	5-17	1730	RF	
3-1		storage at MRI	5-19	0900	F Bausch	locked at MRI
3-1		analysis	6-7	—	M. Hammond	completed
3-1		storage	6-7	—	"	beakers - plastic covers
3-1		residue transported to EPA - G. Riley	6-13	—	"	in beakers registered air mail

Comments

MIDWEST RESEARCH INSTITUTE

SAMPLE HANDLING LOG

MRI Task No. 3585-C11 PLANT: ASARCO Blast F. Baghouse Recorded by RCT

Run No.	Sample No.	Activity	1972 Date	Time	Personnel	Remarks
3-2	1	collection	5-17	1310-1537	R Conkling, H Moloney	
3-2	0647	transfere to field lab	5-17	1630	crew	
3-2	0647	probe cleaning	5-17	1700	JD - EPA, ET OR MRI	broken glass insert
3-2	0647	sample box cleaning	5-17	1700	RF	
3-2	0647	field storage	5-17	1730	RF Rental truck	locked at night
3-2	0647	silica gel discarded	5-17	1730	RF	
3-2		transport to MRI	5-18	1200	G Kelso	personal car
3-2		storage at MRI	5-19	0900	F. Bergman	locked
3-2		analysis	6-7	—	M. Hammons	completed
3-2		storage	6-7	—	"	beakers - plastic covers
3-2		residue transport to EPA - G. Riley	6-13	—	"	in beakers registered air mail

Comments

MIDWEST RESEARCH INSTITUTE

SAMPLE HANDLING LOG

MRI Task No. 3585-C11 PLANT: ASARCO Blast F. Baghouse Recorded by RCT

Run No.	Sample No.	Activity	1972 Date	Time	Personnel	Remarks
3-3		collection	5-17	1310-1535	E Trompeter G Kalso	
3-3		transfere to field lab	5-17	1630	crew	
3-3		probe cleaning	5-17	1715	GR JB - EPA GR ET HM - MRI	
3-3		sample box cleaning	5-17	1700	RF	
3-3		field storage	5-17	1730	RF Rental Truck	locked at night
3-3		~~silica gel discarded~~	~~5-17~~	~~1730~~	~~RF~~	
3-3		transport to MRI	5-18	1200	G Kelso	personal car
3-3	0653	silica gel discarded	5-17	1730	RF	
3-3		storage at MRI	5-19	0900	F Bergman	locked
3-3		analysis	6-7	-	M. Hammms	completed
3-3		storage	6-7	-	"	beakers - plastic covers
3-3		residue transport to EPA - G. Riley	6-13	-	"	in beakers registered air mail

Comments

APPENDIX G

SAMPLE NUMBER LOG

TABLE G-I

SAMPLE NUMBER SUMMARY

Test No. 1 Sample Type Run (1-1)	MRI No.	EPA No.
Probe and cyclone bypass	0606	72-000- 807
Filter	0607 (1098)	72-000- 808
Ether chloroform ext	0608	72-000- 809
Imp H_2O	0609	72-000- 810
Acetone wash	0610	72-000- 811
Silica gel	0611	72-000- 812
Run (1-2)		
Probe and cyclone bypass	0600	72-000- 801
Filter	0601 (1095)	72-000- 802
Ether chloroform Ext.	0602	72-000- 803
Impinger H_2O	0603	72-000- 804
Acetone wash	0604	72-000- 805
Silica gel	0605	72-000- 806
Run (1-3)		
Probe and cyclone bypass	0612	72-000-813
Filter	0613 (1097)	72-000-814
Ether chloroform ext	0641	72-000-815
Impinger H_2O	0615	72-000-816
Acetone wash	0616	72-000-817
Silica gel	0617	72-000-818

TABLE G-I (Continued)

Test No. 2 Sample Type Run (2-1)	MRI No.	EPA No.
Probe and cyclone bypass	0618	72-000- 819
Filter	0619 (1099)	72-000- 820
Ether chloroform ext.	0620	72-000- 821
Impinger H_2O	0621	72-000- 822
Acetone wash	0622	72-000- 823
Silica gel	0623	72-000- 824
Run (2-2)		
Probe and cyclone bypass	0624	72-000- 825
Filter	0625 (1100)	72-000- 826
Ether chloroform ext	0626	72-000- 827
Impinger H_2O	0627	72-000- 828
Acetone wash	0628	72-000- 829
Silica gel	0629	72-000- 830
Run (2-3)		
Probe and cyclone bypass	0630	72-000- 831
Filter	0631 (1101)	72-000- 832
Ether chloroform ext	0632	72-000- 833
Impinger H_2O	0633	72-000- 834
Acetone wash	0634	72-000- 835
Silica gel	0635	72-000- 836

TABLE G-I (Continued)

Test No. 3 Sample Type Run (3-1)	MRI No.	EPA No.
Probe and cyclone bypass	0636	72-000- 837
Filter	0637 (1102)	72-000- 838
Ether chloroform ext	0638	72-000- 839
Impinger H_2O	0639	72-000- 840
Acetone wash	0640	72-000- 841
Silica gel	0641	72-000- 842
Run (3-2)		
Probe and cyclone bypass	0642	72-000- 843
Filter	0643 (1103)	72-000- 844
Ether chloroform ext	0644	72-000- 845
Impinger H_2O	0645	72-000- 846
Acetone wash	0646	72-000- 847
Silica gel	0647	72-000- 848
Run (3-3)		
Probe and cyclone bypass	0648	72-000- 849
Filter	0649 (1104)	72-000- 850
Ether chloroform ext	0650	72-000- 851
Impinger H_2O	0651	72-000- 852
Acetone wash	0652	72-000- 853

TABLE G-I (Concluded)

Test No. 3 Sample Type Run (3-3)	MRI No.	EPA No.
Silica gel	0653	72-000-854
Acetone blank (all tests)	0654	72-000- 855
Dist H_2O blank (all tests)	0655	72-000- 856

ASARCO

Plant Glover, Mo.

MRI Project No. 3585-C(11)

MIDWEST RESEARCH INSTITUTE

SAMPLE NUMBER LOG

Recorded By Flynn

Sample Numbers: 600 to 699

#	Sample Type EPA	#	Sample Type EPA #	#	Sample Type EPA #	#	Sample Type
C 600	Probed Process Cyclone Bypass 801	625	Filter 826	650	Ether Chloroform Ext. 851	75	
C 601	Filter 802	626	Ether Chloroform Ext 827	651	Impinger H_2O 852	76	
C 602	Ether Acetone 803	627	Impinger H_2O 828	652	Acetone Wash 853	77	
C 603	Imp. H_2O 804	628	Acetone Wash 829	653	Silica Gel 854	78	
C 604	Acetone Wash 805	629	Silica Gel 830	654	Acetone Blank 855	79	
C 605	Silica Gel 806	630	Probed Cyclone Bypass 831	655	Dist. H_2O Blank 856	80	
C 606	Probed Cyclone Bypass 807	631	Filter 832	56		81	
C 607	Filter 808	632	Ether Chloroform Ext 833	57		82	
C 608	Ether Chloroform Ext. 809	633	Impinger H_2O 834	58		83	
C 609	Imp. H_2O 810	634	Acetone Wash 835	59		84	
C 610	Acetone Wash 811	635	Silica Gel 836	60		85	
C 611	Silica Gel 812	636	Probed Cyclone Bypass 837	61		86	
C 612	Probed Cyclone Bypass 813	637	Filter 838	62		87	
C 613	Filter 814	638	Ether Chloroform Ext 839	63		88	
C 614	Ether Chloroform Ext. 815	639	Impinger H_2O 840	64		89	
C 615	Imp. H_2O 816	640	Acetone Wash 841	65		90	
C 616	Acetone Wash 817	641	Silica Gel 842	66		91	
C 617	Silica Gel 818	642	Probed Cyclone Bypass 843	67		92	
C 618	Probed Cyclone Bypass 819	643	Filter 844	68		93	
C 619	Filter 820	644	Ether Chloroform Ext 845	69		94	
C 620	Ether Chloroform Ext. 821	645	Impinger H_2O 846	70		95	
C 621	Impinger H_2O 822	646	Acetone Wash 847	71		96	
C 622	Acetone Wash 823	647	Silica Gel 848	72		97	
C 623	Silica Gel 824	648	Probed Cyclone Bypass 849	73		98	
C 624	Probed Cyclone Bypass 825	649	Filter 850	74		99	

APPENDIX H

PARTICULATE ANALYSIS DATA REDUCTION

This appendix presents particulate analysis data reduction for mass emissions, trace element analysis results performed by Battelle, Columbus; and lead analysis results performed by EPA/OAP.

TABLE H-I

PARTICULATE WEIGHTS

RUN	SAMPLE TYPE[a/]	CONT NUMBER	FINAL WEIGHT (GRAMS)	TARE WEIGHT (GRAMS)	WEIGHT GAIN (GRAMS)	VOL OF SAMPLE (ML)	BLANK RESID (GM/ML)	BLANK WEIGHT (GRAMS)	PARTIC WT (GRAMS)
1-1	7	--	82.365410	82.365400	.000010	200.0	.0000000		
1-1	8	--	86.111340	86.111320	.000020	200.0	.0000001		
1-1	9	0655	81.743790	81.743590	.000200	175.0	.0000011		
1-1	10	0654	82.341170	82.341170	0.000000	150.0	0.0000000		
1-1	1	0608	85.558140	85.547310	.010830	150.0		.000022	.010808
1-1	2	0609	84.154650	84.095540	.059310	382.0		.000437	.058873
1-1	3	0610	84.601940	84.594870	.007070	143.0		0.000000	.007070
1-1	5	0606	83.928590	83.793640	.134950	555.0		0.000000	.134950
1-1	6	1098	.209130	.205470	.003660				.003660

PARTIAL PARTICULATE WEIGHT[b/] - .138610 GRAMS OR 138.61 MILLIGRAMS
TOTAL PARTICULATE WEIGHT - .215361 GRAMS OR 215.36 MILLIGRAMS

1-2	7	--	82.365410	82.365400	.000010	200.0	.0000000		
1-2	8	--	86.111340	86.111320	.000020	200.0	.0000001		
1-2	9	0655	81.743790	81.743590	.000200	175.0	.0000011		
1-2	10	0654	82.341170	82.341170	0.000000	150.0	0.0000000		
1-2	1	0602	80.712790	80.702180	.010610	150.0		.000022	.010588
1-2	2	0603	80.962380	80.911360	.051020	338.0		.000386	.050634
1-2	3	0604	84.398860	84.389820	.009040	84.0		0.000000	.009040
1-2	5	0600	67.024150	66.986160	.037990	386.0		0.000000	.037990
1-2	6	1095	.207160	.202470	.004690				.004690

PARTIAL PARTICULATE WEIGHT - .042680 GRAMS OR 42.68 MILLIGRAMS
TOTAL PARTICULATE WEIGHT - .112941 GRAMS OR 112.94 MILLIGRAMS

a/ See field data form - last page.

b/ The partial weight agrees with the December 23, 1971 method in the Federal Register and the total weight agrees with the August 17, 1971 method. The impinger catch is included per the August method.

