

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.

**DRAFT
REVISION 0**

7

**PM10 EMISSION FACTORS
FOR A
LIMESTONE CRUSHING PLANT
VIBRATING SCREEN
AND CRUSHER FOR
MARYVILLE, TENNESSEE**

**EPA CONTRACT NO. 68-D2-0163
WORK ASSIGNMENT NO. 19**

JULY 19, 1993

Prepared for:

**Emission Measurement Branch
Office of Air Quality Planning and Standards
U.S. Environmental Protection Agency
Research Triangle Park, North Carolina 27711**

Prepared by:

**Todd T. Brozell and Dr. John Richards, P.E.
Control Equipment Testing And Optimization Division
Entropy Environmentalists, Inc.
P.O. Box 12291
Research Triangle Park, North Carolina 27709-2291
Entropy Project Number 50119**

TABLE OF CONTENTS

1.0	Summary	1
1.1	Test Procedures and Results.....	1
1.2	Key Personnel.....	2
2.0	Plant and Sampling Location Description.....	3
2.1	Process Description and Operation.....	3
2.2	Fugitive Dust Control.....	5
2.3	Sampling and Emission Testing Procedures.....	5
2.4	Monitoring of Process Operating Conditions.....	14
3.0	Test Results.....	16
3.1	Objectives and Test Matrix.....	16
3.2	Stone Moisture Levels	16
3.3	Ambient PM10 Concentrations	17
3.4	Stone Production Rates	18
3.5	PM10 Emission Factors	18
4.0	QA/QC Activities.....	21
4.1	QC Procedures.....	21
4.2	Velocity/Volumetric Flow Rate Determination.....	21
4.3	QA Audits.....	22
4.4	Particulate/Condensibles Sampling QC Procedures.....	22
4.6	Sample Volume and Percent Isokinetics.....	23
4.7	Manual Sampling Equipment Calibration Procedures.....	23
4.8	Data Validation.....	25
5.0	References.....	26
6.0	Glossary.....	27
Appendix A. Field Data and Results Tabulation		
Appendix B. Example Emission Factor Calculations		
Appendix C. Audit Calibration Data Sheets		
Appendix D. Sampling Log and Chain-of-Custody Records		
Appendix E. Moisture Analytical Data		

1.0 SUMMARY

1.1 TEST PROCEDURES AND RESULTS

The U.S. Environmental Protection Agency (EPA), Emission Measurement Branch (EMB) issued a work assignment to Entropy Environmentalists, Inc. (Entropy) to develop and conduct a set of emission tests at two limestone crushing plants to determine the PM10 emission factors. The specific sources tested were a 5.5 foot shorthead cone crusher (5.5' crusher) and an 6 by 16 foot vibrating screen. The plants selected by the EPA Task Manager were the Vulcan Materials Company, Maryville and Bristol, Tennessee Plants. This report will reflect the tests conducted at the Maryville, Tennessee Plant.

The primary objective of the tests was to determine the PM10 emissions from the specific processes with the maximum degree of accuracy. The EPA Reference Method used to quantify the PM10 emissions was Method 201A. This procedure utilizes an extractive sampling train consisting of a cyclonic precollector to remove the greater than 10 micron particles, followed by a filter. To use Method 201A, it was necessary to design a fugitive emission capture system to collect the PM10 particle laden gas stream.

A Quasi-stack system was used to conduct emission tests on the inlet and outlet of the 5.5' crusher. Small enclosures were built at both the inlet and outlet locations. Clean make-up air from HEPA filters was blown into each enclosure at a rate approximately equal to the exhaust gas stream flow rate being drawn to the emission sampling location. Using this testing approach, all of the PM10 emissions from the crusher inlet and outlet were efficiently captured and adjacent sources of PM10 emissions did not affect the results.

The vibrating screen emission tests were conducted using a track-mounted hood system. The hood has dimensions of 2 feet by 2 feet and was mounted approximately 12 inches above the upper screen deck of the vibrating screen. The small scale and the mounting position of the hood ensured that the normal PM10 emissions were not significantly influenced by the presence of the hood. The capture velocity in the hood was set by adjusting the variable speed DC motor of the tubeaxial fan installed on the hood outlet duct. The hood capture velocity was selected based on observations of the fugitive dust capture characteristics of the hood. This testing approach is an adaptation of the conventional "roof monitoring" technique for fugitive emission testing.

The PM10 emissions were tested using EPA Method 201A. The tests were divided into two sets: stone moisture levels greater than 1%, and stone moisture levels less than 1%. The results of the PM10 emission tests are presented in Table 1. The emission rates determined during both series of tests on the 5.5' crusher and the vibrating screen were low. These wet stone emission factor results are entirely consistent with the zero visible emissions operating conditions observed during all of these tests. Stone samples obtained during each of the tests were also analyzed and found to have very low levels of material below approximately less than 10 microns.

TABLE 1. CRUSHER PM10 EMISSIONS

PM10 Source	Stone Moisture (% Weight)	PM10 Emissions (Pounds/Ton)	Control Efficiency
Crusher	(< 1%)	0.001041	85.9 %
	(> 1%)	0.000147	
Vibrating Screen	(< 1%)	0.006920	92.1 %
	(> 1%)	0.000549	

1.2 KEY PERSONNEL

The U.S. EPA EIB Project Manager for this project was Mr. Dennis Shipman. Mr. Solomon Ricks served as the U.S. EPA EMB Project Manager. The Entropy Project Director was Dr. John Richards, P.E. The Entropy project manager was Mr. Todd Brozell. The tests were coordinated through the assistance of Mr. Allen Blake P.E. of Vulcan Materials, Inc. The tests were observed by Mr. Steve Whitt of Martin Marietta. A summary of the key personnel and their phone number are provided in Table 2.

TABLE 2. KEY PERSONNEL

	Telephone Numbers
U.S. EPA, Emission Inventory Branch Mr. Dennis Shipman	(919) 541-5477
U.S. EPA, Emission Measurement Branch Mr. Solomon Ricks	(919) 541-5242
Vulcan Materials, Inc. Mr. Allen Blake P.E.	(615) 579-2938
National Stone Association Mr. Bill Ford P.E.	(202) 342-1100
Martin Marietta Mr. Horace Wilson Mr. Steve Whitt	(919) 781-4550 (919) 781-4550
Entropy Environmentalists, Inc. Mr. Todd Brozell Dr. John Richards P.E.	(919) 781-3550 (919) 781-3550

2.0 PLANT AND SAMPLING LOCATION DESCRIPTION

2.1 PROCESS DESCRIPTION AND OPERATION

A 5.5' Shorthead, conical type tertiary crusher was tested at the Maryville, Tennessee plant. This receives the oversize stone from a pair of 6' x 16' triple deck vibrating screens downstream from the secondary surge pile. The stone is feed to the tertiary crusher by means of a conveyor (stream number 17 in Figure 1). The stone is discharged into a feed hopper which serves a vibrating feeder above the 5.5' shorthead crusher (equipment number 15 in Figure 1). There were very limited free fall distances from the feed conveyor to the feed hopper to the vibrating feeder and from the vibrating feeder to the inlet of the shorthead crusher. The crusher discharges the crushed stone onto a conveyor (stream number 16 in Figure 1) leading to the 6' X 16' vibrating screens.

The inlet to the shorthead crusher was defined as the discharge of the vibrating feeder to the shorthead crusher vessel. This area, having a height of approximately 6 feet above the platform, was enclosed with galvanized steel flashing to allow capture of the PM10 emissions caused by the stone-to-stone attrition during movement of the stone. The gas velocities around the layers of stone were maintained at gas flow rates equivalent to 1 to 5 mph.

The discharge point of the shorthead tertiary crusher is the same conveyor leading from the secondary surge pile that feeds the 6' X 16' vibrating screens (stream number 16 on Figure 1). The discharge point is enclosed approximately 5 feet upstream and downstream of the shorthead discharge point. The discharge of the shorthead crusher was defined as the total enclosure presently surrounding conveyor number 16 underneath the crusher.

The vibrating screens at the Maryville, Tennessee plant of Vulcan Materials Company consists of two parallel 6 x 16 triple deck screens (equipment numbers 13 and 14 in Figure 1). These screens receive stone from the conveyor numbered 16 in Figure 1. A splitter is used to proportion the stone between the two screens. The vibrating screen source was defined as the 6 foot wide, 16 foot long open, sloped surface above the upper screen deck. There is approximately a 10 inch freeboard above the upper screen to reduce wind entrainment of dust. The area traversed as part of this test program was the sloped surface parallel to the top of the freeboard.

The stone flow to the vibrating screens and the 5.5' crusher is termed "closed circuit" since oversized material containing some fines adhering to the surface can recirculate through the vibrating screens and 5.5' crusher until the stone is crushed small enough to fall through the vibrating screen. The oversized material remaining on the top screen goes to the inlet of the 5.5' crusher. The total quantity of oversized material entering the 5.5' crusher was approximately 260 tons per hour. The stone feed rates to the two vibrating screens were approximately 350 tons per hour or 175 tons per hour per screen.

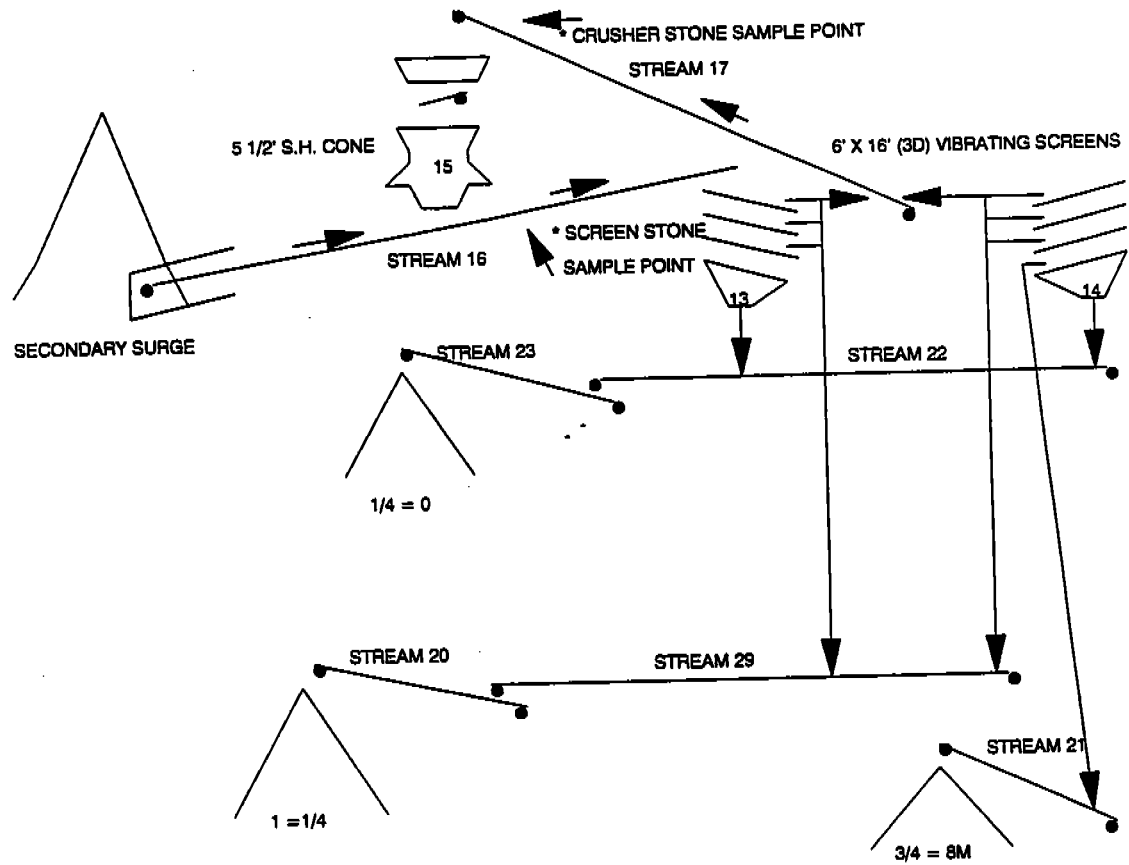


Figure 1. Simplified Process Flowchart

2.2 FUGITIVE DUST CONTROL

Wet suppression is used for fugitive dust control of the 5.5' shorthead crusher, and the vibrating screens. There are water spray nozzles located on the vibrating feeder to the 5.5' crusher. Over-wetting of the rock can cause blinding of the lower screen or blockage of the fines discharge chute underneath the triple deck vibrating screen. During these emission tests, the plant experienced no screen blinding conditions.

2.3 SAMPLING AND EMISSION TESTING PROCEDURES

2.3.1 Fugitive Emission Test Approach

Since there are no air pollution control devices on the vibrating screens or the 5.5' crusher, fugitive emission testing procedures were needed to capture and measure the PM10 emissions. Entropy considered the criteria listed in Table 3 in designing the test program. Entropy evaluated alternative testing procedures during site visits by Entropy personnel. The emission testing techniques which are generally applied to fugitive dust emission sources include,

- Upwind-downwind profiling,
- Roof monitor sampling, and
- Enclosures and Quasi-stack sampling.

Vibrating Screen Testing Alternatives

The roof monitoring approach of fugitive emission testing appeared to be the most applicable technique for the vibrating screen at the Maryville plant. This involved the sampling at a horizontal array of sampling points above the surface of the emission source. However, an adaption of the general procedure was necessary due to the lack of a partial enclosure to serve as the roof monitor and due to the swirling gas flows created by wind leakage around the screen enclosure. Accordingly, Entropy designed and installed a track-mounted hood system for fugitive emission capture. By using this track-mounted hood version of roof monitor sampling, it was possible to accurately capture and measure the PM10 emissions without influencing the PM10 emission rates from the screen surface.

Upwind-downwind profiling techniques involve measurement of the increase in PM10 concentrations as a gas stream passes over or around the source being evaluated. This is usually performed using ambient PM10 monitors in upwind and downwind locations. Entropy concluded that this approach was not applicable to the vibrating screens at the Maryville, Tennessee plant because of the height and inaccessibility around the vibrating screens. Also, there were a number of possible sources immediately upwind and downwind of the 5.5' crusher. These sources included crushers, conveyors and conveyor transfer points, and commercial product haul roads. It would be impossible to isolate the 5.5' crusher from these nearby sources using an upwind-downwind testing procedure.

The quasi-stack method would involve the construction of a temporary enclosure around the vibrating screen and the installation of a duct and fan

**Table 3. FUGITIVE EMISSION CAPTURE
SYSTEM DESIGN CRITERIA**

- The capture system should not create higher-than-actual PM10 emission rates due to high gas velocity conditions near the point of PM10 particle entrainment.
- The capture system should not create a sink for PM10 emissions.
- The capture system should isolate the process unit being tested from other adjacent sources of PM10 emissions.
- The capture system should not create safety hazards for the emission test crew or for plant personnel. It should not create risks to the plant process equipment.
- The capture systems should not obstruct routine access to the process equipment by plant personnel.
- The capture system and overall test procedures must be economical, practical, and readily adaptable to other plants so that these tests can be repeated by organizations wishing to confirm or challenge the emission factor data developed in this project.

system for gas handling. Entropy rejected this approach primarily because of the extremely high gas flow rates necessary. To simulate the identical emission conditions for typical wind speeds at the plant would require gas flow rates between 13,200 and 52,800 actual cubic feet per minute (ACFM). Ductwork with a diameter between 4 and 6 feet would be necessary to carry this large gas flow at velocities where PM10 losses would be minimized. Since the vibrating screen is on a relatively small platform 60 feet above the ground, this ductwork would have to be quite long and carefully supported. This approach would be prohibitively expensive. Other disadvantages include:

- It would be extremely difficult to simulate actual wind speeds and wind approach angles using make-up air.
- An enclosure restricts plant operations personnel's access to the vibrating screen
- Construction safety risks are possible due to the lack of access and due to the rotating equipment in restricted areas.

5.5' Crusher Inlet and Outlet Testing Alternatives

The quasi-stack method appeared to be the most accurate and practical approach for capturing the fugitive emissions from the inlet and outlet areas of the 5.5' crusher. This approach allowed isolation of the 5.5' crusher from the other fugitive dust sources in the immediate vicinity.