TABLE H-I (Continued)

RUN	SAMPLE TYPE	CONT NUMBER	FINAL WEIGHT (GRAMS)	TARE WEIGHT (GRAMS)	WEIGHT GAIN (GRAMS)	VOL OF SAMPLE (ML)	BLANK RESID (GM/ML)	BLANK WEIGHT (GRAMS)	PARTIC WT (GRAMS)
1-3	7	--	82.365410	82.365400	.000010	200.0	.0000000		
1-3	8	--	86.111340	86.111320	.000020	200.0	.0000001		
1-3	9	0655	81.743790	81.743590	.000200	175.0	.0000011		
1-3	10	0654	82.341170	82.341170	0.000000	150.0	0.0000000		
1-3	1	0614	81.250660	81.242000	.008660	150.0		.000022	.008638
1-3	2	0615	78.692400	78.666340	.026060	370.0		.000423	.025637
1-3	3	0616	81.096710	81.089000	.007710	80.0		0.000000	.007710
1-3	5	0612	82.897650	82.881490	.016160	426.0		0.000000	.016160
1-3	6	1097	.200120	.199030	.001090				.001090

PARTIAL PARTICULATE WEIGHT - .017250 GRAMS OR 17.25 MILLIGRAMS
TOTAL PARTICULATE WEIGHT - .059235 GRAMS OR 59.23 MILLIGRAMS

2-1	7	--	82.365410	82.365400	.000010	200.0	.0000000		
2-1	8	--	86.111340	86.111320	.000020	200.0	.0000001		
2-1	9	0655	81.743790	81.743590	.000200	175.0	.0000011		
2-1	10	0654	82.341170	82.341170	0.000000	150.0	0.0000000		
2-1	1	0620	88.584580	88.576660	.007920	150.0		.000022	.007898
2-1	2	0621	82.621080	82.553220	.067860	366.0		.000418	.067442
2-1	3	0622	82.304500	82.300190	.004310	93.0		0.000000	.004310
2-1	5	0618	86.991540	86.951630	.039910	330.0		0.000000	.039910
2-1	6	1099	.213090	.203350	.009740				.009740

PARTIAL PARTICULATE WEIGHT - .049650 GRAMS OR 49.65 MILLIGRAMS
TOTAL PARTICULATE WEIGHT - .129299 GRAMS OR 129.30 MILLIGRAMS

TABLE H-I (Continued)

RUN	SAMPLE TYPE	CONT NUMBER	FINAL WEIGHT (GRAMS)	TARE WEIGHT (GRAMS)	WEIGHT GAIN (GRAMS)	VOL OF SAMPLE (ML)	BLANK RESID (GM/ML)	BLANK WEIGHT (GRAMS)	PARTIC WT (GRAMS)
2-2	7	--	82.365410	82.365400	.000010	200.0	.0000000		
2-2	8	--	86.111340	86.111320	.000020	200.0	.0000001		
2-2	9	0655	81.743790	81.743590	.000200	175.0	.0000011		
2-2	10	0654	82.341170	82.341170	0.000000	150.0	0.0000000		
2-2	1	0626	78.393900	78.386210	.007690	150.0		.000022	.007668
2-2	2	0627	82.093440	82.059850	.033590	356.0		.000407	.033183
2-2	3	0628	79.296260	79.294100	.002160	90.0		0.000000	.002160
2-2	5	0624	78.592440	78.565750	.026690	289.0		0.000000	.026690
2-2	6	1100	.212570	.206290	.006280				.006280

PARTIAL PARTICULATE WEIGHT - .032970 GRAMS OR 32.97 MILLIGRAMS
TOTAL PARTICULATE WEIGHT - .075981 GRAMS OR 75.98 MILLIGRAMS

2-3	7	--	82.365410	82.365400	.000010	200.0	.0000000		
2-3	8	--	86.111340	86.111320	.000020	200.0	.0000001		
2-3	9	0655	81.743790	81.743590	.000200	175.0	.0000011		
2-3	10	0654	82.341170	82.341170	0.000000	150.0	0.0000000		
2-3	1	0632	89.613930	89.602430	.011500	150.0		.000022	.011478
2-3	2	0633	81.270260	81.215210	.055050	372.0		.000425	.054625
2-3	3	0634	79.289390	79.268000	.021390	102.0		0.000000	.021390
2-3	5	0630	77.122850	77.094700	.028150	308.0		0.000000	.028150
2-3	6	1101	.196460	.193060	.003400				.003400

PARTIAL PARTICULATE WEIGHT - .031550 GRAMS OR 31.55 MILLIGRAMS
TOTAL PARTICULATE WEIGHT - .119042 GRAMS OR 119.04 MILLIGRAMS

TABLE H-I (Continued)

RUN	SAMPLE TYPE	CONT NUMBER	FINAL WEIGHT (GRAMS)	TARE WEIGHT (GRAMS)	WEIGHT GAIN (GRAMS)	VOL OF SAMPLE (ML)	BLANK RESID (GM/ML)	BLANK WEIGHT (GRAMS)	PARTIC WT (GRAMS)
3-1	7	--	82.365410	82.365400	.000010	200.0	.0000000		
3-1	8	--	86.111340	86.111320	.000020	200.0	.0000001		
3-1	9	0655	81.743790	81.743590	.000200	175.0	.0000011		
3-1	10	0654	82.341170	82.341170	0.000000	150.0	0.0000000		
3-1	1	0638	78.901090	78.889810	.011280	150.0		.000022	.011257
3-1	2	0639	86.021200	85.972230	.048970	384.0		.000439	.048531
3-1	3	0640	81.998070	81.995810	.002260	116.0		0.000000	.002260
3-1	5	0636	81.809090	81.791880	.017210	386.0		0.000000	.017210
3-1	6	1102	.200000	.193470	.006530				.006530

PARTIAL PARTICULATE WEIGHT - .023740 GRAMS OR 23.74 MILLIGRAMS
TOTAL PARTICULATE WEIGHT - .085789 GRAMS OR 85.79 MILLIGRAMS

3-2	7	--	82.365410	82.365400	.000010	200.0	.0000000		
3-2	8	--	86.111340	86.111320	.000020	200.0	.0000001		
3-2	9	0655	81.743790	81.743590	.000200	175.0	.0000011		
3-2	10	0654	82.341170	82.341170	0.000000	150.0	0.0000000		
3-2	1	0644	87.287300	87.275890	.011410	150.0		.000022	.011388
3-2	2	0645	89.485260	89.428420	.056840	372.0		.000425	.056415
3-2	3	0646	80.102770	80.097690	.005080	98.0		0.000000	.005080
3-2	5	0642	77.065020	77.044370	.020650	232.0		0.000000	.020650
3-2	6	1103	.213430	.204930	.008500				.008500

PARTIAL PARTICULATE WEIGHT - .029150 GRAMS OR 29.15 MILLIGRAMS
TOTAL PARTICULATE WEIGHT - .102032 GRAMS OR 102.03 MILLIGRAMS

TABLE H-I (Concluded)

RUN	SAMPLE TYPE	CONT NUMBER	FINAL WEIGHT (GRAMS)	TARE WEIGHT (GRAMS)	WEIGHT GAIN (GRAMS)	VOL OF SAMPLE (ML)	BLANK RESID (GM/ML)	BLANK WEIGHT (GRAMS)	PARTIC WT (GRAMS)
3-3	7	--	82.365410	82.365400	.000010	200.0	.0000000		
3-3	8	--	86.111340	86.111320	.000020	200.0	.0000001		
3-3	9	0655	81.743790	81.743590	.000200	175.0	.0000011		
3-3	10	0654	82.341170	82.341170	0.000000	150.0	0.0000000		
3-3	1	0650	80.771480	80.761900	.009580	150.0		.000022	.009558
3-3	2	0651	82.447760	82.410560	.037200	382.0		.000437	.036763
3-3	3	0652	77.395120	77.380000	.015120	164.0		0.000000	.015120
3-3	5	0648	83.668710	83.652210	.016500	318.0		0.000000	.016500
3-3	6	1104	.203190	.201000	.002190				.002190

PARTIAL PARTICULATE WEIGHT - .018690 GRAMS OR 18.69 MILLIGRAMS
TOTAL PARTICULATE WEIGHT - .080131 GRAMS OR 80.13 MILLIGRAMS

Battelle
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201
Telephone (614) 299-3151
Telex 24-5454

August 16, 1972

Dr. Robert E. Lee, Jr.
Division of Atmospheric Surveillance
Environmental Protection Agency
Research Triangle Park, North Carolina 27711

Dear Dr. Lee:

Contract No. 68-02-0447
Solution Samples 72-000-801 through 72-000-815;
72-000-820; 72-000-837 through 72-000-841;
72-000-843 through 72-000-847; and 72-000-849
through 72-000-853

The analyses of 29 samples plus 4 blanks, described in Mr. Lampe's letter dated July 10, 1972, are shown in Table 1. Each bottle contained approximately 50 ± 2 ml except 72-000-844 which contained 40 ± 2 ml. Some leakage in the shipping box was noted; This may account for one sample having less solution than the others. Note that the results in Table 1 are expressed in micrograms per milliliter (μg/ml), not per total sample.

Those samples showing relatively high amounts of Pb by optical emission spectrography (OES) were checked for Pb by atomic absorption spectrophotometry (AAS). For these samples the AAS value is given as noted in Table 1; all other data are by OES.

The blank values for the filters show considerably higher concentrations of some elements than do the sample filters. We cannot explain this; perhaps more filter material was taken for the blank than was used to prepare the samples. The reported values were rechecked for possible errors.

Please call if you have any questions.