The quasi-stack method required the construction of temporary enclosures around the inlet and outlet of the 5.5' crusher and the installation of a duct and fan system for gas handling. Since the PM10 emissions are generated primarily by stone-to-stone attrition in the crusher and during falling, the use of an enclosure does not influence the rate of PM10 emissions.

The roof monitoring approach of fugitive emission capture involves the sampling at a horizontal array of sampling points above the surface of the emission source. This approach was rejected because there was no logical means to sample in the area immediately above the crusher inlet or outlet. The emission profiling technique was also rejected for the crusher emission points since there were a number of other possible PM10 sources in the immediate vicinity of the crusher.

2.3.2 PM10 Emission Testing Procedure

Screen Testing Equipment

The track-mounted hood system used for sampling the vibrating screen consisted of a 2 foot by 2 foot aluminum hood suspended 12 inches above the upper deck of the vibrating screen. The position of the hood above the stone is shown in Figures 2 and 3. This hood position was close enough to the upper screen deck to ensure good emission capture but not so close that the entering air stream caused greater-than-actual PM10 emissions. A variable speed DC-driven tubeaxial fan controlled the capture velocity of the air entering the hood. This velocity was set at 150 feet per minute based on the hood capture characteristics observed using smoke and lightweight strips of fabric. This velocity is higher than the 50 feet per minute minimum capture velocity specified in reference 9 for vibrating screens.

The top area of the vibrating screen was divided into a 3 by 5 array of sampling locations, each of which was 2 feet by 2 feet in size. The only area not sampled was the 6-foot strip across the upper inlet side of the vibrating screen where the stone feed dumps onto the top of the screen. Positioning the hood in this location would have artificially increased PM10 emissions and caused rapid abrasion of the hood. PM10 from the inlet chute area of the screen are captured as the hood traverses the uppermost portions of the screen.

Entropy sized the ductwork from the hood to the sampling location for an average gas flow velocity less than 1000 feet per minute. This transport velocity is well below the 3500 to 4500 feet per minute velocity used to size commercial ductwork in stone crushing plants and other facilities handling large diameter dusts^{2,8}. The purpose of the high velocities in commercial ducts is to ensure that large diameter dust particles do not settle and accumulate in the ductwork over long time periods. PM10 sized dust particles have negligible gravity settling rates in the gas stream residence times in the ducts.

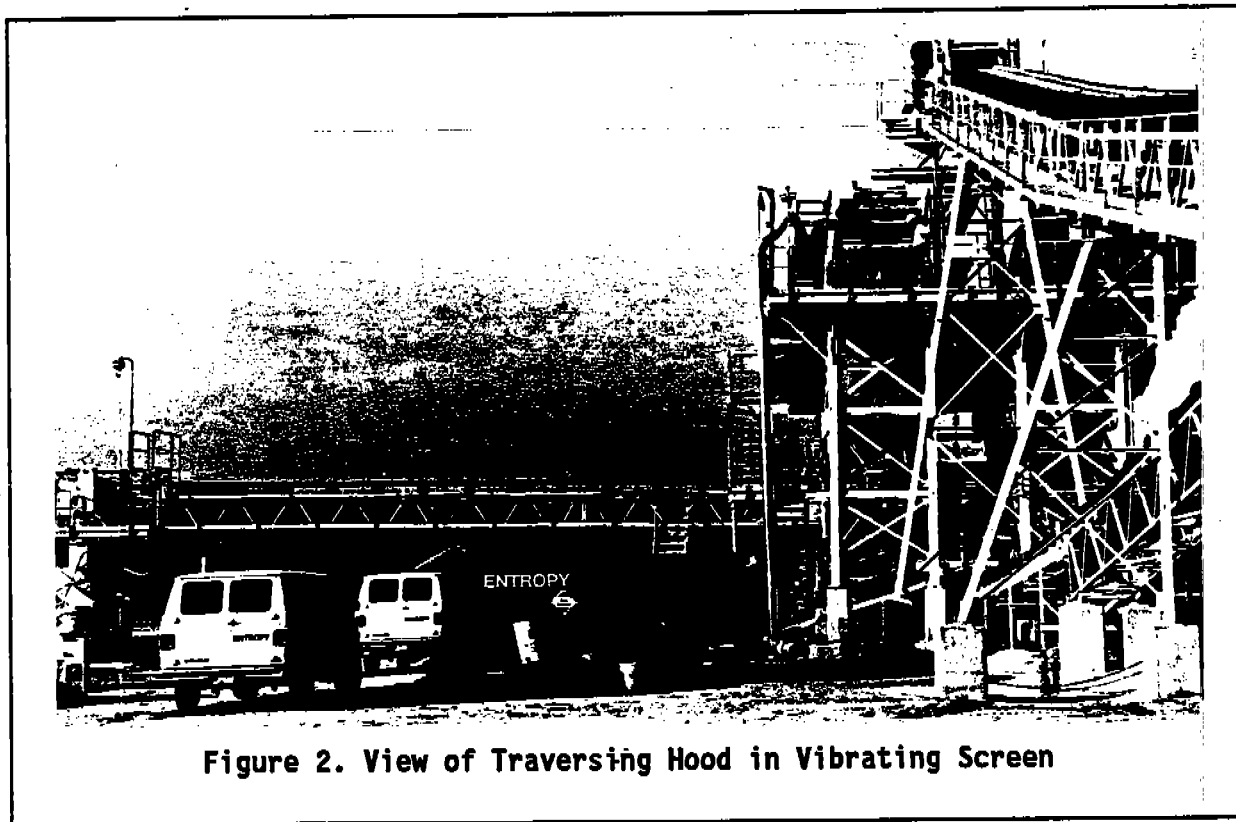


Figure 2. View of Traversing Hood in Vibrating Screen

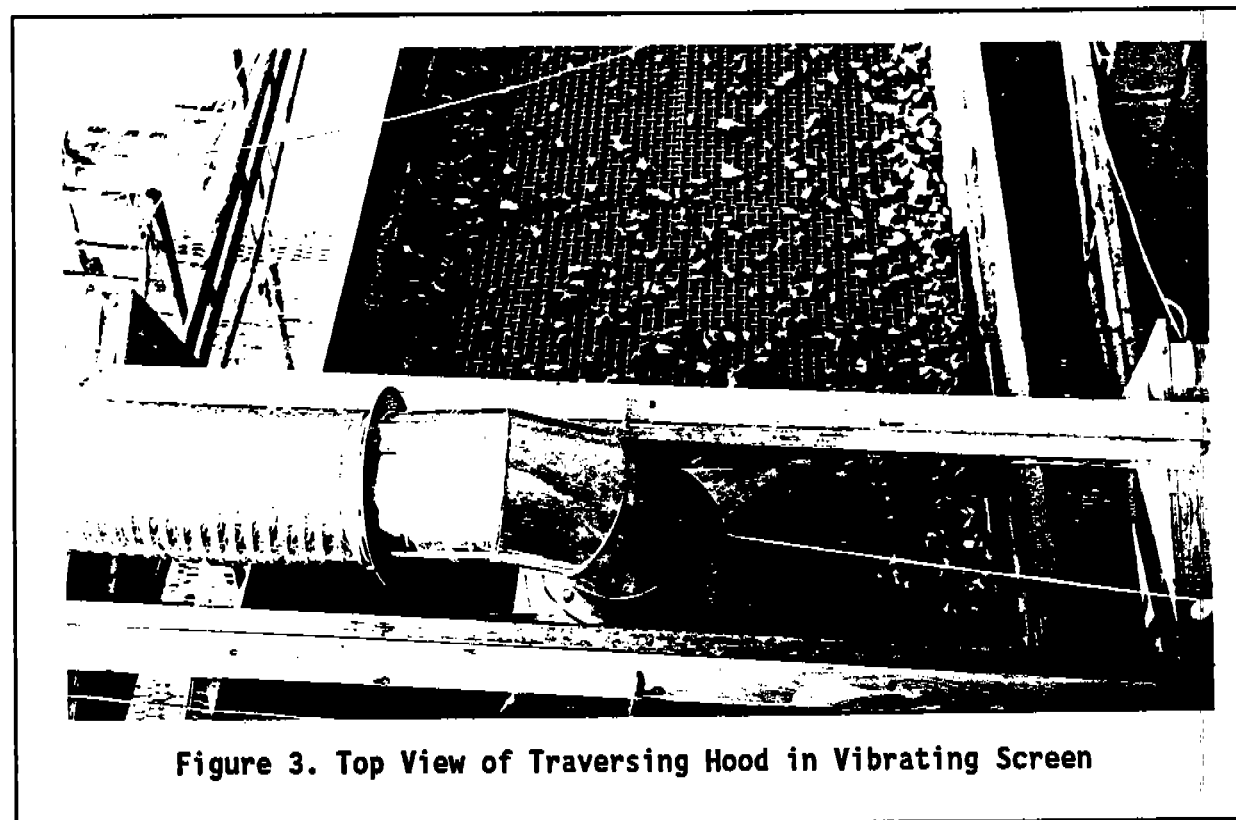
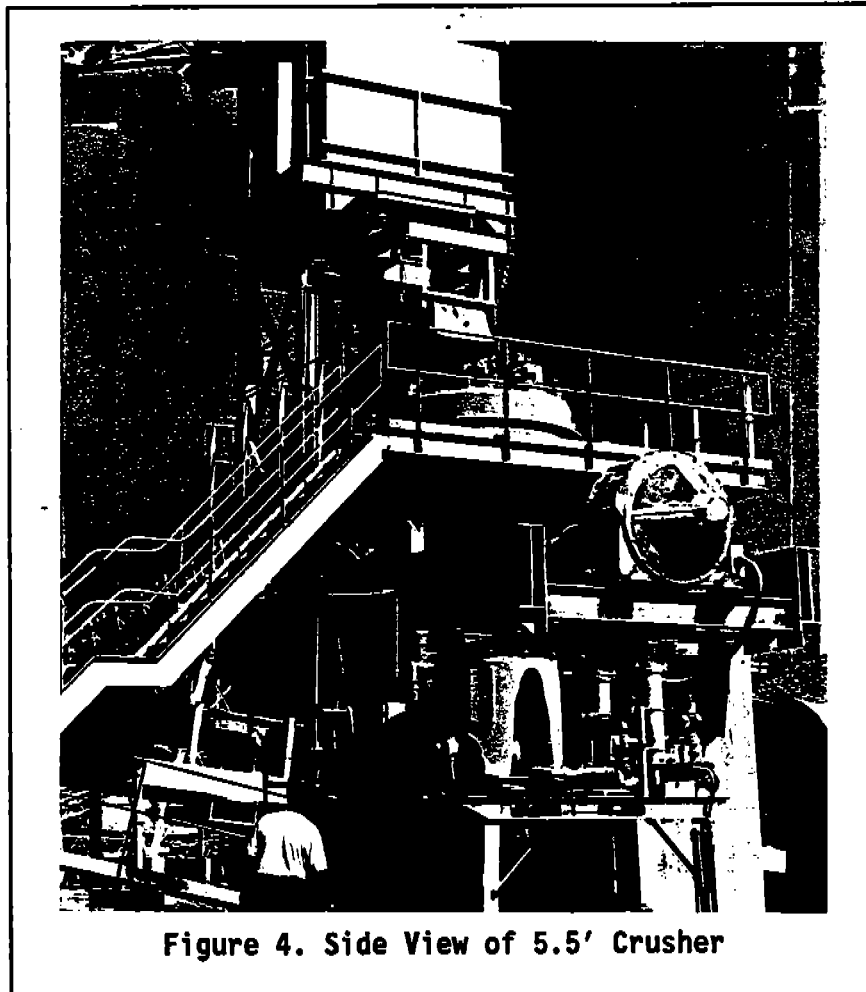


Figure 3. Top View of Traversing Hood in Vibrating Screen

Dust accumulation in the ductwork was not a problem during this study since the hood operating times were relatively short and the flexible duct was cleaned regularly. The 1000 feet per minute duct velocity limit is advantageous since this limits the impaction of particles less than 10 microns on the side walls of the hood elbow and the side walls of the flexible duct. Also, the low gas transport velocity limits any formation of PM10 emissions due to the movement of the gas stream over the surfaces of large diameter particles entrained in the gas stream or settling on the bottom of the duct.

5.5' Crusher Testing Equipment

The inlet to the 5.5' crusher was defined as the discharge of the vibrating feeder into the crusher vessel. This area, having a height of approximately 6 feet, was enclosed with galvanized steel flashing to allow capture of the PM10 emissions caused by the stone-to-stone attrition during movement of the stone. The discharge point of the 5.5' crusher is a conveyor leading to the triple deck vibrating screens. The discharge point was enclosed approximately 4 feet upstream and downstream of the 5.5' crusher discharge point. There are water spray nozzles on the downstream side of this conveyor. Figure 4 shows a side view of the 5.5' crusher.



Enclosures were built around the inlet and outlet of the crusher. The inlet enclosure measured approximately 28" high with a 60" diameter, the outlet measured approximately 12'H X 12'D X 9'W. The enclosure outlet ducts were combined into a single 1 foot diameter outlet duct. The single one foot diameter duct was used as a combined sample point for both the inlet and outlet of the crusher. The one foot diameter duct was then increased to a two foot diameter duct, to allow use of a two foot diameter SCR driven tubeaxial fan. Filtered air was supplied to each of the enclosures by means of HEPA (high efficiency particulate absolute) filters and centrifugal fans, see Figure 5. Use of HEPA make-up air ensured that PM10 emissions measured in the outlet duct were generated by the unit being tested rather than from adjacent sources. The air flows from each enclosure were set by adjusting the variable speed DC motor of the tubeaxial fan installed on the combined outlet duct. The mounting

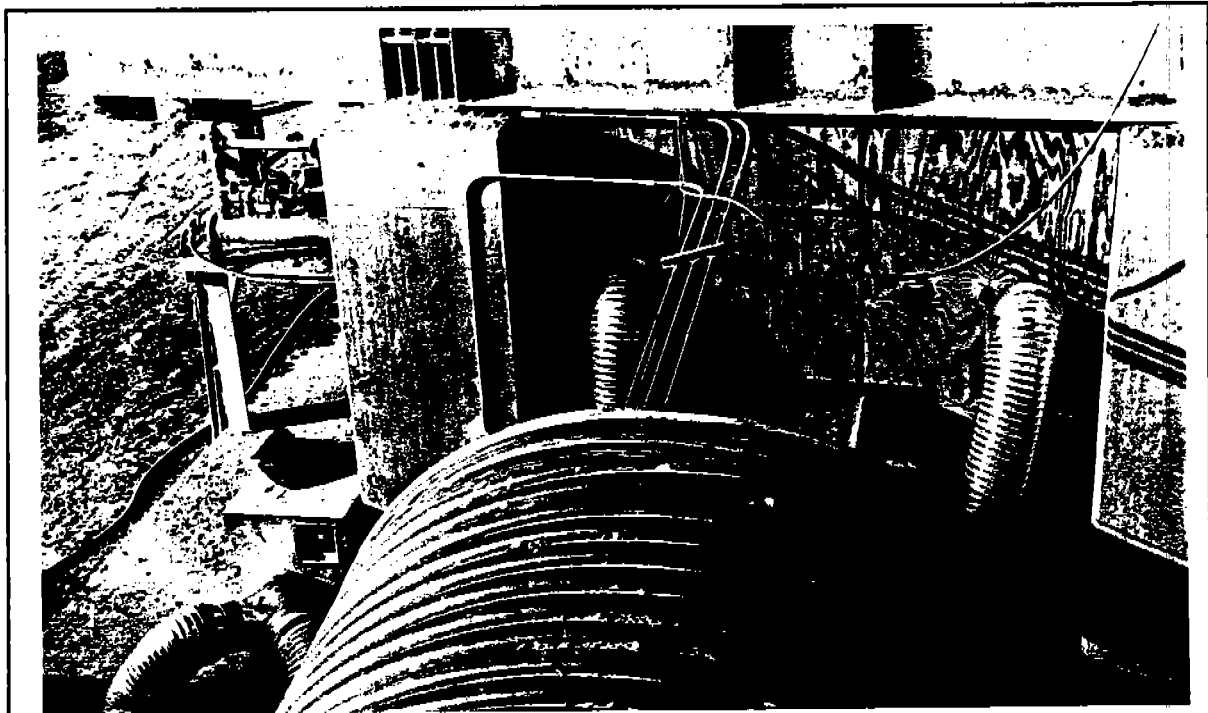


Figure 5. 5.5' Crusher Hepa Filtered Air Makeup

positions of the inlet and outlet ducts on the enclosures ensured that the normal PM10 emissions were not significantly influenced by air flow patterns.

Close-up views of the crusher inlet before and after installation of the enclosure are provided in Figures 6 and 7. In Figure 7, the flexible duct delivers the HEPA filtered make-up air to the enclosure and the duct in Figure 7 takes PM10-laden air to the emission testing location. The crusher outlet enclosure is shown in Figures 8 and 9. In Figure 8, the horizontal duct in the photographs contains the PM10 emissions from the inlet and outlet enclosures and the vertical duct contains the PM10 emissions descending from the inlet enclosures. The gas streams are joined at the duct TEE shown in the lower left of Figure 8.



Figure 6. Crusher Inlet Before Installation

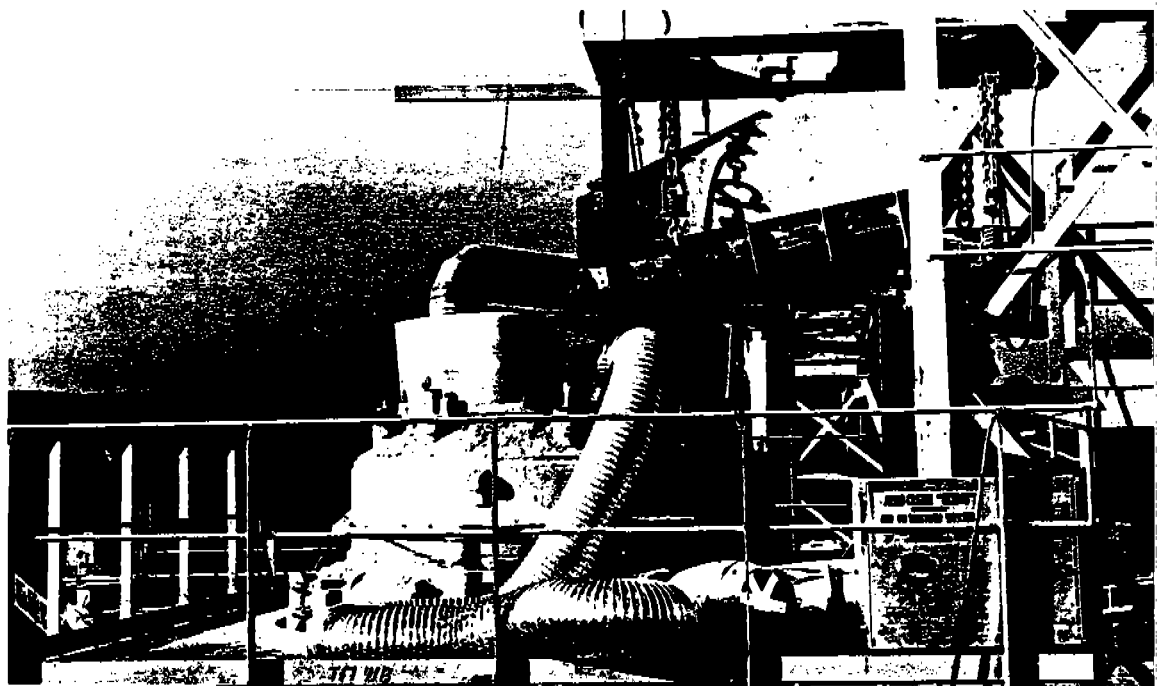


Figure 7. Crusher Inlet with Enclosure

The combined gas flow from the inlet and outlet enclosures was controlled by a Dayton Model 3C411 24 inch, 2 HP direct current (DC) driven tubeaxial fan. This variable speed fan was set at the gas flow rate necessary to maintain a slightly negative static pressure within the enclosure. Negative pressures were required to ensure that there was no loss of PM10 emissions from the enclosure. Highly negative static pressures were undesirable since there could be high velocity ambient air streams entering the enclosure which could increase the PM10 emissions.

PM10 Sampling Equipment

EPA Reference Method 201A was used to monitor the PM10 emissions from the 5.5' crusher. This complete sampling system consists of: (1) a sampling nozzle, (2) a PM10 sampler, (3) a probe and umbilical cord, (4) an impinger train, and (5) flow control system. Due to the relatively small ducts and the constant sample gas flow rates set using the DC-driven tubeaxial fans, the "S"-type pitot tube was not mounted on the PM10 sampler probe. Gas velocities were determined prior to the emission tests.

Particulate matter larger than 10 microns in diameter is collected in the cyclone located immediately downstream of the sampling nozzle. Particulate smaller than 10 microns is collected on the outlet tube of the cyclone and on the downstream glass-fiber filter.

The cyclone and filter system used in this study met the design and sizing requirements of Section 5.2 of Method 201A. The gas flow rate through the cyclone was set based on the orifice pressure head equation provided in Figure 4 of Method 201A. The gas flow rate was kept constant throughout the emission test program.

PM10 sampling was performed in a 1-foot (inlet / outlet location) diameter smooth wall duct mounted directly off the enclosures of the crusher. The 4-inch diameter sampling port was located 8 duct diameters downstream of the inlet / outlet tee junction and 2 duct diameters upstream of the 2 foot fan duct. Sampling in the vertical direction across the ducts was not possible since dust collected in the cyclone could be resuspended and pass through to the filter. The sampling nozzles were selected to provide 80 to 120% isokinetic conditions. The cyclone and nozzle assembly were mounted within the duct during sampling.

The particulate samples were recovered using the procedures specified in Method 201A. The material from the filter, cyclone outlet tube, and filter inlet housing were combined to determine the total PM10 catch weight.

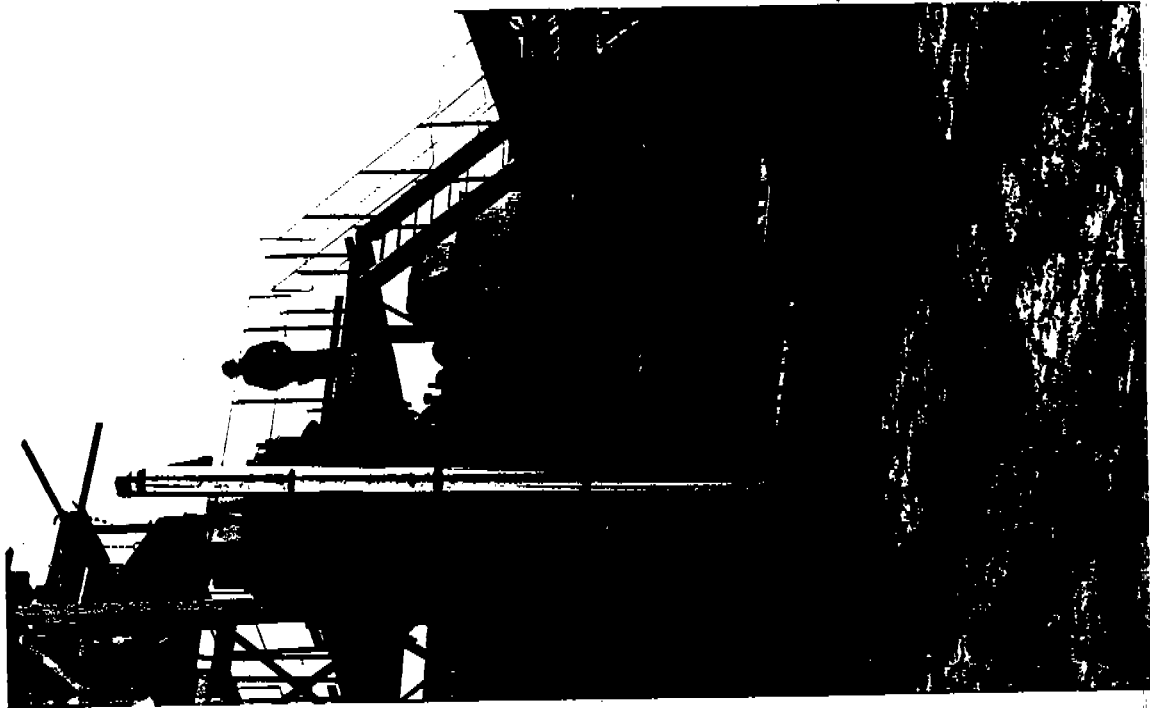


Figure 8. Crusher Outlet Enclosure

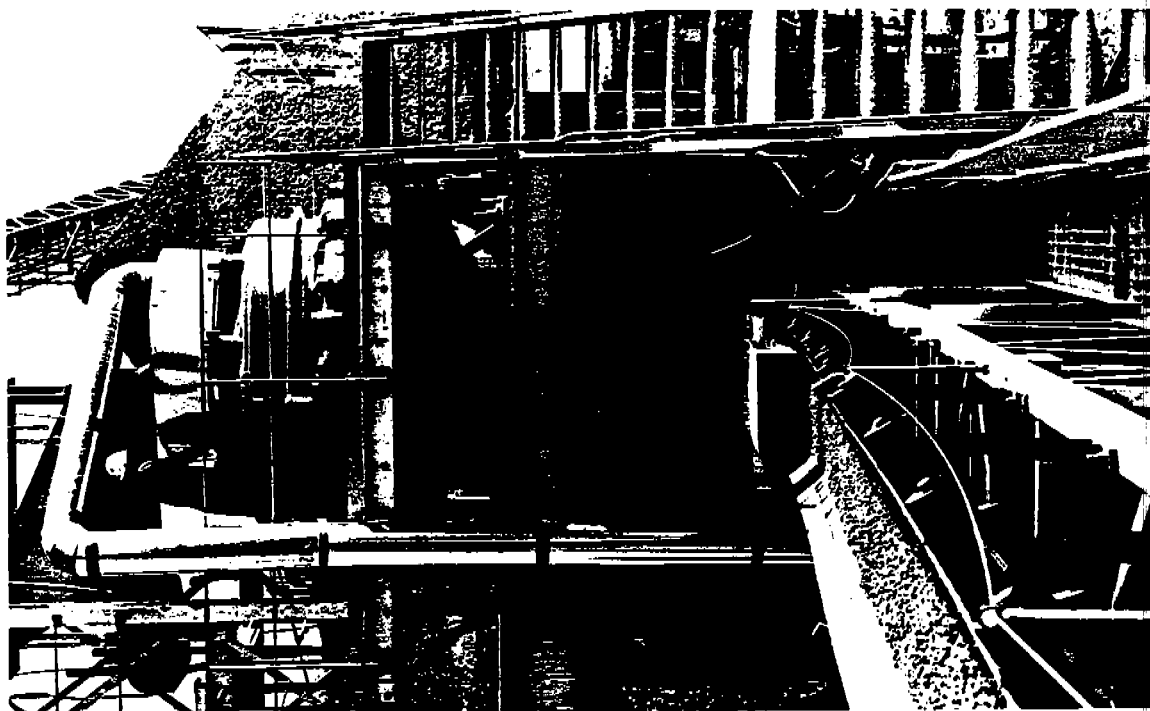


Figure 9. Crusher Enclosures

2.4 MONITORING OF PROCESS OPERATING CONDITIONS

There are a number of process variables and weather conditions which could conceivably influence PM10 emission rates from the vibrating screen:

- Stone moisture level
- Stone size distribution
- Stone silt content
- screen stone feed rates
- Stone friability
- Stone hardness and density

All of these variables with the exception of stone type were monitored using a combination of plant instruments, special monitoring equipment, and stone sample analyses. Stone type was not monitored since limestone is the only type of stone processed at this plant.

2.4.1 Stone Moisture Level

Two stone samples were removed during each of the emission tests. In all cases, this sample consisted of a 2 linear foot sample of stone from the main conveyor leaving the 5.5' crusher and a sample from the conveyor leaving the 6' X 16' vibrating screens. The conveyors was stopped by plant personnel for approximately 5 minutes to permit the Entropy test crew to remove the stone sample. The sample was placed in a sealed plastic bucket. The samples were weighed and multiplied by the conveyor speed to yield a stone production rate in tons per hour.

A sample was selected for analysis by placing the stone in a pile and dividing it into four quadrants. The quadrant randomly selected for analysis was further subdivided in quadrants until the sample quantity was less than approximately 2 pounds. This sample was then weighed and heated in an oven at a gas temperature of approximately 350 degrees Fahrenheit. The weight loss during heating was calculated and reported as the stone moisture level.

2.4.2 Ambient PM10 Levels

One ambient PM10 monitor was operated in the vibrating screen sample area. It was operated only during the time periods that PM10 emission sampling was in progress. The ambient air flow rates through the samplers were calibrated using an Airdata micromanometer. The filters were weighed and PM10 levels during the test were calculated and subtracted from the vibrating screen emission rates. This data however was not used in the emissions calculations for the 5.5' crusher due to the enclosures and HEPA filtered make-up air.

2.4.3 Stone Size Distribution and Silt Content

Samples of the stone obtained during the test (see Section 2.4.1) were used to determine the size distribution and silt content. The initial sample quadrants used for moisture analysis were also used for analysis by ASTM sizing screens. The sample of approximately 2 pounds was heated to 350 Fahrenheit for

30 minutes to drive off the moisture, then allowed to cool, then loaded into the top pan. The screen size mesh openings included:

- 37.5 Millimeters
- 19.0 Millimeters
- 4.75 Millimeters
- 2.00 Millimeters
- 150 Microns
- 75 Microns
- 38 Microns
- Bottom Pan

The loaded ASTM screens were placed in a R0-TAP shaker and processed for 10 minutes. The weights of stone remaining on each of the screens were then determined by subtracting the screen tare weights from the loaded weights.

2.4.4 Stone Processing and Production Rates

The stone processing rate of the 5.5' crusher has been defined by Entropy as the total volume of stone entering the 5.5' crusher. The volume of stone in tons for a particular test was calculated by removing and weighing a 2 foot section of the stone from the conveyor entering the 5.5' crusher. This amount in pounds/feet was then multiplied by the speed of the conveyor in feet/minute (400 fpm crusher feed, 426 fpm screen feed) to produce a rate in pounds/minute. Then to obtain the total amount of stone per hour this number was multiplied by 60 minutes per hour. This calculation was also performed for the screen production rates. However the screen production rates were divided by 2 because there were two screens receiving stone from one conveyor. This calculation is shown below:

5.5 Crusher

(Pounds Stone per 2 FT) X (Belt Speed to Crusher 400 FT per Minute)

= Pounds Stone per Minute

(Pounds Stone/Minute) X (60 Minutes/Hour) X (Ton/2000 Pounds)

= Tons of Stone/Hour

6' X 16' Vibrating Screen

(Pounds Stone per 2 FT) X (Belt Speed to Screens 426 FT per Minute)

= Pounds Stone per Minute

((Pounds Stone/Minute) X (60 Minutes/Hour) X (Ton/2000 Pounds)) / 2 Screens

= Tons of Stone/Hour/Screen

3.0 TEST RESULTS

3.1 OBJECTIVES AND TEST MATRIX

The objective of this test program was to determine the PM10 emission factors for a shorthead 5.5' crusher and a vibrating screen at a lime stone crushing plant. The test program concerned both wet and dry stone conditions. The specific objectives included the following:

- Capture the PM10 emissions from the inlet and outlet of a 5.5' crusher without significantly affecting the emission rate.
- Capture the PM10 emissions from the vibrating screen without significantly affecting the emission rate.
- Determine the PM10 emission concentrations by means of EPA Reference Method 201A.
- Calculate the total PM10 emission rates using the known outlet duct gas flow rates and the Method 201A emission concentrations.
- Measure the stone moisture content, stone feed rate, stone size distribution, and stone silt content.