Very truly yours,

W. M. Henry

W. M. Henry, Chief
Environmental and Materials Characterization Division

WMH:ees

cc: Dr. Darryl J. von Lehmden
Mr. Robert Lampe

TABLE H-II

OPTICAL EMISSION SPECTROGRAPHIC ANALYSIS OF NITRIC ACID-FILTER SOLUTIONS

(Results in micrograms per milliliter)

Contract No - 68-02-0447

Determinations Requested - Priority 1 and 2 elements

Type of Analysis - Optical Emission Spectrography (OES) and Atomic Absorption Spectrophotometry (AAS)

	Sample Designation								
Element	Front 1/2 Ace. 72-000-801	Filter 72-000-802	Blank 72-000-802	E-C Ext. 72-000-803	Imp. 72-000-804	Back 1/2 Ace. 72-000-805	Front 1/2 Ace. 72-000-807	Filter 72-000-808	Blank 72-000-[illegible]
B	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.00[illegible]
Cd	0.3	0.5	<0.05	<0.05	<0.05	<0.05	1.	0.2	<0.05
As	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
V	<0.01	0.02	0.05	<0.01	<0.01	<0.01	<0.01	0.02	0.1
Mn	0.5	0.03	0.03	<0.01	0.02	0.01	0.03	0.03	0.03
Ni	0.03	0.03	0.05	<0.01	0.05	0.05	0.05	0.1	0.1
Sb	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cr	0.03	0.06	0.1	0.01	0.2	0.1	0.1	0.1	0.1
Zn	5.	1.	10.	<0.1	0.1	<0.1	5.	1.	10.
Cu	0.05	0.01	0.01	<0.01	0.01	0.02	0.1	0.03	0.03
Pb	10.(b)	50.(b)	0.1	0.1	0.3	0.1	20.(b)	25.(b)	0.1
Se(a)	-	-	-	-	-	-	-	-	-
B	0.1	8.	80.	0.01	0.01	0.1	0.1	10.	80.
F(a)	-	-	-	-	-	-	-	-	-
Li	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Ag	0.03	0.003	<0.001	<0.001	<0.001	<0.001	0.05	0.002	<0.001
Sn	0.1	0.1	0.03	0.03	<0.03	<0.03	0.2	0.1	0.03
Fe	0.5	1.	2.	0.05	0.3	0.5	1.	1.	1.

TABLE H-II (Continued)

Element	Sample Designation								
	Front 1/2 Ace. 72-000-801	Filter 72-000-802	Blank 72-000-802	E-C Ext. 72-000-803	Imp. 72-000-804	Back 1/2 Ace. 72-000-805	Front 1/2 Ace. 72-000-807	Filter 72-000-808	Blank 72-000-
Sr	0.03	0.5	2.	<0.03	<0.03	<0.03	<0.03	0.05	2.
Na	1.	30.	80.	0.3	2.	1.	2.	30.	130.
K	0.3	10.	40.	0.1	0.3	0.3	0.5	20.	50.
Ca	3.	30.	65.	0.2	2.	90.	5.	40.	65.
Si	3.	10.	5.	0.5	0.5	5.	5.	10.	5.
Mg	0.3	20.	15.	0.03	0.1	0.5	0.5	20.	15.
Bi	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Co	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.2	<0.01
Ge	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Mo	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ti	0.02	0.05	0.3	<0.01	<0.01	0.01	0.02	0.04	0.3
Sm	-	-	-	-	-	-	-	-	-
Te	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Th	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Zr	<0.01	0.01	0.03	<0.01	<0.01	<0.01	<0.01	0.01	0.05
Ba	0.01	10.	100.	<0.01	<0.01	<0.01	0.05	10.	100.
Al	0.5	20.	80.	0.1	0.3	0.5	1.	20.	80.

TABLE H-II (Continued)

Element	Sample Designation								
	E-C Ext. 72-000-809	Imp. 72-000-810	Back 1/2 Ace. 72-000-811	Front 1/2 Ace. 72-000-813	Filter 72-000-814	Blank 72-000-814	E-C Ext. 72-000-815	Filter 72-000-820	Blank 72-000-
Be	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.00
Cd	<0.05	0.05	<0.05	0.05	<0.05	<0.05	<0.05	1.	0.05
As	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
V	<0.01	<0.01	<0.01	<0.01	0.02	0.1	<0.01	0.02	<0.01
Mn	<0.01	0.03	<0.01	0.01	0.03	0.03	0.01	0.03	<0.02
Ni	<0.01	0.2	0.01	0.03	0.1	0.05	0.03	0.1	0.03
Sb	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cr	0.01	0.5	0.05	0.03	0.3	0.3	0.03	0.3	0.03
Zn	<0.1	0.2	<0.1	0.3	0.2	10.	<0.1	5.	<0.1
Cu	<0.01	0.03	<0.01	0.01	0.01	0.01	<0.01	0.02	<0.01
Pb	0.05	1.	0.1	0.5	2.	0.1	<0.05	130.(b)	<0.05
Se(a)	-	-	-	-	-	-	-	-	-
B	0.05	0.01	0.1	0.1	8.	80.	<0.01	10.	0.01
F(a)	-	-	-	-	-	-	-	-	-
Li	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Ag	<0.001	0.002	<0.001	0.003	<0.001	<0.001	<0.001	0.01	<0.00
Sn	<0.03	0.03	0.03	0.03	0.03	0.03	<0.03	0.2	<0.03
Fe	0.1	1.	0.2	0.5	1.	2.	1.	1.	2.

TABLE H-II (Continued)

Element	Sample Designation								
	E-C Ext. 72-000-809	Imp. 72-000-810	Back 1/2 Ace. 72-000-811	Front 1/2 Ace. 72-000-813	Filter 72-000-814	Blank 72-000-814	E-C Ext. 72-000-815	Filter 72-000-820	Blank 72-000-
Sr	<0.03	<0.03	<0.03	<0.03	0.1	1.	<0.03	0.05	<0.03
Na	0.3	2.	0.3	0.3	35.	15.	0.1	35.	0.1
K	0.3	0.5	0.3	0.3	10.	40.	0.1	25.	0.1
Ca	0.5	5.	15.	0.3	35.	50.	0.2	50.	0.2
Si	2.	5.	1.	1.	5.	5.	0.3	10.	0.3
Mg	0.03	0.03	0.3	0.1	20.	15.	0.02	25.	0.02
Bi	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Co	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ge	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Mo	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ti	0.02	0.01	0.01	0.01	0.03	0.5	<0.01	0.03	0.02
Sm	-	-	-	-	-	-	-	-	-
Te	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Th	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Zr	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	<0.01	<0.01	<0.01
Ba	<0.1	0.03	<0.01	0.03	10.	105.	<0.01	10.	0.01
Al	0.3	1.	0.3	0.3	20.	80.	0.1	25.	0.1

TABLE H-II (Continued)

Element	Sample Designation								
	Front 1/2 Ace. 72-000-837	Filter 72-000-838	E-C Ext. 72-000-839	Imp. 72-000-840	Back 1/2 Ace. 72-000-841	Front 1/2 Ace. 72-000-843	Filter 72-000-844	E-C Ext. 72-000-845	Imp. 72-000-8
Be	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cd	0.2	0.4	<0.05	<0.05	<0.05	0.5	1.	<0.05	<0.05
As	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
V	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mn	0.02	0.03	0.01	0.01	<0.01	0.01	0.03	<0.01	<0.01
Ni	0.03	0.3	0.04	<0.01	<0.01	0.02	0.1	<0.01	<0.01
Sb	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cr	0.05	0.3	0.1	0.05	0.02	0.04	0.1	0.01	0.1
Zn	2.	1.	0.1	0.1	<0.1	1.	2.	<0.1	<0.1
Cu	0.02	0.02	<0.01	0.01	<0.01	0.01	0.02	<0.01	<0.01
Pb	4.	30.(b)	0.1	0.5	0.1	20.(b)	90.(b)	0.05	0.3
Se(a)	-	-	-	-	-	-	-	-	-
B	0.2	7.	0.03	<0.01	<0.01	0.1	10.	0.03	<0.01
F(a)	-	-	-	-	-	-	-	-	-
Li	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Ag	0.03	0.001	<0.001	<0.001	<0.001	0.003	0.003	0.1	<0.001
Sn	0.1	0.05	<0.03	0.03	<0.05	0.05	0.1	<0.05	<0.05
Fe	0.5	2.	0.5	0.3	0.3	0.5	2.	0.3	0.3

TABLE H-II (Continued)

Element	Sample Designation								
	Front 1/2 Ace. 72-000-837	Filter 82-000-838	E-C Ext. 72-000-839	Imp. 72-000-840	Back 1/2 Ace. 72-000-841	Front 1/2 Ace. 72-000-843	Filter 72-000-844	E-C Ext. 72-000-845	Imp. 72-000-8
Sr	<0.03	0.05	<0.03	<0.03	<0.03	<0.03	0.1	<0.03	<0.03
Na	1.	35.	0.5	2.	1.	0.5	35.	0.5	1.
K	0.3	20.	0.1	0.3	0.1	0.1	25.	0.1	0.3
Ca	0.5	35.	0.5	0.5	0.1	0.5	35.	0.1	0.3
Si	0.5	5.	1.	0.5	1.	2.	10.	1.	0.3
Mg	0.2	20.	0.2	0.1	0.05	0.1	25.	0.1	0.05
Bi	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Co	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ge	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Mo	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ti	<0.01	0.04	<0.01	<0.01	<0.01	<0.01	0.05	<0.01	<0.01
Sm	-	-	-	-	-	-	-	-	-
Te	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Th	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Zr	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01
Ba	<0.01	10.	0.03	0.02	<0.01	<0.01	4.	0.01	0.01
Al	0.3	20.	0.3	0.3	0.3	0.5	25.	0.3	0.3

TABLE H-II (Continued)

Element	Sample Designation					
	Back 1/2 Ace. 72-000-847	Front 1/2 Ace. 72-000-849	Filter 72-000-850	E-C Ext. 72-000-851	Imp. 72-000-852	Back 1/2 Ace. 72-000-853
Be	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cd	<0.05	0.3	0.5	<0.05	<0.05	<0.05
As	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
V	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mn	0.01	0.03	0.03	<0.01	<0.01	0.01
Ni	<0.01	0.2	0.2	0.04	<0.01	<0.04
Sb	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cr	0.02	0.1	0.2	0.01	0.03	0.08
Zn	<0.1	1.	0.2	<0.1	<0.1	<0.1
Cu	0.01	0.02	<0.01	<0.01	<0.01	<0.01
Pb	0.3	2.	10.(b)	<0.05	0.2	0.3
Se(a)	-	-	-	-	-	-
B	<0.01	0.1	7.	<0.01	<0.01	<0.01
F(a)	-	-	-	-	-	-
Li	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Ag	<0.001	0.05	<0.001	<0.001	<0.001	<0.001
Sn	<0.05	0.05	<0.05	<0.05	<0.05	<0.05
Fe	1.	2.	3.	0.5	0.3	0.5

TABLE H-II (Concluded)

Element	Sample Designation					
	Back 1/2 Ace. 72-000-847	Front 1/2 Ace. 72-000-849	Filter 72-000-850	E-C Ext. 72-000-851	Imp. 72-000-852	Back 1/2 Ace. 72-000-853
Sr	<0.03	<0.03	0.1	<0.03	<0.03	<0.03
Na	2.	2.	35.	1.	1.	1.
K	0.3	0.4	20.	0.1	0.1	0.1
Ca	0.2	0.4	35.	0.1	0.4	1.
Si	1.	2.	7.	1.	0.3	0.5
Mg	0.1	0.2	20.	0.1	0.05	0.1
Bi	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Co	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ge	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Mo	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ti	0.01	0.01	0.03	0.01	<0.01	<0.01
Sm	-	-	-	-	-	-
Te	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Th	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Zr	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ba	<0.01	0.01	3.	<0.01	<0.01	<0.01
Al	0.3	0.5	20.	0.3	0.3	0.5

(a) Not detectable by analysis technique used.