The stone processing rate calculation at the Maryville plant tested during this study were complicated by the presence of two vibrating screens operated in parallel. Because of the configuration of the equipment there is no quantitative means to determine the separate stone flow rates to each. Entropy has based on emission factor calculations of a 50%-50% split based on observations during the emission tests.

3.2 STONE MOISTURE LEVELS

The stone moisture levels for the PM10 emission factor tests are presented in Table 4. The moisture criteria proposed in the Test Plan were: dry condition - less than 1%, and wet conditions - equal to or greater than 1%. The actual values during the tests were consistent with these criteria.

During the emission tests, the stone color was used to qualitatively evaluate moisture levels. Short term changes in stone moisture were indicated by shifts between grey and white. These variations occurred in all of the wet condition tests, but they could not be quantified because of the time needed to obtain a representative stone sample. Stone moisture levels were controlled by the plant personnel operating certain water spray headers in the process.

TABLE 4. STONE MOISTURE LEVELS

Date	Conditions	Test	Moisture Content (% weight)
6-10-93	Dry	1	0.67
6-10-93	Dry	2	0.89
6-10-93	Dry	3	0.46
Average			0.673
6-7-93	Wet	1	1.21
6-8-93	Wet	2	1.12
6-9-93	Wet	3	1.98
Average			1.437

3.3 AMBIENT PM10 CONCENTRATIONS

The ambient PM10 concentrations were monitored by means of a Anderson PM10 Hi-Vol sampler. This instrument has a cyclonic pre-collector for particles greater than 10 microns followed by a back-up filter. The analyzer was located on the ground on the East side of the vibrating screen platform. In this location, it indicated the ambient PM10 levels in the vibrating screen sampling area.

This analyzer was turned on immediately prior to the emission test and turned off at the conclusion of the test. The PM10 concentrations were calculated by dividing the filter catch weights by the total standard cubic feet sampled during the on-line time. The ambient PM10 levels presented in Table 5.

**TABLE 5.
AMBIENT PARTICULATE CONCENTRATION
STANDARD GAS CONDITIONS**

	Time		Milligrams Catch	HiVol#1 mg/ft ³ Dry
	Start	Stop		
6-7-93	09:18	15:29	154.7	0.0218
6-8-93	07:45	13:58	143.7	0.0205
6-9-93	07:53	14:20	166.6	0.0234
6-10-93	07:37	11:40	230.7	0.0504

3.4 STONE PRODUCTION RATES

The 5.5' crusher and vibrating screen stone processing rates were calculated following the formula given in Section 2.4.4 of this report. The total stone production rate through the vibrating screens was divided in half based on the assumption that both screens received equal stone loadings. The calculated stone production rates for the East vibrating screen during the tests are presented in Table 6.

TABLE 6. STONE PRODUCTION DATA

Date	Test	Condition	East Screen	Crusher
			Processing Rate, Tons/HR	
6-7-93	1	Wet	206	267
6-8-93	2	Wet	168	228
6-9-93	3	Wet	176	291
6-10-93	1	Dry	171	282
6-10-93	2	Dry	166	246
6-10-93	3	Dry	160	267

3.5 PM10 EMISSION FACTORS

The PM10 emission factors were calculated in accordance with the procedures illustrated in the example calculation of Appendix B. The particulate captured on the filter, in the cyclone outlet tube, and in the filter inlet housing was weighed and added to yield a total capture weight. This value is divided by the standard cubic feet of gas sampled to determine the concentration of PM10 particulate matter in the gas sampled.

The total PM10 emissions from the vibrating screen were determined by multiplying the constant gas flow rate (standard conditions) of the hood-fan system times the 24 separate sampling locations. The total gas flow rate from the vibrating screen was multiplied by the measured PM10 concentration to yield the total PM10 emission rate.

The data are expressed in pounds of PM10 per ton of stone processed through the East vibrating screen. The production rate was calculated as described in section 2.4.4. It was assumed that both of the vibrating screens receive an equal stone loading. The measured PM10 emission factors for both the 5.5' crusher and the vibrating screen are presented in Table 7. The average values for the wet tests are well below the average value for the dry tests. This is consistent with general observations during the emission tests. During the dry tests, there were visible emissions from the vibrating screen. No visible emissions were apparent during the wet tests. The extremely low emissions occurring during the wet tests are indicated the photographs shown in Figures 2, 3, 7, 8 and 9.

TABLE 7. VIBRATING SCREEN AND 5.5' CRUSHER PM10 EMISSIONS

PM10 Emissions; Pounds/Ton		
Dry Stone (< 1)	5.5' Crusher	Screen
Run 1	0.00078	0.00677
Run 2	0.00131	0.00731
Run 3	0.00103	0.00668
Average	0.00104	0.00692
Wet Stone (> 1)		
Run 1	0.000190	0.000591
Run 2	0.000147	0.000568
Run 3	0.000105	0.000489
Average	0.000147	0.000549

The emission factors measured during the emission test program are well below previously reported emission factors for total particulate matter⁹. The emission factors applicable to total particulate emissions cannot be compared with PM10 emission factors. The PM10 fraction of the total particulate emissions should be relatively low since very high energy levels are needed to cause stone attrition to the 10 micron range. It is unlikely that the 5.5' crusher and vibrating screens are creating substantial quantities of PM10 particulate. This is indicated by particle size distribution tests conducted by Entropy using dried stone. The size distribution data is provided in Table 8-1 and Table 8-2. As indicated in the wet stone had near negligible levels of dust in the less than 75 micron size range.

**TABLE 8-1. PARTICLE SIZE DISTRIBUTIONS
FOR DRY RUNS**

Size Range	Fraction of Sample in Specified Range	
	Test 1,2,3 Dry	
> 37.5 Millimeters	0	
> 19.0 Millimeters	0.065	
> 4.75 Millimeters	0.280	
> 2.00 Millimeters	0.464	
> 150 Microns	0.141	
> 75 Microns	0.019	
> 38 Microns	0.014	
Bottom Pan	0.017	

**TABLE 8-2. PARTICLE SIZE DISTRIBUTIONS
FOR WET RUNS**

Size Range	Fraction of Sample in Specified Range		
	Test 1, Wet	Test 2, Wet	Test 3, Wet
> 37.5 Millimeters	0	0	0
> 19.0 Millimeters	0.125	0.050	0.034
> 4.75 Millimeters	0.267	0.420	0.268
> 2.00 Millimeters	0.447	0.405	0.453
> 150 Microns	0.111	0.079	0.175
> 75 Microns	0.020	0.020	0.029
> 38 Microns	0.015	0.014	0.023
Bottom Pan	0.016	0.012	0.019

4.0 QA/QC ACTIVITIES

4.1 QC PROCEDURES

The specific internal quality assurance and quality control procedures used during this test program are described in this section. Velocity and volumetric flow rate data collection are discussed in Section 4.2. Section 4.3 discusses QA audits. QC procedures for particulate and percent isokinetics are presented in Sections 4.4 and 4.5, respectively. Manual equipment calibration is described in Section 4.6. Data validation is discussed in Section 4.7.

4.2 VELOCITY/VOLUMETRIC FLOW RATE DETERMINATION

The QC procedures for velocity/volumetric flow rate determinations follow guidelines set forth by EPA Method 2.

Flue gas moisture was determined according to EPA Method 4 sampling trains. Flue gas moisture content (B_{wv}) was determined by dividing the volume (mass) of moisture collected by the impingers by the standardized volume of gas sampled. The following QC procedures were followed in determining the volume of moisture collected:

- Preliminary reagent tare weights were measured to the nearest 0.1 g.
- The balance zero was checked and re-zeroed as necessary before each weighing.
- The balance was leveled and placed in a clean, motionless environment for weighing.
- The indicating silica gel was fresh for each run.
- The silica gel impinger gas temperature was maintained below 68°F.

The QC procedures below were followed regarding accurate sample gas volume determination:

- The dry gas meter is fully calibrated every 6 months using an EPA approved intermediate standard.
- The gas meter was read to a thousandth of a cubic foot for the initial and final readings.
- The meter thermocouples were compared with ambient prior to the test run as a check on operation.
- Readings of the dry gas meter, meter orifice pressure (ΔH), and meter temperatures were taken at every sampling point.

- Accurate barometric pressures were recorded at least once per day.
- Post-test dry gas meter checks were completed to verify the accuracy of the meter full calibration constant (Y).
- The S-type pitot tube was visually inspected before sampling.
- Both legs of the pitot tube were leak checked before and after sampling.
- Proper orientation of the S-type pitot tube was maintained while making measurements. The roll and pitch axis of the S-type pitot tube were maintained at 90° to the flow.
- The pitot tube/manometer umbilical lines were inspected before and after sampling for moisture condensate.
- Cyclonic or turbulent flow checks were performed prior to testing the source.
- An average velocity pressure reading were recorded at each point instead of recording extreme high or low values.
- Pitot tube coefficients were determined based on physical measurement techniques as delineated in Method 2.
- The stack gas temperature measuring system was checked by observing ambient temperatures prior to placement in the stack.

4.3 QA AUDITS

Meterbox calibration audits were performed according to Method 5, section

4.4. All of the equipment pre-test and post-test results are presented in Table 9.

4.4 PARTICULATE/CONDENSIBLES SAMPLING QC PROCEDURES

Quality control procedures for particulate sampling ensure high quality flue gas concentrations and emissions data. Flue gas concentrations are determined by dividing the mass of analyte (particulate) collected by the standardized volume of gas sampled. Sampling QC procedures which ensure that a representative amount of the analytes are collected by the sampling system include:

- The sampling rate is within 20 percent of isokinetic (100 percent).
- Only properly prepared glassware is used.
- All sampling nozzles were be manufactured and calibrated according to EPA standards.
- Filters are weighed, handled, and stored in a manner to prevent any contamination.
- Recovery procedures are completed in a clean environment.
- Field reagent blanks are collected.

4.5 SAMPLE VOLUME AND PERCENT ISOKINETICS

All sampling runs met the results acceptability criteria as defined by Section 6.3.5 of Method 201-A. The isokinetic rates are within ± 20 percent. A summary of the sample volume and percent isokinetics is presented in Table 9.

TABLE 9.
AVERAGE DELTA H AND ISOKINETIC RESULTS

Run #	Percent Iso (%)	Delta H (Avg)
D-1-C-M201A-1	104.2	0.57
D-1-C-M201A-2	103.6	0.57
D-1-C-M201A-3	100.3	0.58
W-1-C-M201A-1	103.0	0.58
W-1-C-M201A-2	107.0	0.57
W-1-C-M201A-3	104.2	0.57

Run #	Percent Is (%)	Delta H (Avg)
D-1-S-M201A-1	103.1	0.67
D-1-S-M201A-2	102.8	0.67
D-1-S-M210A-3	103.0	0.67
W-1-S-M201A-1	93.5	0.68
W-1-S-M210A-2	105.1	0.67
W-1-S-M201A-3	90.1	0.68

4.6 MANUAL SAMPLING EQUIPMENT CALIBRATION PROCEDURES

4.6.1 Type-S Pitot Tube Calibration

The EPA has specified guidelines concerning the construction and geometry of an acceptable Type-S pitot tube. If the specified design and construction guidelines are met, a pitot tube coefficient of 0.84 is used. Information pertaining to the design and construction of the Type-S pitot tube is presented in detail in Section 3.1.1 of EPA Document 600/4-77-027b. Only Type-S pitot tubes meeting the required EPA specifications are used. Pitot tubes are

inspected and documented as meeting EPA specifications prior to field sampling.

4.6.2 Sampling Nozzle Calibration

Calculation of the isokinetic sampling rate requires that the cross sectional area of the sampling nozzle be accurately determined. All nozzles are thoroughly cleaned, visually inspected, and calibrated according to the procedure outlined in Section 3.4.2 of EPA Document 600/4-77-027b.

4.6.3 Temperature Measuring Device Calibration

Accurate temperature measurements are required during source sampling. Bimetallic stem thermometers and thermocouple temperature sensors are calibrated using the procedure described in Section 3.4.2 of EPA Document 600/4-77-027b. Each temperature sensor is calibrated at a minimum of three points over the anticipated range of use against a NIST-traceable mercury-in-glass thermometer. All sensors are calibrated prior to field sampling.

4.6.4 Dry Gas Meter Calibration

Dry gas meters (DGM's) are used in the sample trains to monitor the sampling rate and measure the sample volume. All DGM's are fully calibrated to determine the volume correction factor prior to their use in the field. Post-test calibration checks are performed as soon as possible after the equipment has been returned as a QA check on the calibration coefficients. Pre- and post-test calibrations should agree within 5 percent. The calibration procedure is documented in Section 3.3.2 of EPA Document 600/4-77-237b.

Prior to calibration, a positive pressure leak check of the system is performed using the procedure outlined in Section 3.3.2 of EPA Document 600/4-77-237b. The system is placed under approximately 10 inches of water pressure and a gauge oil manometer is used to determine if a pressure decrease can be detected over a one-minute period. If leaks are detected, they are eliminated before actual calibrations are performed.

After the sampling console is assembled and leak checked, the pump is allowed to run for 15 minutes to allow the pump and DGM to warm-up. The valve is then adjusted to obtain the desired flow rate. For the pre-test calibrations, data are collected at orifice manometer settings (ΔH) of 0.5, 1.0, 1.5, 2.0, 3.0 and 4.0 inches H_2O . Gas volumes of 5 ft^3 are used for the two lower orifice settings, and volumes of 10 ft^3 are used for the higher settings. The individual gas meter correction factors (Y_i) are calculated for each orifice setting and averaged. The method requires that each of the individual correction factors fall within ± 2 percent of the average correction factor or the meter is cleaned, adjusted, and recalibrated. For the post-test calibration, the meter is calibrated three times at the average orifice setting and vacuum used during the actual test. The meter box calibration data is presented in Table 10.

Table 10. Meter Box Calibration Audit.

Meter Box Number	Pre-Audit Value	Allowable Error	Calculated Gamma	Acceptable
NU-7	0.9850	0.9456<Y<1.0244	1.0073	Yes
EN-2	0.9831	0.9438<Y<1.0224	0.9741	Yes

4.7 DATA VALIDATION

All data and/or calculations for flow rates, moisture content, and isokinetic rates made using a computer software program are validated by an independent check. All calculations are spot checked for accuracy and completeness.

In general, all measurement data are validated based on the following criteria:

- Process conditions during sampling or testing.
- Acceptable sample collection procedures.
- Consistency with expected other results.
- Adherence to prescribed QC procedures.

5.0 REFERENCES

1. M. Kestner, "Water-spray systems: the dust-control workhorse," Pit & Quarry, March 91, p. 26-31.
2. Determination of Emissions for the Stone Crushing Industry, JACA Corporation, Final Report for the U. S. Environmental Protection Agency, SSCD, July 1978.
3. M. White, "Crusher and screen training: a key to better operating costs," Pit & Quarry, September 1991, p. 26-32.
4. L.C. Lucas and L.M. Noland, "Keeping down the dust," Pit & Quarry, November 1988, p. 27-29.
5. B. Weaver, "Stretching water resources," Pit & Quarry, March 1991, p. 22-24.
6. R.E. Kenson and P.T. Bartlett, Technical Manual for the Measurement of Fugitive Emissions: Roof Monitor Sampling Method for Industrial Fugitive Emissions, EPA-600/2-76-089b, U.S. Environmental Protection Agency, Research Triangle Park, 1976.
7. H.J. Kolnsberg, P.W. Kalika et al, Technical Manual for the Measurement of Fugitive Emissions: Quasi-Stack Sampling Method for Industrial Fugitive Emissions, EPA-600/2-76-089c, U.S. Environmental Protection Agency, Research Triangle Park, 1976.
8. Industrial Ventilation, A Manual of Recommended Practice, Edwards Brothers, 1980.
9. JACA Corporation, Control of Air Emissions from Process Operations in the Rock Crushing Industry, EPA Contract No. 68-01-4135, U.S. Environmental Protection Agency, Washington, D.C., February 1978.
10. IT Environmental Programs, Inc., Regulatory and Inspection Manual for Nonmetallic Mineral Processing Plant, EPA-240/1/90-010, U.S. Environmental Protection Agency, Washington, D.C., 1991.

6.0 GLOSSARY

1. **ASTM:** American Society for Testing & Materials
2. **Aggregate:** in the case of materials of construction, essentially inert materials which, when bound together into a conglomerated mass by a matrix, form concrete, mastic, mortar or plaster; crushed rock or gravel screened to size for use in road surfaces, concrete or bituminous mixes; any of several hard materials such as sand, gravel, stone, slag, cinders or other inert materials used for mixing with a cementing material to form concrete. Aggregate, in a surface course in the building of roads is often called a "road metal".
3. **Conveyor belt:** a rubberized belt, usually 18" to 60" wide, used to carry aggregates.
4. **Crusher (cone):** a crusher that is specially designed to produce fines.
5. **Crusher (primary):** usually a jaw or gyratory type crusher which reduces very large rocks to a size that can be processed by a secondary crusher.
6. **Crusher (secondary):** any second or third stage crusher that further reduces the size of stone.
7. **Fines:** the smaller particles of aggregates; usually less than .25" in size.
8. **Head Pulley:** the driving pulley, usually at the discharge end of conveyor belt.
9. **Ro-Tap screen:** trade name for a type of testing screen.
10. **Scalping:** a screening operation, removing stone too large for the crusher.
11. **Scalping Screen:** removes oversize material.
12. **Screen (or sieve):** a metallic plate or sheet, woven wire cloth or similar device, with regularly spaced apertures of uniform size mounted in a suitable frame or holder for use in separating material according to size.

Appendix A.

Sampling and Velocity Traverse Point Determination EPA Method 1

PLANT NAME <u>Vulcan Materials</u>		
CITY, STATE <u>Mayville, Tenn.</u>		
SAMPLING LOCATION _____		
NO. OF PORTS AVAILABLE _____		
NO. OF PORTS USED <u>1</u>		
PORT INSIDE DIAMETER <u>4"</u>		
DISTANCE FROM FAR WALL TO OUTSIDE OF PORT <u>12"</u>		
NIPPLE LENGTH AND/OR WALL THICKNESS <u>0</u>		
DEPTH OF STACK OR DUCT <u>12"</u>		
STACK OR DUCT WIDTH (IF RECTANGULAR) <u>N.A.</u>		
EQUIVALENT DIAMETER:		
$D_E = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2 (\quad) (\quad)}{(\quad) + (\quad)} = \underline{N.A.}$		
DISTANCE FROM PORTS TO FLOW DISTURBANCES	UPSTREAM	DOWNSTREAM
	<u>96" +</u>	<u>24"</u>
DIAMETERS	<u>8 +</u>	<u>2</u>
STACK/DUCT AREA = $(12/2)^2 \pi = \underline{113.10 \text{ IN}^2}$		

[illegible][illegible]

DRAW HORIZONTAL LINE THROUGH DIAMETERS

If more than 8 and 2 diameters and If duct dia. is less than 24", use 8 or 9 points.

<u>VELOCITY</u>	<u>PARTICULATE</u>
DIAMETERS UP DOWN	
8 — 2.0	
7 — 1.75	
6 — 1.5	
5 — 1.25	
2 — 0.5	

PITOT USED (✓) TYPE "S" _____ STANDARD

POINT	% OF DUCT DEPTH	DISTANCE FROM INSIDE WALL	DISTANCE FROM OUTSIDE OF PORT
1	4.4	0.53	1 1/2
2	14.6	1.75	1 3/4
3	29.6	3.55	3 1/2
4	70.4	8.45	8 1/2
5	85.4	10.25	10 1/4
6	95.6	11.47	11 1/2
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

FIELD DATA AND RESULTS TABULATION

PLANT: Vulcan Materials, Maryville, TN

SAMPLING LOCATION: Crusher

		D-1-C-M2-1	D-1-C-M2-2	
	Test Date	6/10/93	6/10/93	
	Run Start Time	721	1103	
	Run Finish Time	725	1106	
	Net Traversing Points	6	6	
Cp	Pitot Tube Coefficient	0.84	0.84	
Pbar	Barometric Pressure, Inches Hg	29.09	29.09	Average
Pg	Flue Gas Static Pressure, Inches H2O	-0.64	-0.66	-0.65
Ps	Absolute Flue Gas Pressure, Inches Hg	29.04	29.04	29.04
ts	Flue Gas Temperature, Degrees F	70	83	77
Delta-p	Average Velocity Head, Inches H2O	0.3649	0.4020	0.3832 *

* Represents the square of the average square root of the "Delta-p"

FIELD DATA AND RESULTS TABULATION

PLANT: Vulcan Materials, Maryville, TN

SAMPLING LOCATION: Crusher

		D-1-C-M201A-1	D-1-C-M201A-2	D-1-C-M201A-3
Test Date		6/10/93	6/10/93	6/10/93
	Run Start Time	739	847	954
	Run Finish Time	839	947	1054
	Net Traversing/Sampling Points	6/1	6/1	6/1
Theta	Net Run Time, Minutes	60	60	60
Dia	Nozzle Diameter, Inches	0.198	0.198	0.198
Cp	Pitot Tube Coefficient	0.84	0.84	0.84
Y	Dry Gas Meter Calibration Factor	0.985	0.985	0.985
Pbar	Barometric Pressure, Inches Hg	29.09	29.09	29.09
Delta H	Avg. Pressure Differential of Orifice Meter, Inches H2O	0.57	0.57	0.58
Vm	Volume of Metered Gas Sample, Dry ACF	27.503	27.900	27.964
tm	Dry Gas Meter Temperature, Degrees F	79	93	103
Vmstd	Volume of Metered Gas Sample, Dry SCF*	25.839	25.548	25.152
Vlc	Total Volume of Liquid Collected in Impingers & Silica Gel, mL	16.2	17.4	4.7
Vwstd	Volume of Water Vapor, SCF*	0.763	0.819	0.221
%H2O	Moisture Content, Percent by Volume	2.87 **	3.11 **	0.87 **
%H2OSAT	Moisture Sat. @ Flue Gas Conditions, %	3.22	3.22	3.22
Mfd	Dry Mole Fraction	0.971	0.969	0.991
%CO2	Carbon Dioxide, Percent by Volume, Dry	0	0	0
%O2	Oxygen, Percent by Volume, Dry	20.9	20.9	20.9
Md	Gas Molecular Weight, Lb/Lb-Mole, Dry	28.84	28.84	28.84
Ms	Gas Molecular Weight, Lb/Lb-Mole, Wet	28.53	28.50	28.74
Pg	Flue Gas Static Pressure, Inches H2O	-0.65	-0.65	-0.65
Ps	Absolute Flue Gas Pressure, Inches Hg	29.04	29.04	29.04
<u>Volumetric Air Flow Rate</u>				
ts	Flue Gas Temperature, Degrees F	77	77	77
Delta-p	Average Velocity Head, Inches H2O	0.3832	0.3832	0.3832
vs	Flue Gas Velocity, Feet per Second	35.79	35.81	35.66
A	Stack/Duct Area, Square Inches	113.1	113.1	113.1
Qad	Volumetric Air Flow Rate, Dry SCFM*	1,564	1,560	1,590
Qmsd	Volumetric Air Flow Rate, Dry SCFM*	44	44	45
Qaw	Volumetric Air Flow Rate, Wet ACFM	1,687	1,687	1,680
ton/hr	Production Rate, tons/hour	282.00	246.00	267.00

* 68 ° F (20 ° C) -- 29.92 Inches of Mercury (Hg).

** Moisture used in calculations.

(Continued Next Page)

FIELD DATA AND RESULTS TABULATION

PLANT: Vulcan Materials, Maryville, TN

SAMPLING LOCATION: Crusher

		D-1-C-M201A-1	D-1-C-M201A-2	D-1-C-M201A-3
	<u>Percent Isokinetic</u>			
ts	Flue Gas Temperature, Degrees F	75	79	81
Delta-p	Average Velocity Head, Inches H ₂ O	0.36	0.36	0.36
vs	Flue Gas Velocity, Feet per Second	34.63	34.77	34.69
%I	Isokinetic Sampling Rate, Percent	104.2	103.6	100.3
	<u>PM10 Calculations</u>			
ucyc	Stack Gas Viscosity	180.5	180.4	182.0
Qs	PM10 Flow, at Cyclone Conditions, ACFM	0.465	0.460	0.443
D50	Dia. of Particles in Cyclone, Microns	9.79	9.84	10.16
	Particulate Catch,			
mg<D50	≤ 10 Microns, Milligrams	27.6	39.9	32.9
mg>D50	> 10 Microns, Milligrams	416.6	798.3	521.6
mg	Total Milligrams	444.2	838.2	554.5
	Percent of Total Particulate,			
%<D50	≤ 10 Microns	6.2	4.8	5.9
%>D50	> 10 Microns	93.8	95.2	94.1
	Particulate ≤ 10 Microns			
	<u>Concentration, milligrams/DSCF*</u>			
mg/DSCF	Concentration in Gas Sample	1.07	1.56	1.31
mg/DSCF,A	Concentration in Ambient Air	0.00	0.00	0.00
mg/DSCF,adj	Adjusted Concentration in Gas Sample	1.07	1.56	1.31
lb/hr	Emission Rate, lb/hr	0.221	0.322	0.275
lb/ton	Emission Rate, lb/ton	7.83E-04	1.31E-03	1.03E-03

* 68 ° F (20 ° C) -- 29.92 Inches of Mercury (Hg).

Plant Name Vulcan Materials Run No. Dry-1-Crusher-M.
City/State Maryville, Tenn. Date 6/10/93
Test Location Crusher Personnel JRW
Barometric Pres. (Pbar) 29.09 In. Hg Static Pres. (Pg) -0.64 In. H₂O
Pitot/Orifice ID DP48-8 Pitot Coef. (Cp) 0.84 Pres. Gauge Set ID XU-7
Thermocouple ID R284 Duct Length/Diameter 12" Width N/A.
--Specify inches (") or feet (')--

ORSAT DATA					
Sampling Time	Analysis Time	CO ₂ (A) Reading	O ₂ (B) Reading	%O ₂ (B-A)	%CO+N ₂ (100-B)
Average					
Bag No. _____		Pump _____			

FYRITE DATA, % CO ₂				
--------------------------------	--	--	--	--

MOISTURE DATA (WET BULB/DRY BULB)					
Port	Time	Dry Bulb °F	Wet Bulb °F	Diff.	% H ₂ O

MOISTURE DATA (STOICHIOMETRIC)		
Free Water in Fuel, %		
Water from Fuel Combustion, %		
Ambient Water, %		
Relative Humidity, %		
Ambient Temperature, °F		
Total %		

VOLUMETRIC AIR FLOW RATES	
Dry at Standard Conditions, Q _{sd} =	SCFM
Wet at Stack Conditions, Q _{aw} =	ACFM

ADDITIONAL DATA

DC
06-10-93

METHOD 201A (PM-10) FIELD DATA

Client EPA
 Plant Name Vulcan Materials
 City/State Maryville, Tenn.
 Sampling Location Crusher
 Date 6/10/93
 Team Leader JRW Techs TJB, JB
 *Train Leak Check Vacuum, In. Hg 10
 Train Leak Rate, Cubic Ft./Min. 0.007
 Barometric Pressure, In. Hg 29.09
 Static Pressure, In. H₂O -0.64

Run Number Dry-1 - Crusher - Method 1
 Time Start 0738 0739
 Time Stop 0839
 Job Number 50119
 Barometric Pressure, In. Hg 29.09
 Static Pressure, In. H₂O -0.64

EQUIPMENT CHECKS

✓ Pitot, Pretest
✓ Pitot, Posttest
N.A. M3 Sampling Sys/Ted Bag
✓ Thermocouple @ 70 Pre
✓ Thermocouple @ 71 Post

IDENTIFICATION NUMBERS

Meterbox NV-7 Meterbox Gamma 0.9850 Reagent Box N.A.
 T/C Readout F38 T/C Probe R218 Umbilical 481
 Sampling Box 9 Orsat Pump N.A. Tedlar Bag N.A.
 Nozzle(s) Actually Used: TJB 0.198 Pitot N.A.
 No. 0.198 Diameter 0.198 No. 0.198 Diameter

FILTER NO. TARE

PM 394 0.2715

NOZZLE SELECTION CRITERIA

Delta H_g 1.728 Desired Dia. 0.198 Nozzle 2
 Delta H_t 0.5880 0.577
 Delta H_t+50 0.2410 0.482 Nozzle 1
 Delta H_t-50 0.2462 0.704 Diameter 0.188
 Delta Pavg 0.3649 Nozzle Number 0.2013
 Meter Temp. 85 Delta Pmin 0.7450
 Stack Temp. 70 Delta Pmax

Est & H₂O 2.4

Cp 0.84

Sample Point	Dwell Time, Minutes	Elapsed Time, Minutes	Dry Gas Meter Readings Cubic Feet 32.2-48.84	Pitot Reading, In. H ₂ O (ΔP)	Gas Meter Temp, °F	Stack Temp, °F	Orifice Setting, In. H ₂ O (ΔH)	Vacuum Gauge, In. Hg	Gas Temp Filter Box, °F	Impingement Temp, °F	Cyclone Temp, °F
1 A-3	10:00	00:00	32.2-70.03	0.36	71	73	0.57	1	N.A.	51	N.A.
2	10:00	10:00	32.2-76		74	74	0.57	2		44	
3	10:00	20:00	33.1-73		78	74	0.57	2		44	
4	10:00	30:00	33.5-71		81	75	0.57	2		43	
5	10:00	40:00	34.0-73		83	76	0.57	2		44	
6	10:00	50:00	34.5-73	↓	86	77	0.57	2		42	
7	10:00	60:00	34.9-751								
8											
9											
10											
11											
12											

* REMOVE HEAD BEFORE POSTTEST LEAK CHECK
 F-1109 rev. 5-93

minutes 60 27.503 Vm 0.36 79 75 0.57 ΔH
 (ΔP)² tm ts

OC 06-10-93

METHOD 201A (PM-10) FIELD DATA

Client EPA
 Plant Name Vulcan Materials
 City/State Maryville Tenn.
 Sampling Location Critcher
 Date 6/10/93 Team Leader JRW Techs TJB, JB
 *Train Leak Check Vacuum, In. Hg 6
 Train Leak Rate, Cubic Ft./Min. 0.002 0.003
 Barometric Pressure, In. Hg 30.19
 Static Pressure, In. Hg 29.07

Run Number Dry-1-Crushe-M201A
 Time Start 0847
 Time Stop 0947
 Job Number 50119
 Barometric Pressure, In. Hg 30.19
 Static Pressure, In. Hg 29.07

EQUIPMENT CHECKS

☒ Pitot, Pretest
☒ Pitot, Posttest
☒ M3 Sampling Sys/Ted Bag
☒ Thermocouple @ 74 Pre
☒ Thermocouple @ 81 Post

IDENTIFICATION NUMBERS

Meterbox N4-7 Meterbox Gamma 0.9850 Reagent Box NA
 T/C Readout F32 T/C Probe R302 Umbilical 481
 Sampling Box 2 Orsat Pump NA Tedlar Bag 464
 Nozzle(s) Actually Used: 0.98 No. 1 Pitot NA
 No. 1 Diameter 0.188 Diameter

FILTER NO. TARE

P4 372 0.2684

Delta Hg 1-728
 Delta Ht 0.5827
 Delta Ht+50 0.4865
 Delta Ht-50 0.7104
 Delta Pavg 0.3649
 Meter Temp. 90
 Stack Temp. 79

NOZZLE SELECTION CRITERIA

Desired Dia. 0.198 Nozzle 1
 Diameter 0.188 Nozzle 2
 Nozzle Number 0.2913
 Delta Pmin 0.745
 Delta Pmax 0.745