(b) AAS value.

T = Trace.

TABLE H-III

EPA ANALYTICAL REQUEST & REPORT

(Must be filled out for each test run)

Sampling Date Yr. 72 | Mo. 5 | Day 16 . First Ident. No. Used 72-000 801 Last Ident. No. Used 72-000 865

Test No. 72-MM-14

Run No. 1

INDUSTRY Lead Smelter (Use Table A)

COMPANY ASARCO

ADDRESS Glover, Missouri

SAMPLING METHOD Particulate (Method 5

UNIT PROCESS/OPERATION Blast Furnace

AIR POLLUTION CONTROL Baghouse

FUEL USED Natural Gas

INLET ☐ Stack No. 2

OUTLET ☑

GAS VOLUME SAMPLED (METER VOL. IN FT^3) 102.10

Ident. No.	Description of Sample or Sample Fraction	Sample Wt. (Solid) mg	Sample Vol. (Liquid) ml	Analysis Requested - General Comments (approx. concentrations-possible interferences etc.) (Indicate specific analysis on backside)
72-000 801	Front half sections wash (acetone)			Lead + Trace Metals
72-000 802	Glass fiber filter (w/ Blank)			Lead + Trace
72-000 803	Ether - Chloroform Extraction			Lead + Trace Metals
72-000 804	Aqueous water + wash			Lead + Trace Metals
72-000 805	Back half sections wash			Lead + Trace Metals

COMMENTS:

SAMPLING CONTRACTOR Midwest Research (if applicable) Date submitted 6/26/72

PROJECT OFFICER Clyde E. Riley

REQUEST REVIEWED BY

DATE ANALYSIS REQUESTED July 14, 1972

TABLE H-III (Continued)

REPORT OF ANALYSIS
Trace Elements
ppm - for solid samples
μg/ml - for liquid samples

Mark (x) for specific analysis requested
Mark (X) in block to left of Ident. No. when requesting all analysis on that line

	Ident. No.	Hg	Be	Cd	As	V	Mn	Ni	Sb	Cr	Zn	Cu	Pb	Se	B	F	Li	Ag	Sn	Fe	Sr	Na	K	Ca	Si	Mg	Ba	Analyst's Initial
22-000 801	X 801																											
	X 802																											
	X 803																											
	X 804																											
22-000 805	X 805																											

Analysis Method: 1-NAA, 2-SSMS, 3-OES, 4-AA, 5-ASV, 6-XRF, and 7- other

Comments:

Other Analysis - Use Table B to fill analysis requested (above each column)

Mark (x) for specific analysis requested

Ident. No.	Lead		Filter	Blank μg Pb	Orig	filter Blank					
801	☒ 525			35		37 μg					
802	☒ 2710			40							
803	☒ 105			42							
804	☒ 90			35							
805	☒ 32.5			34							
				1160 –	not included in calculation			of average filter blank			
				The following samples were							
				816	821	825	828	832	835		
Analyst	K. MacLeod			817	822	826	829	833			
Method	A A			819	823	827	831				

Comments: All Lead data given in μg/sample. Filter results reflect subtraction of the average filter blank

TABLE H-III (Continued)

REQUEST & REPORT

(Must be filled out for each test run)

Sampling Date 72 | 5 | 16 (Yr. | Mo. | Day)

First Ident. No. Used 72-000 808 7

Last Ident. No. Used 72-000 — 811

Test No. 72-MM-14

Run No. 1

INDUSTRY: Lead Smelter (Use Table A)

COMPANY: American Smelting and Refining

ADDRESS: Glover, Missouri

SAMPLING METHOD: Particulate (Method 5)

UNIT PROCESS/OPERATION: Blast Furnace

AIR POLLUTION CONTROL: Baghouse

FUEL USED: Natural Gas

INLET ☐ Stack No. 1.

OUTLET ☑

GAS VOLUME SAMPLED (METER VOL. IN FT^3): 92.20

Ident. No.	Description of Sample or Sample Fraction	Sample Wt. (Solid) mg	Sample Vol. (Liquid) ml	Analysis Requested - General Comments (approx. concentrations-possible interferences etc.) (Indicate specific analysis on backside)
72-000 807	Front half acetone wash (with etc.)			Lead and Trace Metals
72-000 808	Blank filter (w/ blank)			Lead + Trace Metals
72-000 809	Ether-Chloroform Extraction			Lead + Trace Metals
72-000 810	Orsg. H2O + water wash			Lead + Trace Metals
72-000 811	Back half acetone wash			Lead + Trace Metals

COMMENTS:

SAMPLING CONTRACTOR: Midwest Research (if applicable)

PROJECT OFFICER: Clyde E. Riley

Date submitted 6/26/72

REQUEST REVIEWED BY

DATE ANALYSIS REQUESTED: July 14, 1972

TABLE H-III (Continued)

REPORT OF ANALYSIS
Trace Elements
ppm - for solid samples
μg/ml - for liquid samples

Mark (x) for specific analysis requested
Mark (X) in block to left of Ident. No. when requesting all analysis on that line

	Ident. No.	Hg	Be	Cd	As	V	Mn	Ni	Sb	Cr	Zn	Cu	Pb	Se	B	F	Li	Ag	Sn	Fe	Sr	Na	K	Ca	Si	Mg	Ba	Analyst's Initial
72-000807	X 807																											
	X 808																											
	X 809																											
	X 810																											
2-000 811	X 811																											

Analysis Method: 1-NAA, 2-SSMS, 3-OES, 4-AA, 5-ASV, 6-XRF, and 7- other

Comments:

Other Analysis - Use Table B to fill analysis requested (above each column)

Mark (x) for specific analysis requested

Ident. No.	Lead										
807	X 1055										
808	X 1320										
809	X ~~120~~ 20										
810	X 120										
811	X 30										
Analyst	K. MacLeod										
Method	AA										

Comments:

TABLE H-III (Continued)

REQUEST & REPORT

(Must be filled out for each test run).

Sampling Date Yr. 72 | Mo. 5 | Day 16

First Ident. No. Used 72-000 813

Last Ident. No. Used 72-000 817

Test No. 72-MT-16

Run No. 1

INDUSTRY: Lead Smelter (Use Table A)

COMPANY: ASARCO

ADDRESS: Glover, Missouri

SAMPLING METHOD: Particulate (Method 5)

UNIT PROCESS/OPERATION: Blast furnace

AIR POLLUTION CONTROL: Baghouse

FUEL USED: Natural Gas

INLET ☐ Stack No. 3

OUTLET ☑

GAS VOLUME SAMPLED (METER VOL. IN FT^3): 79.28

Ident. No.	Description of Sample or Sample Fraction	Sample Wt. (Solid) mg	Sample Vol. (Liquid) ml	Analysis Requested - General Comments (approx. concentrations-possible interferences etc.) (Indicate specific analysis on backside)
72-000 813	Front half acetone wash (probe)			Lead & Trace metals
72-000 814	Glass fiber filter (w/ blank)			Lead & Trace metals
72-000 815	Ether Chloroform Ext.			Lead & Trace metals
72-000 816	Dmng. H_2O + wash			Lead & Trace metals
72-000 817	Back half acetone wash			Lead & Trace metals

1st results

COMMENTS:

SAMPLING CONTRACTOR: Midwest Research (if applicable)

PROJECT OFFICER: Clyde E. Riley

Date submitted 6/26/72

REQUEST REVIEWED BY

DATE ANALYSIS REQUESTED: July 14, 1972

TABLE H-III (Continued)

REPORT OF ANALYSIS
Trace Elements
ppm - for solid samples
µg/ml - for liquid samples

Mark (x) for specific analysis requested
Mark (X) in block to left of Ident. No. when requesting all analysis on that line

	Ident. No.	Hg	Be	Cd	As	V	Mn	Ni	Sb	Cr	Zn	Cu	Pb	Se	B	F	Li	Ag	Sn	Fe	Sr	Na	K	Ca	Si	Mg	Ba	Analyst's Initial
72-000 813	X 813																											
	X 814																											
	X 815																											
	X 816																											
72-000 817	X 817																											

Analysis Method: 1-NAA, 2-SSMS, 3-OES, 4-AA, 5-ASV, 6-XRF, and 7- other

Comments:

Other Analysis - Use Table B to fill analysis requested (above each column)

Mark (x) for specific analysis requested

Ident. No.	Lead										
813	X 100										
814	X 155.8										
815	X 30										
816	X 135										
817	X 45										
Analyst	X Mashed										
Method	AA										

Comments:

TABLE H-III (Continued)

REQUEST & REPORT

(Must be filled out for each test run)

Sampling Date 72 | 5 | 16 (Yr. | Mo. | Day)

First Ident. No. Used 72-000 819

Last Ident. No. Used 72-000 823

Test No. [illegible]

Run No. 2

INDUSTRY: Lead Smelter (Use Table A)

COMPANY: ASARCO

ADDRESS: Glover, Missouri

SAMPLING METHOD: Particulate (Method 5)

UNIT PROCESS/OPERATION: Blast Furnace

AIR POLLUTION CONTROL: Baghouse

FUEL USED: Natural Gas

INLET ☐ Stack No. 1

OUTLET ☑

GAS VOLUME SAMPLED (METER VOL. IN FT^3): 116.88

Ident. No.	Description of Sample or Sample Fraction	Sample Wt. (Solid) mg	Sample Vol. (Liquid) ml	Analysis Requested - General Comments (approx. concentrations-possible interferences etc.) (Indicate specific analysis on backside)
72-000 817	Front half acetone wash (one)			Lead + Trace Metals
72-000 818	Filter half filter (a/filter)			Lead + Trace
72-000 819	Filter + Dessicant Extraction			Lead + Trace
72-000 820	Impinger H2O + water wash			Lead + Trace
72-000 821	Back half acetone wash			Lead + Trace

COMMENTS:

SAMPLING CONTRACTOR: Midwest Research (if applicable)

PROJECT OFFICER: Clyde E. Riley

Date submitted 6/24/72

REQUEST REVIEWED BY

DATE ANALYSIS REQUESTED July 14, 1972

TABLE H-III (Continued)

REPORT OF ANALYSIS
Trace Elements
ppm - for solid samples
μg/ml - for liquid samples

Mark (x) for specific analysis requested
Mark (X) in block to left of Ident. No. when requesting all analysis on that line

Ident. No.	Hg	Be	Cd	As	V	Mn	Ni	Sb	Cr	Zn	Cu	Pb	Se	B	F	Li	Ag	Sn	Fe	Sr	Na	K	Ca	Si	Mg	Ba	Analyst's Initial
X 819																											
X 820																											
X 821																											
X 822																											
X 823																											