Est % H₂O 2.4

Cp 0.84

Sample Point	Dwell Time, Minutes	Elapsed Time, Minutes	Dry Gas Meter Readings Cubic Feet	Pitot Reading, In. H ₂ O (ΔP)	Gas Meter Temp, °F	Stack Temp, °F	Orifice Setting, In. H ₂ O (ΔH)	Vacuum Gauge, In. Hg	Gas Temp, °F	Impingement Temp, °F	Cyclone Temp, °F
1	10:00	00:00	349.912	0.36	88	77	0.57	1	NA	62	NA
2	10:00	10:00	354.98		90	78	0.57	1		60	
3	10:00	20:00	359.24		93	79	0.57	1		55	
4	10:00	30:00	363.89		94	80	0.57	1		55	
5	10:00	40:00	368.54		95	80	0.57	1		57	
6	10:00	50:00	373.17	↓	98	80	0.57	1	↓	57	↓
7		60:00	377.812								
8											
9											
10											
11											
12											

* REMOVE HEAD BEFORE POSTTEST LEAK CHECK
 F-1109 rev. 5-93

60 minutes 27.900 Vm 0.2600 93 tm 79 ts 0.57 ΔH

OC
 01-10-93

METHOD 201A (PM-10) FIELD DATA

Client EPA
 Plant Name Vulcan Materials
 City/State Maryville, Tenn.
 Sampling Location Crusher
 Date 1/10/93 Team Leader JRN Techs TJB, JJB
 Train Leak Check Vacuum, In. Hg 6
 Train Leak Rate, Cubic Ft./Min. 0.002 0.002

Run Number 0954
 Time Start 1054
 Time Stop 5019
 Job Number 2909
 Barometric Pressure, In. Hg 29.09
 Static Pressure, In. H₂O -0.64

EQUIPMENT CHECKS

☒ Pitot, Pretest
☒ Pitot, Posttest
N/A M3 Sampling Sys/Ted Bag
☒ Thermocouple @ 80 Pre
☒ Thermocouple @ 82 Post

IDENTIFICATION NUMBERS

Meterbox N4-7 Meterbox Gamma 0.1850
 T/C Readout F38 T/C Probe R218
 Sampling Box 4 Orsat Pump N/A
 Nozzle(s) Actually Used: 0.18 No. 0.18
 No. 0.18 Diameter 0.18

Reagent Box N/A
 Umbilical N/A
 Tedlar Bag N/A
 Pitot N/A
 Diameter N/A

FILTER NO. TARE

PM771 0.2711

NOZZLE SELECTION CRITERIA

Desired Dia. 0.200 Nozzle 1
 Diameter 0.188
 Nozzle Number 0.2066
 Delta Pmin 0.7619
 Delta Pmax

NOZZLE SELECTION CRITERIA

Desired Dia. 0.200 Nozzle 2
 Diameter
 Nozzle Number
 Delta Pmin
 Delta Pmax

FYRTE

N/A

 Cp 0.84

Est & H₂O 2.4

Sample Point	Dwell Time, Minutes	Elapsed Time, Minutes	Dry Gas Meter Readings Cubic Feet	Pitot Reading, In. H ₂ O (ΔP)	Gas Meter Temp, °F	Stack Temp, °F	Orifice Setting, In. H ₂ O (ΔH)	Vacuum Gauge, In. Hg	Gas Temp Filter Box, °F	Imping Cyclone Exit, °F
1	A-3	10:00	377.900	0.36	100	81	0.58	1	N/A	62
2		10:00	382.58		102	81		1		61
3		10:00	387.24		104	80		1		53
4		10:00	391.91		104	81		1		52
5		10:00	396.51		104	81		1		54
6	✓	10:00	401.23		105	82		1		55
7		60:00	405.864	✓			✓			✓
8										
9										
10										
11										
12										

* REMOVE HEAD BEFORE POSTTEST LEAK CHECK
 F-1109 rev. 5-93

minutes 60 Vm 27.969 0.36 103 81 0.58 ΔH
 (ΔP)² tm ts

DC 06-10-93

FIELD DATA AND RESULTS TABULATION

PLANT: Vulcan Materials, Maryville, TN

SAMPLING LOCATION: Crusher

		W-1-C-M2-1	W-1-C-M2-2	
	Test Date	6/8/93	6/8/93	
	Run Start Time	814	1542	
	Run Finish Time	819	1548	
	Net Traversing Points	6	6	
Cp	Pitot Tube Coefficient	0.84	0.84	
Pbar	Barometric Pressure, Inches Hg	29.12	29.1	Average
Pg	Flue Gas Static Pressure, Inches H2O	-0.57	-0.58	-0.58
Ps	Absolute Flue Gas Pressure, Inches Hg	29.08	29.08	29.08
ts	Flue Gas Temperature, Degrees F	67	85	76
Delta-p	Average Velocity Head, Inches H2O	0.3390	0.3950	0.3665 *

* Represents the square of the average square root of the "Delta-p"

FIELD DATA AND RESULTS TABULATION

PLANT: Vulcan Materials, Maryville, TN

SAMPLING LOCATION: Crusher

		W-1-C-M2-3	W-1-C-M2-4	
	Test Date	6/8/93	6/8/93	
	Run Start Time	722	1352	
	Run Finish Time	726	1355	
	Net Traversing Points	6	6	
Cp	Pitot Tube Coefficient	0.84	0.84	
Pbar	Barometric Pressure, Inches Hg	29.00	29.00	Average
Pg	Flue Gas Static Pressure, Inches H2O	-0.48	-0.62	-0.550
Ps	Absolute Flue Gas Pressure, Inches Hg	28.96	28.95	28.96
ts	Flue Gas Temperature, Degrees F	72	83	78
Delta-p	Average Velocity Head, Inches H2O	0.3250	0.4110	0.3667 *

* Represents the square of the average square root of the "Delta-p"

FIELD DATA AND RESULTS TABULATION

PLANT: Vulcan Materials, Maryville, TN

SAMPLING LOCATION: Crusher

		W-1-C-M2-5 ----- 6/9/93	W-1-C-M2-6 ----- 6/9/93	
	Test Date			
	Run Start Time	726	1412	
	Run Finish Time	728	1414	
	Net Traversing Points	6	6	
Cp	Pitot Tube Coefficient	0.84	0.84	
Pbar	Barometric Pressure, Inches Hg	29.3	29.3	Average -----
Pg	Flue Gas Static Pressure, Inches H2O	-0.52	-0.55	-0.54
Ps	Absolute Flue Gas Pressure, Inches Hg	29.26	29.26	29.26
ts	Flue Gas Temperature, Degrees F	71	86	79
Delta-p	Average Velocity Head, Inches H2O	0.3277	0.3810	0.3538 *

* Represents the square of the average square root of the "Delta-p"

FIELD DATA AND RESULTS TABULATION

PLANT: Vulcan Materials, Maryville, TN

SAMPLING LOCATION: Crusher

		W-1-C-M201A-1	W-1-C-M201A-2	W-1-C-M201A-3
Test Date		6/7/93	6/8/93	6/9/93
	Run Start Time	917	737	758
	Run Finish Time	1527	1343	1406
	Net Traversing/Sampling Points	6/1	6/1	6/1
Theta	Net Run Time, Minutes	360	360	360
Dia	Nozzle Diameter, Inches	0.198	0.198	0.198
Cp	Pitot Tube Coefficient	0.84	0.84	0.84
Y	Dry Gas Meter Calibration Factor	0.985	0.985	0.985
Pbar	Barometric Pressure, Inches Hg	29.12	29.00	29.30
Delta H	Avg. Pressure Differential of Orifice Meter, Inches H ₂ O	0.58	0.57	0.57
Vm	Volume of Metered Gas Sample, Dry ACF	167.156	167.599	167.086
tm	Dry Gas Meter Temperature, Degrees F	99	97	97
Vmstd	Volume of Metered Gas Sample, Dry SCF*	151.581	151.897	152.997
Vlc	Total Volume of Liquid Collected in Impingers & Silica Gel, mL	70.9	88.0	83.9
Vwstd	Volume of Water Vapor, SCF*	3.337	4.142	3.949
%H ₂ O	Moisture Content, Percent by Volume	2.15 **	2.65 **	2.52 **
%H ₂ O SAT	Moisture Sat. @ Flue Gas Conditions, %	3.11	3.34	3.41
Mfd	Dry Mole Fraction	0.978	0.973	0.975
%CO ₂	Carbon Dioxide, Percent by Volume, Dry	0	0	0
%O ₂	Oxygen, Percent by Volume, Dry	20.9	20.9	20.9
Md	Gas Molecular Weight, Lb/Lb-Mole, Dry	28.84	28.84	28.84
Ms	Gas Molecular Weight, Lb/Lb-Mole, Wet	28.60	28.55	28.56
Pg	Flue Gas Static Pressure, Inches H ₂ O	-0.58	-0.55	-0.54
Ps	Absolute Flue Gas Pressure, Inches Hg	29.08	28.96	29.26
<u>Volumetric Air Flow Rate</u>				
ts	Flue Gas Temperature, Degrees F	76	78	79
Delta-p	Average Velocity Head, Inches H ₂ O	0.3665	0.3667	0.3538
vs	Flue Gas Velocity, Feet per Second	34.90	35.08	34.30
A	Stack/Duct Area, Square Inches	113.1	113.1	113.1
Qsd	Volumetric Air Flow Rate, Dry SCFM*	1,541	1,529	1,510
Qmsd	Volumetric Air Flow Rate, Dry SCMM*	43.6	43.3	42.8
Qaw	Volumetric Air Flow Rate, Wet ACFM	1,645	1,653	1,616
ton/hr	Production Rate, tons/hour	267.00	228.00	291.00

* 68 ° F (20 ° C) -- 29.92 Inches of Mercury (Hg).

** Moisture used in calculations.

(Continued Next Page)

FIELD DATA AND RESULTS TABULATION

PLANT: Vulcan Materials, Maryville, TN

SAMPLING LOCATION: Crusher

		W-1-C-M201A-1	W-1-C-M201A-2	W-1-C-M201A-3
		-----	-----	-----
<u>Percent Isokinetic</u>				
ts	Flue Gas Temperature, Degrees F	79	79	81
Delta-p	Average Velocity Head, Inches H ₂ O	0.35	0.33	0.35
vs	Flue Gas Velocity, Feet per Second	34.20	33.31	34.18
%I	Isokinetic Sampling Rate, Percent	103.0	107.0	104.2
<u>PM10 Calculations</u>				
ucyc	Stack Gas Viscosity	180.8	180.9	181.3
Qs	PM10 Flow, at Cyclone Conditions, ACFM	0.450	0.456	0.455
D50	Dia. of Particles in Cyclone, Microns	10.02	9.94	9.95
Particulate Catch,				
mg<D50	≤ 10 Microns, Milligrams	37.4	25.1	23.4
mg>D50	> 10 Microns, Milligrams	267.9	227.2	162.5
mg	Total Milligrams	305.3	252.3	185.9
Percent of Total Particulate,				
%<D50	≤ 10 Microns	12.3	9.9	12.6
%>D50	> 10 Microns	87.7	90.1	87.4
Particulate ≤ 10 Microns				
<u>Concentration, milligrams/DSCF*</u>				
mg/DSCF	Concentration in Gas Sample	0.247	0.165	0.153
mg/DSCF,A	Concentration in Ambient Air	0.00	0.00	0.00
mg/DSCF,adj	Adjusted Concentration in Gas Sample	0.247	0.165	0.153
lb/hr	Emission Rate, lb/hr	0.0503	0.0334	0.0305
lb/ton	Emission Rate, lb/ton	0.00019	0.000147	0.000105

* 68 ° F (20 ° C) -- 29.92 Inches of Mercury (Hg).

AIR FLOW RATE DETERMINATIONS

Plant Name Vulcan Materials Run No. Wet-1-Crusher
City/State Maryville, Tenn. Date 6/7/93
Test Location Crusher Personnel JRW, JB
Barometric Pres. (Pbar) 29.12 In. Hg Static Pres. (Pg) -0.57 In. H₂O
Pitot/Orifice ID DP48-8 Pitot Coef. (Cp) 0.84 Pres. Gauge Set ID NU-7
Thermocouple ID R284 Duct Length/Diameter 12" Width N.A.
--Specify inches (") or feet (')--

Point No.	ΔP In. H ₂ O	Temp. °F
A-6	0.31	68
5	0.39	67
4	0.39	67
3	0.35	67
2	0.29	67
1	0.31	67
Avg. *	0.339	67

ORSAT DATA					
Sampling Time	Analysis Time	CO ₂ (A) Reading	O ₂ (B) Reading	%O ₂ (B-A)	%CO+N ₂ (100-B)
Average					
Bag No. _____		Pump _____			

FYRITE DATA, % CO ₂				
--------------------------------	--	--	--	--

MOISTURE DATA (WET BULB/DRY BULB)					
Port	Time	Dry Bulb °F	Wet Bulb °F	Diff.	% H ₂ O

MOISTURE DATA (STOICHIOMETRIC)	
Free Water in Fuel, %	
Water from Fuel Combustion, %	
Ambient Water, %	
Relative Humidity, %	
Ambient Temperature, °F	
Total %	

VOLUMETRIC AIR FLOW RATES	
Dry at Standard Conditions, Qsd =	SCFM
Wet at Stack Conditions, Qaw =	ACFM

ADDITIONAL DATA

* ΔP average is square of average square root. See page 2 for field flow rate calculations.

AIR FLOW RATE DETERMINATIONS

Plant Name Vulcan Materials Run No. Wet-1-Crusher-
City/State Maryville, Tenn. Date 6/7/93^{m²-2}
Test Location Crusher Personnel JRW, JTB
Barometric Pres. (Pbar) 29.12 In. Hg Static Pres. (Pg) -0.58 In. H₂O
Pitot/Orifice ID DP48-8 Pitot Coef. (Cp) 0.84 Pres. Gauge Set ID NU-7
Thermocouple ID R 284 Duct Length/Diameter 12" Width N/A.
--Specify inches (") or feet (')--

VELOCITY TRAVERSES		
Start-Finish Times: <u>1542 - 1548</u>		
Point No.	ΔP In. H₂O	Temp. °F
A-6	0.40	86
5	0.43	85
4	0.41	85
3	0.39	84
2	0.37	84
1	0.37	84
Avg. *	0.395	85

ORSAT DATA					
Sampling Time	Analysis Time	CO ₂ (A) Reading	O ₂ (B) Reading	%O ₂ (B-A)	%CO+N ₂ (100-B)
Average					
Bag No. _____		Pump _____			

FYRITE DATA, % CO ₂				
--------------------------------	--	--	--	--

MOISTURE DATA (WET BULB/DRY BULB)					
Port	Time	Dry Bulb °F	Wet Bulb °F	Diff.	% H ₂ O

MOISTURE DATA (STOICHIOMETRIC)		
Free Water in Fuel, %		
Water from Fuel Combustion, %		
Ambient Water, %		
Relative Humidity, %		
Ambient Temperature, °F		
Total %		

VOLUMETRIC AIR FLOW RATES	
Dry at Standard Conditions, Q _{sd} =	SCFM
Wet at Stack Conditions, Q _{aw} =	ACFM

<u>ADDITIONAL DATA</u>	

* ΔP average is square of average square root. See page 2 for field flow rate calculations.

AIR FLOW RATE DETERMINATIONS

Plant Name Vulcan Materials Run No. Wet-1-Crusher-
City/State Maryville, Tenn. Date 6/8/93 ¹¹²⁻³
Test Location Crusher Personnel JRW TTB JB
Barometric Pres. (Pbar) 29.0 In. Hg Static Pres. (Pg) -0.48 In. H₂O
Pitot/Orifice ID DP48-8 Pitot Coef. (Cp) 0.84 Pres. Gauge Set ID NA-7
Thermocouple ID R284 Duct Length/Diameter 12" Width N.A.
--Specify inches (") or feet (')--

[illegible]

ORSAT DATA					
Sampling Time	Analysis Time	CO ₂ (A) Reading	O ₂ (B) Reading	%O ₂ (B-A)	%CO+N ₂ (100-B)
Average					
Bag No. _____		Pump _____			

FYRITE DATA, % CO ₂				
--------------------------------	--	--	--	--

MOISTURE DATA (WET BULB/DRY BULB)					
Port	Time	Dry Bulb °F	Wet Bulb °F	Diff.	% H ₂ O

MOISTURE DATA (STOICHIOMETRIC)		
Free Water in Fuel, %		
Water from Fuel Combustion, %		
Ambient Water, %		
Relative Humidity, %		
Ambient Temperature, °F		
Total %		

VOLUMETRIC AIR FLOW RATES	
Dry at Standard Conditions, Q _{sd} =	SCFM
Wet at Stack Conditions, Q _{aw} =	ACFM

ADDITIONAL DATA

* ΔP average is square of average square root. See page 2 for field flow rate calculations.

AIR FLOW RATE DETERMINATIONS

Plant Name Vulcan Materials Run No. Wet-1-Crusher-
City/State Maryville, Tenn. Date 6/8/93^{M2-4}
Test Location Crusher Personnel JRW
Barometric Pres. (Pbar) 29.0 In. Hg Static Pres. (Pg) -0.62 In. H₂O
Pitot/Orifice ID DP48-8 Pitot Coef. (Cp) 0.84 Pres. Gauge Set ID N4-7
Thermocouple ID R284 Duct Length/Diameter 12" Width N.A.
--Specify inches (") or feet (')--

[illegible]

ORSAT DATA					
Sampling Time	Analysis Time	CO ₂ (A) Reading	O ₂ (B) Reading	%O ₂ (B-A)	%CO+N ₂ (100-B)
Average					
Bag No. _____		Pump _____			

FYRITE DATA, % CO ₂				
--------------------------------	--	--	--	--

MOISTURE DATA (WET BULB/DRY BULB)					
Port	Time	Dry Bulb °F	Wet Bulb °F	Diff.	% H ₂ O

MOISTURE DATA (STOICHIOMETRIC)		
Free Water in Fuel, %		
Water from Fuel Combustion, %		
Ambient Water, %		
Relative Humidity, %		
Ambient Temperature, °F		
Total %		

VOLUMETRIC AIR FLOW RATES	
Dry at Standard Conditions, Q _{sd} =	SCFM
Wet at Stack Conditions, Q _{aw} =	ACFM

ADDITIONAL DATA

* ΔP average is square of average square root. See page 2 for field flow rate calculations.

AIR FLOW RATE DETERMINATIONS

Plant Name Vulcan Materials Run No. Wet-1 - Crusher-
City/State Maryville, Tenn. Date 6/9/93
Test Location Crusher Personnel JRW, TTB, JB
Barometric Pres. (Pbar) 29.3 In. Hg Static Pres. (Pg) -0.52 In. H₂O
Pitot/Orifice ID DP48-8 Pitot Coef. (Cp) 0.84 Pres. Gauge Set ID N4-7
Thermocouple ID R284 Duct Length/Diameter 12" Width N/A.
--Specify inches (") or feet (')--

[illegible]

ORSAT DATA					
Sampling Time	Analysis Time	CO ₂ (A) Reading	O ₂ (B) Reading	%O ₂ (B-A)	%CO+N ₂ (100-B)
Average					
Bag No. _____		Pump _____			

FYRITE DATA, % CO ₂				
--------------------------------	--	--	--	--

MOISTURE DATA (WET BULB/DRY BULB)					
Port	Time	Dry Bulb °F	Wet Bulb °F	Diff.	% H ₂ O

MOISTURE DATA (STOICHIOMETRIC)	
Free Water in Fuel, %	
Water from Fuel Combustion, %	
Ambient Water, %	
Relative Humidity, %	
Ambient Temperature, °F	
Total %	

VOLUMETRIC AIR FLOW RATES	
Dry at Standard Conditions, Q _{sd} =	SCFM
Wet at Stack Conditions, Q _{aw} =	ACFM

<u>ADDITIONAL DATA</u>	

* ΔP average is square of average square root. See page 2 for field flow rate calculations.

AIR FLOW RATE DETERMINATIONS

Plant Name Vulcan Materials Run No. Wet-1-Crusher
City/State Maryville, Tenn. Date 6/9/93
Test Location Crusher Personnel JRW, JB
Barometric Pres. (Pbar) 29.3 In. Hg Static Pres. (Pg) -0.55 In. H₂O
Pitot/Orifice ID DP48-8 Pitot Coef. (Cp) 0.84 Pres. Gauge Set ID NA-7
Thermocouple ID R284 Duct Length/Diameter 12" Width NA
--Specify inches (") or feet (')--

[illegible]

ORSAT DATA					
Sampling Time	Analysis Time	CO ₂ (A) Reading	O ₂ (B) Reading	%O ₂ (B-A)	%CO+N ₂ (100-B)
Average					
Bag No. _____		Pump _____			

FYRITE DATA, % CO ₂				
--------------------------------	--	--	--	--

MOISTURE DATA (WET BULB/DRY BULB)					
Port	Time	Dry Bulb °F	Wet Bulb °F	Diff.	% H ₂ O

MOISTURE DATA (STOICHIOMETRIC)		
Free Water in Fuel, %		
Water from Fuel Combustion, %		
Ambient Water, %		
Relative Humidity, %		
Ambient Temperature, °F		
Total %		

VOLUMETRIC AIR FLOW RATES	
Dry at Standard Conditions, Q _{sd} =	SCFM
Wet at Stack Conditions, Q _{aw} =	ACFM

ADDITIONAL DATA

* ΔP average is square of average square root.

METHOD 201A (PM-10) FIELD DATA

Client EPA Run Number Wet-1 - Crusher-M20A-1
 Plant Name Vulcan Materials Time Start 0917
 City/State Maryville, Tenn. Time Stop 1527
 Sampling Location Crusher Job Number 50119
 Date 6/7/93 Team Leader JRU Techs TJB
 *Train Leak Check Vacuum, In. Hg 10 Barometric Pressure, In. Hg 29.12
 Train Leak Rate, Cubic Ft./Min. 0.010 Static Pressure, In. H₂O -0.57

EQUIPMENT CHECKS

☒ Pitot, Pretest
☒ Pitot, Posttest
N.A. M3 Sampling Sys/Ted Bag
☒ Thermocouple @ 78 Pre
☒ Thermocouple @ 88 Post

IDENTIFICATION NUMBERS

Meterbox MU-7 Meterbox Gamma 0.950
 T/C Readout F-38 T/C Probe R218
 Sampling Box 12 Orsat Pump N.A.
 Nozzle(s) Actually Used: 11B
 No. 0.188 Diameter 0.188 No. 0.188

Reagent Box N.A.
 Umbilical 481
 Tedlar Bag N.A.
 Pitot N.A.
 Diameter

FILTER NO.

PM148 TARE 0.2710
 Delta Hg 1.728
 Delta H_t 0.5130581
 Delta H_t+50 0.5130581
 Delta H_t-50 0.2490740
 Delta P avg 0.739
 Meter Temp. 90
 Stack Temp. 67

NOZZLE SELECTION CRITERIA

Desired Dia. 0.202
 Nozzle 1 0.188
 Nozzle 2 0.182
 Diameter 0.2008
 Nozzle Number 0.7440
 Delta P_{min}
 Delta P_{max}

FYRITE
N.A.
↓
↓
↓
Cp 0.81

Est & H₂O 2

Sample Point	Dwell Time, Minutes	Elapsed Time, Minutes	Dry Gas Meter Readings Cubic Feet	Pitot Reading, In. H ₂ O (ΔP)	Gas Meter Temp, °F	Stack Temp, °F	Orifice Setting, In. H ₂ O (ΔH)	Vacuum Gauge, In. Hg	Gas Temps Filter Imping Box, °F	Cyclone Temp, °F
1	15:00	00:00	810.700	0.35	76	71	0.50	1	N.A.	N.A.
2	15:00	15:00	817.70		82	71		1		50
3	15:00	30:00	824.68		87	72		1		50
4	15:00	45:00	831.5		92	75		1		52
5	15:00	60:00/0	838.44		95	74		1		55
6	15:00	15:00	845.35		96	73		1		55
7	15:00	30:00	852.28		99	74		1		50
8	15:00	45:00	859.21		102	76		1		52
9	15:00	120:00/0	866.16		103	76		1		55
10	15:00	15:00	873.11		105	77		1		60
11	15:00	30:00	880.06		106	78		1		34
12	15:00	45:00	887.01		108	78		1		36

* REMOVE HEAD BEFORE POSTTEST LEAK CHECK

F-1109 rev. 5-93

minutes 360 Vm 167.156 $(\sqrt{\Delta P})^2$ 0.35 tm 99 ts 79 ΔH 0.55

METHOD 201A (PM-10) FIELD DATA (continued)

Client EPA
 Plant Name Vulcan Materials
 City/State Maryville, Tenn.
 Sampling Location Crusher

Run Number Net-1 - Crusher - M20A-
 Job Number 50119

Sample Point	Dwell Time, Minutes	Elapsed Time, Minutes	Dry Gas Meter Readings Cubic Feet	Pitot Reading, In. H ₂ O (P)	Gas Meter Temp, °F	Stack Temp, °F	Orifice Setting, In. H ₂ O (H)	Vacuum Gauge, In. Hg	Gas Temp, Filter Box, °F	Impingement Exit, °F	Cyclone Temp, °F
13	15:00	180:00/0	894.04	0.35	109	80	0.58	1	N.A.	62	N.A.
14	15:00	15:00	901.03		104	81				54	
15	15:00	30:00	908.07		101	82				60	
16	15:00	45:00	914.95		101	82				58	
17	15:00	240:00/0	921.95		103	83				64	
18	15:00	15:00	928.95		104	84				55	
19	15:00	30:00	935.94		102	84				60	
20	15:00	45:00	942.91		102	84				63	
21	15:00	300:00/0	949.88		99	84				55	
22	15:00	15:00	956.90		100	84				59	
23	15:00	30:00	963.86		103	85				56	
24	15:00	45:00	970.86	↓	105	85	↓	↓	↓	63	↓
25		360:00	977.856								
26											
27											
28											
29											
30											
31											
32											
33											
34											
35											
36											
37											
38											
39											
40											

METHOD 201A (PM-10) FIELD DATA

Client EPA

Plant Name Vulcan Materials

City/State Marionville Tenn

Sampling Location Crusher

Date 6/8/93

*Train Leak Check Vacuum, In. Hg 10

Train Leak Rate, Cubic Ft./Min. 0.003

Run Number Wet-1-Crusher - 102014

Time Start 09270737

Time Stop 1343

Job Number 50119

Barometric Pressure, In. Hg 29.0

Static Pressure, In. H₂O -0.48

Team Leader JRW

Techs TTH JB

IDENTIFICATION NUMBERS

Meterbox NA7

T/C Readout F38

Sampling Box 9

Nozzle(s) Actually Used: 3' 180

Meterbox Gamma 0.9850

T/C Probe R302

Orsat Pump NA

No. 0488

Reagent Box NA

Umbilical U81

Tedlar Bag NA

Pitot NA

Diameter 0.084

EQUIPMENT CHECKS

Pitot, Pretest

Pitot, Posttest

M3 Sampling Sys/Ted Bag

Thermocouple @ 74 Pre

Thermocouple @ Post

NOZZLE SELECTION CRITERIA

Desired Dia. 0.202

Diameter 0.188

Nozzle Number 0.2067

Delta P_{min} 0.7624

Delta P_{max}

FILTER NO. P108

TARE 0.2184

Delta H_g 1.728

Delta H_t 0.5952

Delta H_{t+50} 0.4986

Delta H_{t-50} 0.7229

Delta P_{avg} 0.3245

Meter Temp. 80

Stack Temp. 95

Est % H₂O 2

NOZZLE SELECTION CRITERIA

Desired Dia. 0.202

Diameter 0.188

Nozzle Number 0.2067

Delta P_{min} 0.7624

Delta P_{max}

Sample Point	Dwell Time, Minutes	Elapsed Time, Minutes	Dry Gas Meter Readings Cubic Feet	Pitot Reading, In. H ₂ O (ΔP)	Gas Meter Temp, °F	Stack Temp, °F	Orifice Setting, In. H ₂ O (ΔH)	Vacuum Gauge, In. Hg	Gas Temp Filter Box, °F	Impingement Exit, °F	Cyclone Temp, °F
1	15:00	00:00	982.801	0.33	84	72	0.57	2	NA	44	NA
2	15:00	15:00	989.75		90	74	0.57	2		42	
3	15:00	30:00	996.68		89	74	0.57	2		41	
4	15:00	45:00	1003.60		92	75	0.57	2		41	
5	15:00	60:00	1010.59		94	76	0.57	2		43	
6	15:00	15:00	1017.54		96	77	0.57	2		44	
7	15:00	30:00	1024.52		98	77	0.57	2		43	
8	15:00	45:00	1031.49		99	78	0.57	2		42	
9	15:00	120:00	1038.46		100	78	0.57	2		46	
10	15:00	15:00	1045.45		100	79	0.57	2		42	
11	15:00	30:00	1052.43		100	79	0.57	2		44	
12	15:00	45:00	1059.44		98	80	0.57	2		48	

METHOD 201A (PM-10) FIELD DATA (continued)

Client EPA
 Plant Name Vulcan Materials
 City/State Maryville, Tenn.
 Sampling Location Crusher

Run Number Wet-1-Crusher-M201A-2
 Job Number 50119

Sample Point	Dwell Time, Minutes	Elapsed Time, Minutes	Dry Gas Meter Readings Cubic Feet	Pitot Reading, In. H ₂ O (P)	Gas Meter Temp, °F	Stack Temp, °F	Orifice Setting, In. H ₂ O (H)	Vacuum Gauge, In. Hg	Gas Temp Filter Box, °F	Gas Temp Imping Exit, °F	Cyclone Temp, °F
13	15:00	18:00/0	1066.33	0.33	97	80	0.57	2	N.A.	49	N.A.
14	15:00	15:00	1073.45		97	80	0.57	2		50	
15	15:00	30:00	1080.45		98	81	0.57	2		42	
16	15:00	45:00	1088.12		99	81	0.57	2		44	
17	15:00	240:00/0	1092.13		100	81	0.57	2		48	
18	15:00	15:00	1094.15		99	80	0.57	2		42	
19	15:00	30:00	1106.07		97	81	0.57	2		46	
20	15:00	45:00	1113.18		98	82	0.57	2		48	
21	15:00	300:00/0	1120.12		101	82	0.57	2		50	
22	15:00	15:00	1127.09		102	83	0.57	2		49	
23	15:00	30:00	1134.08		102	83	0.57	2		41	
24	15:00	45:00	1141.07	↓	103	82	0.57	2	↓	47	↓
25		360:00/med	1150.400								
26											
27											
28											
29											
30											
31											
32											
33											
34											
35											
36											
37											
38											
39											
40											

METHOD 201A (PM-10) FIELD DATA

Client EPA Run Number Wet-1-M 201A-3
 Plant Name Kalkan Materials Time Start 0758
 City/State Maryville, Tenn. Time Stop 1406
 Sampling Location Crusher Job Number 50119
 Date 6/9/93 Team Leader TRW Techs TTB, JB
 *Train Leak Check Vacuum, In. Hg 10 Barometric Pressure, In. Hg 29.3
 Train Leak Rate, Cubic Ft./Min. 0.015 Static Pressure, In. H₂O -0.52

EQUIPMENT CHECKS
 Pitot, Pretest N.A. Reagent Box N.A.
 Pitot, Posttest N.A. Umbilical 481
 M3 Sampling Sys/Ted Bag N.A. Tedlar Bag N.A.
 Thermocouple @ 71 Pre N.A. Pitot N.A.
 Thermocouple @ 84 Post N.A. Diameter N.A.