Analysis Method: 1-NAA, 2-SSMS, 3-OES, 4-AA, 5-ASV, 6-XRF, and 7- other

Comments:

Other Analysis - Use Table B to fill analysis requested (above each column)

Mark (x) for specific analysis requested

Ident. No.	Lead									
819	X 4875									
820	X 6395									
821	X 25									
822	X 65									
823	X 325									
Analyst	K Mashed									
Method	AA									

Comments:

TABLE H-III (Continued)

REQUEST & REPORT

(Must be filled out for each test run)

Sampling Date Yr. 72 | Mo. 5 | Day 16

First Ident. No. Used 72-000 825

Last Ident. No. Used 72-000 829

Test No. [illegible]

Run No. 2

INDUSTRY: Lead Smelter (Use Table A)

COMPANY: ASARCO

ADDRESS: Glover, Missouri

SAMPLING METHOD: Particulate (Method 5)

UNIT PROCESS/OPERATION: Blast furnace

AIR POLLUTION CONTROL: Baghouse

FUEL USED: Natural Gas

INLET ☐ Stack No. 2

OUTLET ☑

GAS VOLUME SAMPLED (METER VOL. IN FT^3): 72.01

Ident. No.	Description of Sample or Sample Fraction	Sample Wt. (Solid) mg	Sample Vol. (Liquid) ml	Analysis Requested - General Comments (approx. concentrations-possible interferences etc.) (Indicate specific analysis on backside)
72-000 825	Front half acetone wash (incl.)			Lead + Trace Metals
72-000 826	Glass filter (incl. filter)			" " " "
72-000 827	Filter - Chloroform extract			" " " "
72-000 828	Chloro. Hept + water wash			" " " "
72-000 829	Back half acetone wash			" " " "

COMMENTS:

SAMPLING CONTRACTOR (if applicable): Midwest Research

Date submitted 6/26/72

PROJECT OFFICER: Clyde E. Riley

REQUEST REVIEWED BY

DATE ANALYSIS REQUESTED: July 14, 1972

TABLE H-III (Continued)

REPORT OF ANALYSIS
Trace Elements
ppm - for solid samples
μg/ml - for liquid samples

Mark (x) for specific analysis requested
Mark (X) in block to left of Ident. No. when requesting all analysis on that line

72-000 825

	Ident. No.	Hg	Be	Cd	As	V	Mn	Ni	Sb	Cr	Zn	Cu	Pb	Se	B	F	Li	Ag	Sn	Fe	Sr	Na	K	Ca	Si	Mg	Ba	Analyst's Initial
X	825																											
X	826																											
X	827																											
X	828																											
X	829																											

Analysis Method: 1-NAA, 2-SSMS, 3-OES, 4-AA, 5-ASV, 6-XRF, and 7- other

Comments:

Other Analysis - Use Table B to fill analysis requested (above each column)

Mark (x) for specific analysis requested

Ident. No.	[illegible]										
825	X 470										
826	X 5213										
827	X 20										
828	X 45										
829	X 20										
Analyst	K Maeland										
Method	AA										

Comments: The blank filter (#2) supplied w/ 826 had 1400 μg Pb. This was a significant amount. 20% [illegible] was attributed to the filter. I do not think this is reasonable since none of the other filter blanks had significant amounts of lead.

TABLE H-III (Continued)

REQUEST & REPORT

(Must be filled out for each test run)

Sampling Date Yr. 72 | Mo. 5 | Day 16

First Ident. No. Used 72-000 831

Last Ident. No. Used 72-000 835

Test No. 72-MM-14

Run No. 2

INDUSTRY: Lead Smelter (Use Table A)

COMPANY: ASARCO

ADDRESS: Glover, Missouri

SAMPLING METHOD: Particulate (Method 5)

UNIT PROCESS/OPERATION: Blast furnace

AIR POLLUTION CONTROL: Baghouse

FUEL USED: Natural Gas

INLET ☐ Stack No. 3

OUTLET ☑

GAS VOLUME SAMPLED (METER VOL. IN FT^3): 89.19

Ident. No.	Description of Sample or Sample Fraction	Sample Wt. (Solid) mg	Sample Vol. (Liquid) ml	Analysis Requested - General Comments (approx. concentrations-possible interferences etc.) (Indicate specific analysis on backside)
72-000 831	Front half acetone wash (probe)			Lead and Trace Metals
72-000 832	Glass fiber filter (w/ Tare)			" " " "
72-000 833	Ether-Chloroform extraction			" " " "
72-000 834	Impinger H_2O & wash			" " " "
72-000 835	Back half acetone wash			" " " "

COMMENTS:

SAMPLING CONTRACTOR: Midwest Research (if applicable)

PROJECT OFFICER: Clyde E. Riley

Date submitted 6/26/72

REQUEST REVIEWED BY

DATE ANALYSIS REQUESTED July 14, 1972

TABLE H-III (Continued)

REPORT OF ANALYSIS
Trace Elements
ppm - for solid samples
µg/ml - for liquid samples

Mark (x) for specific analysis requested
Mark (X) in block to left of Ident. No. when requesting all analysis on that line

	Ident. No.		Hg	Be	Cd	As	V	Mn	Ni	Sb	Cr	Zn	Cu	Pb	Se	B	F	Li	Ag	Sn	Fe	Sr	Na	K	Ca	Si	Mg	Ba	Analyst's Initial
72-000831	X	831																											
	X	832																											
	X	833																											
	X	834																											
72-000-835	X	835																											

Analysis Method: 1-NAA, 2-SSMS, 3-OES, 4-AA, 5-ASV, 6-XRF, and 7- other

Comments:

Other Analysis - Use Table B to fill analysis requested (above each column)

Mark (x) for specific analysis requested

Ident. No.		Lead										
831	X	170										
832	X	255										
833	X	15										
834	X	85										
835	X	35										
Analyst		H. Wieland										
Method		AA										

Comments:

TABLE H-III (Continued)

REQUEST & REPORT

(Must be filled out for each test run)

Sampling Date 72 | 5 | 17 (Yr. | Mo. | Day)

First Ident. No. Used 72-000 837

Last Ident. No. Used 72-000 841

Test No. 72-MM-14

Run No. 3

INDUSTRY: Lead Smelter (Use Table A)

COMPANY: ASARCO

ADDRESS: Glover, Missouri

SAMPLING METHOD: Contin. 4 (Method 5)

UNIT PROCESS/OPERATION: Blast furnace

AIR POLLUTION CONTROL: Baghouse

FUEL USED: Natural Gas

INLET ☐ Stack Nos 1

OUTLET ☑

GAS VOLUME SAMPLED (METER VOL. IN FT^3): 81.16

Ident. No.	Description of Sample or Sample Fraction	Sample Wt. (Solid) mg	Sample Vol. (Liquid) ml	Analysis Requested - General Comments (approx. concentrations-possible interferences etc.) (Indicate specific analysis on backside)
72-000 837	Acid half acetone wash (probe)			Lead and Trace Metals
72-000 838	Filter with fibers			" " " "
72-000 839	Filter 100% Alcohol extraction			" " " "
72-000 840	Impinger H_2O & wash			" " " "
72-000 841	Both half acetone wash			" " " "

COMMENTS:

SAMPLING CONTRACTOR: Midwest Research (if applicable)

PROJECT OFFICER: Robert E. Ruby

Date submitted 6/27/72

REQUEST REVIEWED BY

DATE ANALYSIS REQUESTED July 14, 1972

TABLE H-III (Continued)

REPORT OF ANALYSIS
Trace Elements
ppm - for solid samples
µg/ml - for liquid samples

Mark (x) for specific analysis requested
Mark (X) in block to left of Ident. No. when requesting all analysis on that line

Ident. No.	Hg	Be	Cd	As	V	Mn	Ni	Sb	Cr	Zn	Cu	Pb	Se	B	F	Li	Ag	Sn	Fe	Sr	Na	K	Ca	Si	Mg	Ba	Analyst's Initial
X 837																											
X 838																											
X 839																											
X 840																											
X 841																											

Analysis Method: 1-NAA, 2-SSMS, 3-OES, 4-AA, 5-ASV, 6-XRF, and 7- other

Comments:

Other Analysis - Use Table B to fill analysis requested (above each column)

Mark (x) for specific analysis requested

Ident. No.	Lead										
837	X 550										
838	X 1850										
839	X 35										
840	X 150										
841	X 35										
Analyst	K. Yipa										
Method	AA										

Comments:

TABLE H-III (Continued)

REQUEST & REPORT

(Must be filled out for each test run)

Sampling Date 72 | 5 | 17 (Yr. | Mo. | Day)

First Ident. No. Used 72-000 843

Last Ident. No. Used 72-000 847

Test No. 72-MM-17

Run No. 3

INDUSTRY: Lead Smelter (Use Table A)

COMPANY: ASARCO

ADDRESS: Glover, Missouri

SAMPLING METHOD: Particulate (Method 5)

UNIT PROCESS/OPERATION: Blast furnace

AIR POLLUTION CONTROL: Baghouse

FUEL USED: Natural Gas

INLET ☐ Stack No. 4

OUTLET ☑

GAS VOLUME SAMPLED (METER VOL. IN FT^3): 91.04

Ident. No.	Description of Sample or Sample Fraction	Sample Wt. (Solid) mg	Sample Vol. (Liquid) ml	Analysis Requested - General Comments (approx. concentrations-possible interferences etc.) (Indicate specific analysis on backside)
72-000 843	Front half-acetone wash (probe)			Lead and Trace in Pb.
72-000 844	Glass fiber filter			" " " "
72-000 845	Ether Chloroform extraction			" " " "
72-000 846	Impinger H-O wash			" " " "
72-000 847	Back half acetone wash			" " " "

COMMENTS:

SAMPLING CONTRACTOR: Midwest Research (if applicable)

PROJECT OFFICER: Clyde E. Riley

Date submitted 6/26/72

REQUEST REVIEWED BY

DATE ANALYSIS REQUESTED July 14, 1972

TABLE H-III (Continued)

REPORT OF ANALYSIS
Trace Elements
ppm - for solid samples
µg/ml - for liquid samples

Mark (x) for specific analysis requested
Mark (X) in block to left of Ident. No. when requesting all analysis on that line

	Ident. No.	Hg	Be	Cd	As	V	Mn	Ni	Sb	Cr	Zn	Cu	Pb	Se	B	F	Li	Ag	Sn	Fe	Sr	Na	K	Ca	Si	Mg	Ba	Analyst's Initial
X	843																											
X	844																											
X	845																											
X	846																											
X	847																											

Analysis Method: 1-NAA, 2-SSMS, 3-OES, 4-AA, 5-ASV, 6-XRF, and 7- other

Comments:

Other Analysis - Use Table B to fill analysis requested (above each column)

Mark (x) for specific analysis requested

Ident. No.	Lead										
843	920										
844	4300										
845	35										
846	45										
847	40										
Analyst											
Method	AA										

Comments:

TABLE H-III (Continued)

REQUEST & REPORT

(Must be filled out for each test run)

Sampling Date Yr. 72 | Mo. 5 | Day 17 | First Ident. No. Used 72-000 849 | Last Ident. No. Used 72-000 853 | Test No. 72-[illegible] | Run No. 3

INDUSTRY: Lead Smelter (Use Table A)

COMPANY: ASARCO

ADDRESS: Glover, Missouri

SAMPLING METHOD: Particulate (Method 5)

UNIT PROCESS/OPERATION: Blast furnace

AIR POLLUTION CONTROL: Baghouse

FUEL USED: Natural Gas

INLET ☐ Stack No. 3

OUTLET ☑

GAS VOLUME SAMPLED (METER VOL. IN FT^3): 34.16

Ident. No.	Description of Sample or Sample Fraction	Sample Wt. (Solid) mg	Sample Vol. (Liquid) ml	Analysis Requested - General Comments (approx. concentrations-possible interferences etc.) (Indicate specific analysis on backside)
72-000 849	Front half acetone wash/probe			Lead and Tin in [illegible]
72-000 850	Glass fiber filter			" " " "
72-000 851	Ether/Chloroform extraction			" " " "
72-000 852	Glass Hot wash			" " " "
72-000 853	Back half acetone wash			" " " "

COMMENTS:

SAMPLING CONTRACTOR: Midwest Research (if applicable)

PROJECT OFFICER: [illegible]

Date [illegible] 6/[illegible]/72

REQUEST REVIEWED BY

DATE ANALYSIS REQUESTED [illegible]

TABLE H-III (Concluded)

REPORT OF ANALYSIS
Trace Elements
ppm - for solid samples
μg/ml - for liquid samples

Mark (x) for specific analysis requested
Mark (X) in block to left of Ident. No. when requesting all analysis on that line

	Ident. No.	Hg	Be	Cd	As	V	Mn	Ni	Sb	Cr	Zn	Cu	Pb	Se	B	F	Li	Ag	Sn	Fe	Sr	Na	K	Ca	Si	Mg	Ba	Analyst's Initial
X	[illegible]																											
X	[illegible]																											
X	851																											
X	852																											
X	853																											

Analysis Method: 1-NAA, 2-SSMS, 3-OES, 4-AA, 5-ASV, 6-XRF, and 7- other

Comments:

Other Analysis - Use Table B to fill analysis requested (above each column)

Mark (x) for specific analysis requested

Ident. No.	[illegible]										
850	X 340										
850	X 675										
851	X 15										
852	X 100										
853	X 30										
Analyst	K. Hackett										
Method	[illegible]										

Comments:

APPENDIX I

TEST LOG

MIDWEST RESEARCH INSTITUTE
Sampling Task
Log

ASARCO 3585-C11 Recorded By RC Dossey

1972 Date	Run	Location-Port	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
5-16	1-1	stack 1	particulate	0905 - ~~1213~~	1213	185	0606-0611
5-16	1-2	stack 2	"	0905	1213	188	0600-0605
5-16	1-3	stack 3	"	0905	1218	193	0612-0617
5-16	"1"	stack 3	ORSAT	0915	1030	90	—
5-16	2-1	stack 1	particulate	1555	1825	190	0618-0623
5-16	2-2	stack 2	"	1555	1821	186	0624-0629
5-16	2-3	stack 3	"	1555	1832	197	0630-0635
5-16	"2"	stack 3	ORSAT	1800	"grab"	—	—
5-17	3-1	stack 1	particulate	1310	1544	154	0636-0641
5-17	3-2	stack 2	"	1310	1537	147	0642-0647
5-17	3-3	stack 3	"	1310	1535	145	0648-0653
5-17	"3"	stack 3	ORSAT	1347	"grab"	—	—
5-17	"3"	stack 2	ORSAT	1522	"grab"	—	—

MRI - Form (3/72)

APPENDIX J

PROJECT PARTICIPANTS AND TITLES

Name	Title
Paul Constant	Program Manager
Bob Tussey	Project Chief, Assistant Program Manager
Reid Flippin	Field Lab. Technician
Edward Trompeter	Testing Engineer
Robert Stultz	Testing Engineer
Robert Conkling	Testing Engineer
Gary Kelso	Engr. Technician
Henry Moloney	Engr. Technician
Edward Cartwright	Engr. Technician
Chatten Cowherd	Technical Consultant
Fred Bergman	Analytical Chemist
Michael Hammons	Laboratory Technician

APPENDIX K

RELATED REPORTS

Two reports presented in this appendix are directly related to the performance of these tests. They include (1) MRI plant site Presurvey Report and, (2) ASARCO - Trip Report by EPA.

MIDWEST RESEARCH INSTITUTE
425 Volker Boulevard
Kansas City, Missouri 64110
Telephone (816) 561-0202

May 8, 1972

Mr. Clyde E. Riley
Environmental Protection Agency, OAP, ETB
Research Triangle Park,
North Carolina 27711

Subject: Presurvey report, American Smelting and Refining Company (ASARCO), Glover Missouri, on April 25, 1972, Contract No. 68-02-028, Task 10, MRI Project No. 3585-C, Task 11.

Dear Gene:

The delayed submittal of this presurvey report is due to rescheduling resulting from process changes at this plant, and negotiated testing method deviations from Method 6 and 8 for the MOROCO plant.

On April 25, 1972 we conducted a presurvey visit to the ASARCO plant in Glover, Missouri, to determine the level of effort required to perform testing pursuant to your task order Number 10. The task consists of a presurvey and testing to determine total particulate emissions from three lead smelter blast furnace baghouse stacks simultaneously. Three tests will be performed. The collected samples will be returned to MRI for analysis. Pursuant to your request, we will not analyze collected samples for Pb using atomic absorption. We will however, retain the samples for your analysis.

The following report consists of: (1) an enclosed completed "Prelininary Survey" form, (2) a description of support platform requirements, (3) a description of manpower requirements, (4) proposed scheduling, and (5) process monitoring requirements.

SUPPORT PLATFORM REQUIREMENTS

During the presurvey, we determined that erection of scaffolding on the baghouse roof to support personnel and equipment was excessively complicated and potentially hazardous. Mr. Bates contacted the plant engineer. An inspection and discussion revealed their willingness and preference to erect welded platforms to the stacks. After determining the desirable location for ports, a sketch specification was drafted with plant personnel.

May 8, 1972
Mr. Clyde E. Riley

I have been informed that the platforms are in place at this time. Ports will be installed in our presence during preliminary setup on May 12 or 15. Minor welded angle supports have been installed to serve pullys for equipment hoisting.

Mr. Paul has indicated a preliminary estimated cost of $2,000 for erection of platforms. As instructed by EPA contracts, MRI will issue a purchase order to American Smelting and Refining Company for this work, which will be a project expense.

MANPOWER REQUIREMENTS

Each of the three stacks will require a two-man particulate team. We will also provide a process technician. The process technician will also serve to perform laboratory cleanup and sample handling. The project chief will coordinate testing and complete the 8-man field crew. This structure assumes completion of one test by each team per day for a three-day period. The first day of the week will be for setup completion and the last day for cleanup and testing backup.

Table I presents our estimated manpower requirements.

TABLE I

ESTIMATED MANHOURS FOR ASARCO TESTING

Task	Time/Hours
1. Setup and cleanup	130
2. Travel	60
3. Scaffold erection and removal	-
4. Field testing	240
5. Analysis	80
6. Report writing	80
7. Planning and administration	90
Presurvey	35
Premium overtime	30
Straight overtime	75
	820

Setup and cleanup includes time required up to and including May 8 to checkout and load equipment, setup and take down equipment on site. Checkout at MRI after returning is also included.

Although the plant is located in the same state as MRI, its remoteness requires considerable travel time.

The necessity of completing the tests on schedule justifies our estimated overtime.

SCHEDULING

As you are aware, our initial schedule for this plant required setup on the 4th and 5th of May. The process changes forced rescheduling setup and testing. Platform erection has been completed.

We are scheduled to complete testing at MOLOCO on May 11. Part of the MOLOCO crew will cleanup equipment there while the remaining crew transfers equipment and initiates setup on this plant on May 12. May 15 will be utilized to complete setup. The 16th, 17th, and 18th is scheduled for testing and the 19th for cleanup, and test backup.

Samples will be returned to the institute for analysis during the following two weeks.

We will comply with reporting requirements as stipulated in the task order.

PROCESS MONITORING

Pursuant to your request, we will provide one technician to record process data as directed by an EPA representative. We assume no.

May 8, 1972
Mr. Clyde E. Riley

responsibility in controlling the process during testing. Contact will be maintained with this individual in the control room during testing to insure coordination.

Sincerely,

MIDWEST RESEARCH INSTITUTE

Robert C. Tussey, Jr.
Associate Environmental Engineer

Approved:

Paul C. Constant, Jr.
Program Manager

PCC:mh

cc: Environmental Protection Agency
Durham Contract Operation
Research Triangle Park
North Carolina 27711

Attn: Mr. M. P. Honeycutt
Contracting Officer (1 Copy of the Report)

PRELIMINARY SURVEY

Name of Company American Smelting & Refining Co. ASARCO Date of survey 4-25-

Address P.O. Box 7 City Glover State Mo.

Name of Contacts Mr. R.B. Paul Title Plant Manager

Mr. Curtis Bates Title Superintendent

Title

Plant Telephone Number (314) 546 7492 FTS Number

Description of Process Primary Lead Smelter, blast furnace baghouse.

Operating Schedule of Process 5 days/week; 24 hr./day

Batch or Continuous Process continuous

Feed Composition and Rates 11 T sinter & 1½ T coke per charge

Type of Fuel NA Production Rate furnace - 300T/day

Description of Air Pollution Control Equipment and Operation 6 compartment baghouse, wool bags, designed by ASARCO, 2 compartments per stack, daily inspection, closed for shaking cleaning one at a time, shakes on pressure drop sensors, (not consistent 17-20 seconds shaking followed by approx. 10 sec. delay prior to operation again, cycle varies from 30 min. to 3 hr collected dust is burned, lime added prior to baghouse to aid in combustion, preceeded by dilution air for cooling and water sprayers, collected dust combustion products also emitted.

* ok to close damper during testing and rely on sprayers for cooling.

Page 2 - Preliminary Survey

Assumed Constituents of Stack Gas for Each Sampling Site SO_2 dreëgen by G. Riley on presurvey 180 ppm, (one stack), klinker formed in cellar of baghouse by burning collected dust (≈ 53% Pb, 0.1% Cu, 6½% S, ½ oz./ton silver), grain loading unknown.

Possible Testing Sites (1) Blast furnace baghouse stack # 1

(2) " # 2

(3) " # 3

(4)

Can Samples be Collected of:

a.	Raw materials	yes	e.	Product	yes
b.	Control equipment effluent	yes	f.	Fuel	yes
c.	Ash	yes	g.	Other	—
d.	Scrubber water	yes			

Signature Required on Passes yes Waivers signed by each individual

Best Time to Test daylight - scheduled for May 8, 9, 10

Are the Following Available at the Plant?

a.	Parking Facilities	yes	h.	Weighing Balance	no
b.	Electric Extension Cords	yes	i.	Clean-up Area	no
c.	Electrician	yes	j.	Laboratory Facilities	no
d.	Safety Equipment	yes	k.	Sampling Ports	no
e.	Ice	no	l.	Scaffolding	yes
f.	Acetone	no	m.	Restroom	yes
g.	Distilled water	no	n.	Vending Machines	no

1. Electricity Source
   a. Amperage per circuit 20A each - 3 circuits requested
   b. Location of fuse box control room
   c. Extension cord lengths
   d. Adapters needed? twist lock

2. Safety Equipment Needed
   a. Hard hats MRI
   b. Safety glasses MRI
   c. Goggles
   d. Safety shoes MRI
   e. Alarms
   f. Other respirators by ASARCO 7 for MRI

3. Ice
   a. Vendor Mc Henry's store
   b. Location ≈ 3 miles from plant

4. Acetone
   a. Vendor MRI
   b. Location
   c. Telephone

5. Sampling Ports
   a. Who will provide ASARCO
   b. Size opening 3" ID

6. ~~Scaffolding~~ welded platforms
   a. Height see sketches
   b. Length
   c. Vendor ASARCO
      Address
      Telephone

7. Motels: S #8. D #10.

a. Mimosa, Ironton, Mo. Phone (314) 546-7418 Rate ___

b. _____ Phone _____ Rate ___

c. _____ Phone _____ Rate ___

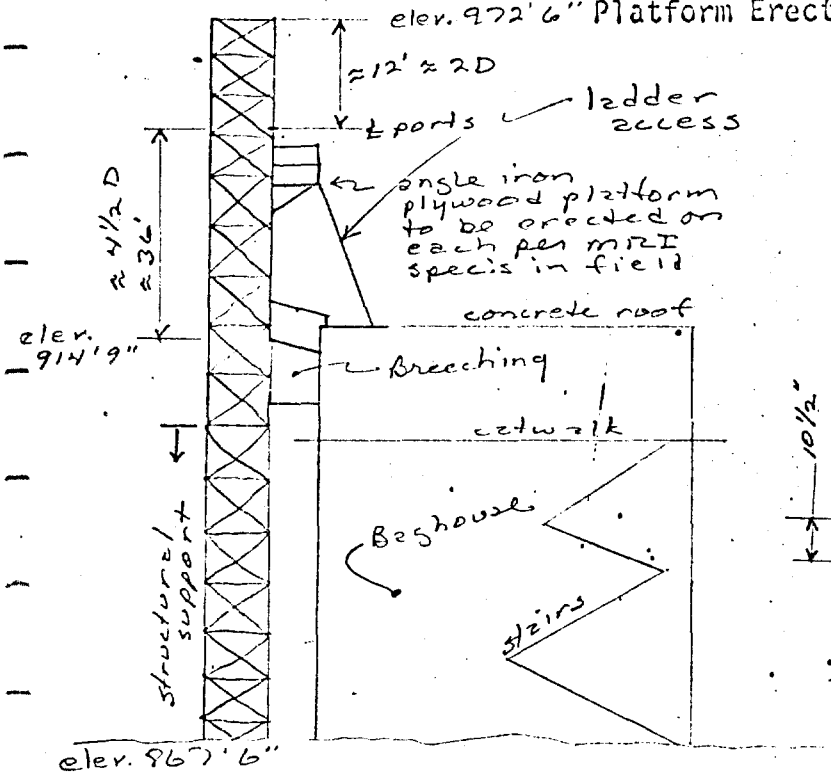
8. Restaurants:

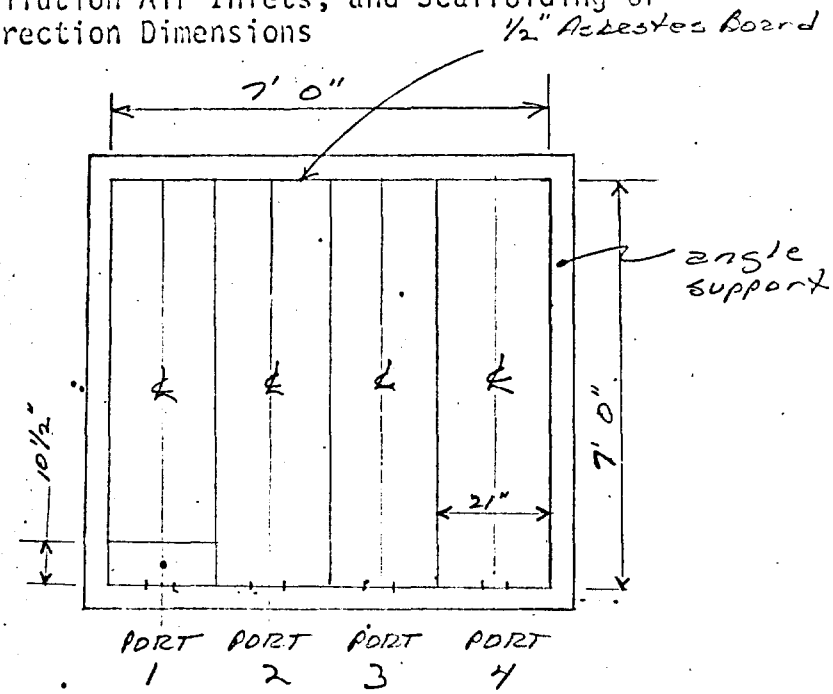
a. Near Plant McHenry's store

b. Near Motel motel

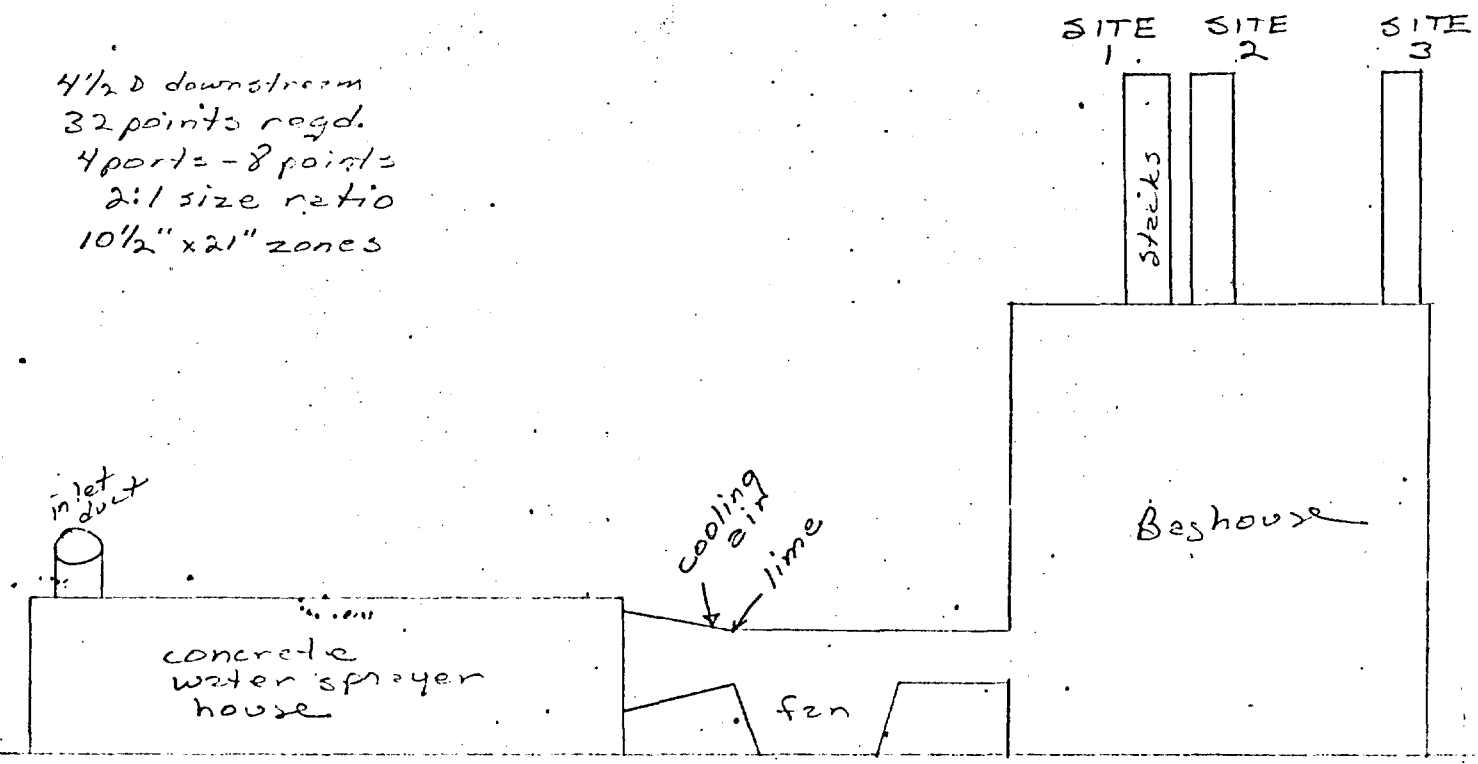
9. Survey By:
R. C. Tussey, Jr., Midwest Research Institute

Sketch of Stack to be Sampled Showing Locations of Port Openings, Water Sprayers, Flow Interferences, Dilution Air Inlets, and Scaffolding or Platform Erection Dimensions





4½ D downstream
32 points reqd.
4 ports = 8 points
2:1 size ratio
10½" x 21" zones



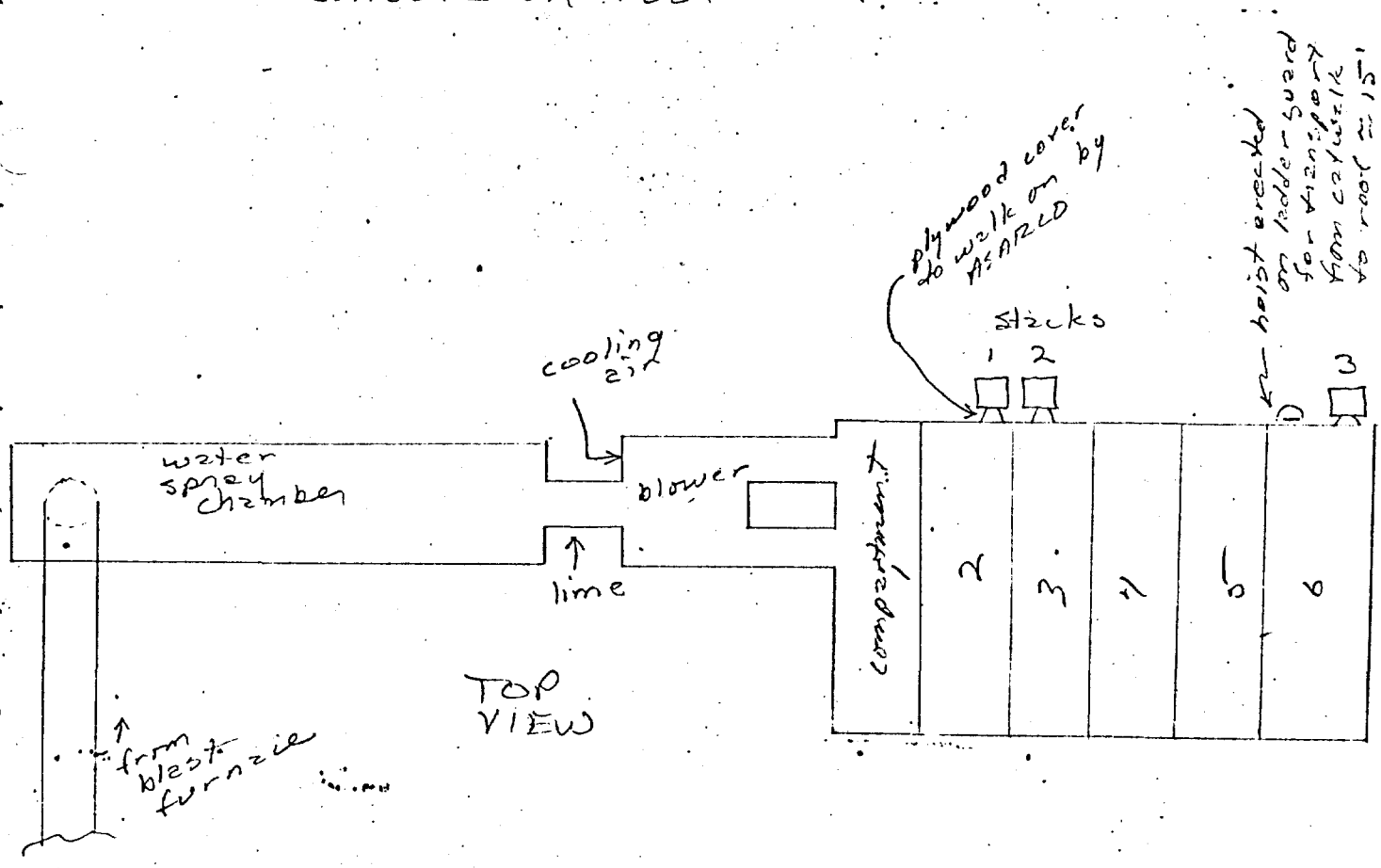
Provide Diagram of Each Sampling Site. Include the Following Information:

Dimensions to nearest obstruction in all directions from sampling port.

Complete description of all ports including all dimensions. Description of any unusual features about environment; height, odors, toxic conditions, temperature, dust, etc.

sites 1, 2, 3

* high Pb dust conc.
* high SO_2 (potentially CO) concentrations
* equipment up and down steps, rope hoist to roof, rope hoist to platform
* exposed to weather
* console on roof



all three are identical

STACK DATA

Properties of Sampling Locations	SITE Stack #1	SITE Stack #2	SITE Stack #3	Stack #4
Purpose of stack	blast furnace	baghouse	stacks	
Height ft.	100'			
Width ft.	7'			
Length ft.	7'			
Diameter ft. I.D.				
Wall thickness in.	1/2" Asbestos Cement Board			
Material of construction				
Ports: a. Existing b. Size opening c. Distance of Platform	none			
Straight distance before port	36'			
Type of restriction	breeching			
Straight distance after port	2D			
Type of restriction	ambient			
Environment	high Pb dust			
Work space	platform			
Ambient temp. °F	ambient			
Avg. pitot reading (H_2O, in Hg)	0.05			
Stack velocity F/M	800			
SCFM	40,000			
Moisture % by volume	3%			
Stack temperature °F	140			
Particulate loading gr/SCF	?			
Particle size	?			
Gases present	CO, SO_2			
Stack pressure H_2O, in Hg	≈ 0			
Water Sprays	yes			
Dilution air	yes			
Elevator	no			

ENVIRONMENTAL PROTECTION AGENCY

Reply to Attn of:

Date: 28 OCT 1971

Subject: Trip Report - ASARCO Lead Smelter at Glover, Missouri

To: Acting Chief, Chemical and Combustion Section

I. Purpose:

To obtain information on the operation of lead smelters and determine the emission control technology used. The smelter was also evaluated to determine the possibility of testing to obtain data for setting standards of performance for new stationary sources under the Clean Air Act of 1970.

II. Place and Date:

ASARCO's lead smelter at Glover, Missouri on August 25, 1971.

III. Attendees:

1. ASARCO

R. B. Paul, Plant Manager

2. Office of Air Programs, EPA

a. H. B. Coughlin, Acting Chief, Performance Standards Development Section, Source Control Branch
b. R. T. Jacobs, Jr., Chemical Engineer, Source Control Branch

IV. Discussion:

1. Plant location:

The smelter is located in the town of Glover, Missouri. That part of the country contains many trees and those near the smelter appeared to be in the same good condition as trees at a distance.

2. General Topics of Discussion:

a. The setting of performance standards for new stationary sources under the Clean Air Act of 1970 was discussed. Also discussed was the Requirements for Preparation, Adoption, and Submittal of Implementation Plans for states.

b. They informed us that their lead smelter at Shelby, California had closed recently. Factors which contributed to its closing were the unstable politics of South American countries which are their suppliers of ore and a generally uneconomical operation due to the out-dated technology being used at the smelter.

3. Process Description:

a. The smelter was designed by ASARCO and built by Kaiser Engineering. It is a custom smelter (all ore is purchased from other companies) with a design capacity of 90,000 tons lead per year and started production in 1968. Presently they are operating only five days per week but are producing at a 90,000 ton per year rate. The average inlet concentrate analysis is 70-75% lead, 2 1/2 percent zinc, 1 percent copper. If the concentrate composition were to change due to changes in suppliers, the particulate emissions from the smelter would remain approximately constant since most of the particulate matter is metallic fumes with very little entrained dust.

b. The smelter operation consists of a sintering machine, blast furnace, drossing, decopperizing, desilverizing, dezincing, and refining kettles. There is control of particulates from the sintering machine and blast furnace, with a separate baghouse for each, but there is no control of particulates from the other operations or of sulfur emissions from any part of the smelter (even though the daily sulfur emissions to the air are about 75 tons).

c. The sintering machine is of the updraft design with a feed rate of 1500 tons per day. There is only one gas stream taken from the machine and it, along with hygiene ventilation air, is sent to a baghouse for recovery of particulates. The sulfur dioxide concentration in the gas stream is unknown.

d. The blast furnace has a production rate of 300 tons per day. The product bullion and slag are removed continuously from the furnace. Gases from the tapping and furnace operation are combined and sent to a baghouse for recovery of particulates. The blast furnace slag is granulated with some being recycled to sintering and the rest being discarded. The gases from granulating are vented to the atmosphere through a water venturi scrubber.

e. The drossing, decopperizing, desilverizing, dezincing, and refining kettles have no emission control devices on them. All are located in a large open building. While there we witnessed the pouring of a ladle of blast furnace lead into the drossing kettle and there was a large quantity of smoke generated during the pouring.

4. Control of Emissions:

a. Two baghouses are used for control of particulate emissions at this smelter. One baghouse treats gas from sintering and hygiene ventilation while the other treats gas from the blast furnace. The use of two baghouses was dictated by general company policy. However, a possible advantage may be realized since changes in emission characteristics due to changes in ore suppliers may be better controlled by having spearate baghouses for the sintering machine and the blast furnace. Both baghouses were designed by ASARCO and are enclosed concrete structures of the compartmented, pressure type with a design efficiency of 99.8 percent. The bags are 12 1/2 inch diameter by 20 foot long with 204 per compartment and made of dacron or orlon (some of each material). Each baghouse is inspected daily to insure proper maintenance of the bags.

b. The sintering machine gas and ventilation gas [illegible] ined and cooled in a water spray chamber before going to the baghouse. The nine compartment baghouse (total cloth area 129,000 square feet) has an inlet gas rate of 232,000 ACFM at 204°F (air to cloth ratio of 1.8 or 2.0 ACFM/square feet with one compartment being cleaned). Gases from the baghouse are vented through a 12 inch thick, 610 foot tall concrete stack of 20 foot diameter. The stack has four temperature monitors which in conjunction with a ground level ambient air SO_2 monitor are used to regulate the smelter production rate based upon weather conditions to prevent an excess ground level concentration of SO_2. There is a sampling house on the ductwork between baghouse and stack which has an "Asagaina" sampler. This sampler collects a continuous isokinetic sample in a bag for 2-3 day period after which the collectid material is weighed. Based upon this sampler the particulate emissions from the main plant stack are estimated at 125 pounds per day. During our visit, the stack emissions were at an opacity of 20 percent.

c. The blast furnace gases are cooled in a water spray chamber before going to the baghouse. The six compartment baghouse (total cloth area 77,000 square feet) has an inlet gas rate of 131,000 ACFM at 137°F (air to cloth ratio of 1.7 or 2.0 ACFM/square feet with one compartment being cleaned). Gases from the baghouse are vented through three 58 foot stacks with each stack taken the exhaust from two compartments. The rate of emissions is unknown. During our visit, the stack emissions were at an opacity of zero percent.

Dia of stack

d. Trace element emissions from the smelter have not been measured. However, it is felt by the plant personnel that the only significant trace element present in their concentrates which is emitted to the air is cadmium. There is about 0.007 percent in the concentrate which would be a yearly emission of about 10 tons.

5. Feasibility of Testing:

a. During the plant visit a visual survey was made of the plant ductwork and stacks and where possible construction drawings were obtained. A meeting was held with Mr. J. Rom the Project Officer for non-ferrous smelters, Chemical and Metallurgical Section, Emissions Testing Branch to determine the possibility of conducting emission tests in the smelter.

b. The sintering machine gases should not be tested in the ductwork between the baghouse and stack but could be tested in the stack with valid results being obtained. The concrete stack has no sampling ports but they could probably be installed if the company agrees. However, during our visit they did not seem agreeable to this idea.

c. The blast furnace gases should not be tested in the ductwork between the baghouse and stack but could be tested in the stacks with valid results being obtained. The metal stacks have no sampling ports but they could be installed if the company agrees. During our visit they seemed agreeable to this idea.

V. Conclusions and Recommendations:

The sintering machine gases from its baghouse and the blast furnace gases from its baghouse should both be tested to determine the particulate emissions from these sources.

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