IDENTIFICATION NUMBERS
 Meterbox NM-7 Meterbox Gamma 0.9850
 T/C Readout F78 T/C Probe R702
 Sampling Box 12 Orsat Pump N.A.
 Nozzle(s) Actually Used: 73, 18 No. 188
 Diameter 0.188

NOZZLE SELECTION CRITERIA
 Desired Dia. 0.205 Nozzle 1 0.188
 Diameter 0.2065
 Nozzle Number 0.2065
 Delta Pmin 0.7629
 Delta Pmax 0.7629

NOZZLE SELECTION CRITERIA
 Delta Hg 1.728
 Delta Ht 0.5914
 Delta Ht+50 0.4954
 Delta Ht-50 0.7182
 Delta Pavg 0.7272
 Meter Temp. 95
 Stack Temp. 80

Est % H₂O 2.4

Sample Point	Dwell Time, Minutes	Elapsed Time, Minutes	Dry Gas Meter Readings Cubic Feet	Pitot Reading, In. H ₂ O (ΔP)	Gas Meter Temp, °F	Stack Temp, °F	Orifice Setting, In. H ₂ O (ΔH)	Vacuum Gauge, In. Hg	Gas Temp, °F	Imping Cyclone Temp, °F
1	15:00	00:00	152.001	0.35	72	74	0.57	1	N.A.	55
2	15:00	15:00	158.87		75	76		1		52
3	15:00	30:00	165.77		80	77		1		54
4	15:00	45:00	172.67		85	77		1		51
5	15:00	60:00	174.57		90	78		1		54
6	15:00	15:00	186.49		93	80		1		50
7	15:00	30:00	192.43		96	79		1		55
8	15:00	45:00	200.76		97	80		1		60
9	15:00	120:00	207.27		94	80		1		60
10	15:00	15:00	214.24		99	81		1		62
11	15:00	30:00	221.21		100	80		1		57
12	15:00	45:00	228.16		100	83		1		60

* REMOVE HEAD BEFORE POSTTEST LEAK CHECK

360 minutes 167.086 Vm 0.35 $(\sqrt{\Delta P})^2$ 97 tm 51 ts 0.011 ΔH

F-1109 rev. 5-93

METHOD 201A (PM-10) FIELD DATA (continued)

Client EPA
 Plant Name Vulcan Materials
 City/State Maryville, Tenn.
 Sampling Location Crusher

Run Number Net-1-Crusher-10201A
 Job Number 50119

Sample Point	Dwell Time, Minutes	Elapsed Time, Minutes	Dry Gas Meter Readings Cubic Feet	Pitot Reading, In. H ₂ O (P)	Gas Meter Temp, °F	Stack Temp, °F	Orifice Setting, In. H ₂ O (H)	Vacuum Gauge, In. Hg	Gas Temp Filter Box, °F	Gas Temp Imping Exit, °F	Cyclone Temp, °F
13	A-4	15:00	180:00	0.35	101	81	0.57	1	11.4	62	114
14		15:00	195:00		101	82		1		63	
15		15:00	210:00		100	82		1		63	
16		15:00	225:00		101	82		1		55	
17		15:00	240:00		102	83		1		60	
18		15:00	255:00		103	84		1		61	
19		15:00	270:00		104	84		1		63	
20		15:00	285:00		105	84		1		63	
21		15:00	300:00		103	84		1		65	
22		15:00	315:00		106	85		1		55	
23		15:00	330:00		106	85		1		58	
24		15:00	345:00		106	86		1		59	
25											
26											
27											
28											
29											
30											
31											
32											
33											
34											
35											
36											
37											
38											
39											
40											

FIELD DATA AND RESULTS TABULATION

PLANT: Vulcan Materials, Maryville, TN

SAMPLING LOCATION: Screen

		D-1-S-M2-1 ----- 6/10/93	D-1-S-M2-2 ----- 6/10/93	
	Test Date			
	Run Start Time	xxxx	xxxx	
	Run Finish Time	xxxx	xxxx	
	Net Traversing Points	6	6	
Cp	Pitot Tube Coefficient	0.84	0.84	
Pbar	Barometric Pressure, Inches Hg	29.09	29.09	Average -----
Pg	Flue Gas Static Pressure, Inches H2O	-0.31	-0.31	-0.310
Ps	Absolute Flue Gas Pressure, Inches Hg	29.07	29.07	29.07
ts	Flue Gas Temperature, Degrees F	70	86	78
Delta-p	Average Velocity Head, Inches H2O	0.0420	0.0567	0.0491 *

* Represents the square of the average square root of the "Delta-p"

FIELD DATA AND RESULTS TABULATION

PLANT: Vulcan Materials, Maryville, TN

SAMPLING LOCATION: Screen

		D-1-S-M201A-1	D-1-S-M201A-2	D-1-S-M201A-3
Test Date		6/10/93	6/10/93	6/10/93
	Run Start Time	810	925	1035
	Run Finish Time	910	1025	1135
	Net Traversing/Sampling Points	6/1	6/1	6/1
Theta	Net Run Time, Minutes	60	60	60
Dia	Nozzle Diameter, Inches	0.341	0.341	0.341
Cp	Pitot Tube Coefficient	0.84	0.84	0.84
Y	Dry Gas Meter Calibration Factor	0.9831	0.9831	0.9831
Pbar	Barometric Pressure, Inches Hg	29.09	29.09	29.09
Delta H	Avg. Pressure Differential of Orifice Meter, Inches H2O	0.6722	0.6722	0.6722
Vm	Volume of Metered Gas Sample, Dry ACF	27.761	28.252	28.353
tm	Dry Gas Meter Temperature, Degrees F	89	103	105
Vmstd	Volume of Metered Gas Sample, Dry SCF*	25.563	25.368	25.369
Vlc	Total Volume of Liquid Collected in Impingers & Silica Gel, mL	14.3	15.2	14.7
Vwstd	Volume of Water Vapor, SCF*	0.673	0.715	0.692
%H2O	Moisture Content, Percent by Volume	2.57 **	2.74 **	2.66 **
%H2OSAT	Moisture Sat. @ Flue Gas Conditions, %	3.33	3.33	3.33
Mfd	Dry Mole Fraction	0.974	0.973	0.973
%CO2	Carbon Dioxide, Percent by Volume, Dry	0	0	0
%O2	Oxygen, Percent by Volume, Dry	20.9	20.9	20.9
Md	Gas Molecular Weight, Lb/Lb-Mole, Dry	28.84	28.84	28.84
Ms	Gas Molecular Weight, Lb/Lb-Mole, Wet	28.56	28.54	28.55
Pg	Flue Gas Static Pressure, Inches H2O	-0.31	-0.31	-0.31
Pb	Absolute Flue Gas Pressure, Inches Hg	29.07	29.07	29.07
<u>Volumetric Air Flow Rate</u>				
ts	Flue Gas Temperature, Degrees F	78	78	78
Delta-p	Average Velocity Head, Inches H2O	0.0491	0.0491	0.0491
vs	Flue Gas Velocity, Feet per Second	12.81	12.81	12.81
A	Stack/Duct Area, Square Inches	113.1	113.1	113.1
Qsd	Volumetric Air Flow Rate, Dry SCFM*	561	560	560
Qmsd	Volumetric Air Flow Rate, Dry SCMM*	16	16	16
Qaw	Volumetric Air Flow Rate, Wet ACFM	604	604	604
ton/hr	Production Rate, tons/hour	170.93	166.14	159.75

* 68 ° F (20 ° C) -- 29.92 Inches of Mercury (Hg).

** Moisture used in calculations.

(Continued Next Page)

FIELD DATA AND RESULTS TABULATION

PLANT: Vulcan Materials, Maryville, TN

SAMPLING LOCATION: Screen

		D-1-S-M201A-1	D-1-S-M201A-2	D-1-S-M201A-3
		-----	-----	-----
<u>Percent Isokinetic</u>				
ts	Flue Gas Temperature, Degrees F	79	83	86
Delta-p	Average Velocity Head, Inches H ₂ O	0.041	0.041	0.041
vs	Flue Gas Velocity, Feet per Second	11.72	11.76	11.79
%I	Isokinetic Sampling Rate, Percent	<u>103.1</u>	<u>102.8</u>	<u>103.0</u>
<u>PM10 Calculations</u>				
ucyc	Stack Gas Viscosity	181.0	180.9	180.9
Qs	PM10 Flow, at Cyclone Conditions, ACFM	0.459	0.456	0.456
D50	Dia. of Particles in Cyclone, Microns	9.90	9.93	9.94
Particulate Catch,				
mg<D50	≤ 10 Microns, Milligrams	17.9	18.6	16.5
mg>D50	> 10 Microns, Milligrams	47.1	223.9	238.2
mg	Total Milligrams	65.0	242.5	254.7
Percent of Total Particulate,				
%<D50	≤ 10 Microns	27.5	7.7	6.5
%>D50	> 10 Microns	72.5	92.3	93.5
Particulate ≤ 10 Microns				
<u>Concentration, milligrams/DSCF*</u>				
mg/DSCF	Concentration in Gas Sample	0.70	0.73	0.65
mg/DSCF,A	Concentration in Ambient Air	0.05002	0.05044	0.05072
mg/DSCF,adj	Adjusted Concentration in Gas Sample	0.65	0.68	0.60
lb/hr	Emission Rate, lb/hr	0.0482	0.0506	0.0445
lb/ton	Emission Rate, lb/ton	<u>0.000282</u>	<u>0.000304</u>	<u>0.000278</u>
M	Screen Size Correction Factor	24	24	24
lb/ton,Tot	Emission Rate, lb/ton, Total	<u>0.00677</u>	0.00731	0.00668

* 68 ° F (20 ° C) -- 29.92 Inches of Mercury (Hg).

AIR FLOW RATE DETERMINATIONS

Plant Name VULCAN MATL - LIMESTONE Run No. DS12011,2,3
City/State MARYVILLE, TENN Date 6/10/93
Test Location SCREEN Personnel TIB
Barometric Pres. (Pbar) 29.09 In. Hg Static Pres. (Pg) -31 In. H₂O
Pitot/Orifice ID 4-42 Pitot Coef. (Cp) .84 Pres. Gauge Set ID ADM-1
Thermocouple ID R234 Duct Length/Diameter _____ Width _____
--Specify inches (") or feet (')--

[illegible]

ORSAT DATA					
Sampling Time	Analysis Time	CO ₂ (A) Reading	O ₂ (B) Reading	%O ₂ (B-A)	%CO+N ₂ (100-B)
Average					
Bag No. _____		Pump _____			

FYRITE DATA, % CO ₂				
--------------------------------	--	--	--	--

MOISTURE DATA (WET BULB/DRY BULB)					
Port	Time	Dry Bulb °F	Wet Bulb °F	Diff.	% H ₂ O

MOISTURE DATA (STOICHIOMETRIC)		
Free Water in Fuel, %		
Water from Fuel Combustion, %		
Ambient Water, %		
Relative Humidity, %		
Ambient Temperature, °F		
Total %		

VOLUMETRIC AIR FLOW RATES	
Dry at Standard Conditions, Q _{sd} =	SCFM
Wet at Stack Conditions, Q _{aw} =	ACFM

ADDITIONAL DATA

* ΔP average is square of average square root. See page 2 for field flow rate calculations.

METHOD 201A (PM-10) FIELD DATA

Plant Name <u>VULCAN MATL - LUMESTONE</u>	Run Number <u>DS12011</u>
City/State <u>MARYVILLE, TENN</u>	Time Start <u>0810</u>
Sampling Location <u>SCREEN</u>	Time Stop <u>0910</u>
Date <u>6/10/93</u>	Job Number <u>50115</u>
Team Leader <u>TJB</u>	Barometric Pressure, In. Hg <u>29.09</u>
Techs <u>DAIS/JB</u>	Static Pressure, In. H ₂ O <u>-31</u>
*Train Leak Check Vacuum, In. Hg <u>10</u>	
Train Leak Rate, Cubic Ft./Min. <u>001</u>	

EQUIPMENT CHECKS				IDENTIFICATION NUMBERS			
☒ Pitot, Pretest	Meterbox	EN-2	Meterbox Gamma	5831	Reagent Box	NA	
☒ Pitot, Posttest	T/C Readout	F-52	T/C Probe	SAMS	Umbilical	0108	
☒ M3 Sampling Sys/Ted Bag	Sampling Box	NA	Orsat Pump	NA	Tedlar Bag	NA	
☒ Thermocouple @ 79 Pre	Nozzle(s) Actually Used:	B3 3/11			Pitot	SAMS	
☒ Thermocouple @ 82 Post	No. CAE	344	Diameter	No.	Diameter		

FILTER NO.	TARE	NOZZLE SELECTION CRITERIA					FYRITE
		Delta H ₀	Delta H _t	Delta H _{t+50}	Delta H _{t-50}	Delta Pavg	
Pu202	2704	1935	6722	5613	8193	0424	
						100	
						70	
Est % H ₂ O	2.0						Cp 84

Sample Point	Dwell Time, Minutes	Elapsed Time, Minutes	Dry Gas Meter Readings Cubic Feet	Pitot Reading, In. H ₂ O (ΔP)	Gas Meter Temp, °F	Stack Temp, °F	Orifice Setting, In. H ₂ O (ΔH)	Vacuum Gauge, In. Hg	Gas Temps	
									Pitot Exit, °F	Cyclone Temp, °F
1	10	0	262.036	.041	75	79	.6722	1.0	0/0	79
2	10	10	266.67	.041	87	77	.6722	1.0	0/0	77
3	10	20	271.27	.041	90	77	.6722	1.0	0/0	77
4	10	30	275.91	.041	92	79	.6722	1.0	0/0	79
5	10	40	280.54	.041	94	79	.6722	1.0	0/0	79
6	10	50	285.23	.041	95	80	.6722	1.0	0/0	80
7		60	289.797							
8										
9										
10										
11										
12										

* REMOVE HEAD BEFORE POSTTEST LEAK CHECK
F-1109 rev. 11-92

60 minutes Vm 27.761 0.041 89 77 0.6722 ΔH

DC 06-10-93

METHOD 201A (PM-10) FIELD DATA

Plant Name WUHAN - MATL - LIMESTONE Run Number DS12012
 City/State MARYVILLE, TENN Time Start 0925
 Sampling Location SCREEN Time Stop 1025
 Date 6/10/93 Team Leader TJB Techs DMS / JR Job Number 50119
 *Train Leak Check Vacuum, In. Hg 10 Barometric Pressure, In. Hg 29.09
 Train Leak Rate, Cubic Ft./Min. .002 Static Pressure, In. H₂O -.31

EQUIPMENT CHECKS
☒ Pitot, Pretest
☒ Pitot, Posttest
☒ M3 Sampling Sys/Ted Bag
☒ Thermocouple @ 82 Pre
☒ Thermocouple @ 85 Post

IDENTIFICATION NUMBERS
 Meterbox EN-2 Meterbox Gamma .7831 Reagent Box NA
 T/C Readout FS2 T/C Probe SAMS Umbilical V.08
 Sampling Box NA Orsat Pump NA Tedlar Bag NA
 Nozzle(s) Actually Used: 13 .341 Pitot SAMS
 No. CAE Diameter .344 No. Diameter

NOZZLE SELECTION CRITERIA
 Desired Dia. .340 Nozzle 1
 Diameter .344 Nozzle 2
 Nozzle Number CAE
 Delta Pmin .0102
 Delta Pmax .0914
 Cp .84

FILTER NO.	TARE	Delta Hg	NOZZLE SELECTION CRITERIA	Desired Dia.	Nozzle	Est % H ₂ O	2.0
1	PM332	.2655	Delta Hg	1.935	Delta Ht	.6722	
2			Delta Ht	.5613	Delta Ht+50	.8193	
3			Delta Ht-50	.0424	Delta Pavg	.160	
4			Meter Temp.	70	Stack Temp.		
5							
6							
7							
8							
9							
10							
11							
12							

* REMOVE HEAD BEFORE POSTTEST LEAK CHECK

60 minutes 28.252 Vm 0.041 103 83 0.6722 NA

DC 06-10-93

METHOD 201A (PM-10) FIELD DATA

Plant Name <u>VULCAN MATL - LIMESTONE</u>	Run Number <u>DS12013</u>
City/State <u>MAXVILLE, TENN</u>	Time Start <u>1035</u>
Sampling Location <u>SCREEN</u>	Time Stop <u>1135</u>
Date <u>6/10/83</u>	Job Number <u>5015</u>
Team Leader <u>MS</u>	Barometric Pressure, In. Hg <u>29.89</u>
Techs <u>MS/AB</u>	Static Pressure, In. H ₂ O <u>-31</u>
*Train Leak Check Vacuum, In. Hg <u>10</u>	
Train Leak Rate, Cubic Ft./Min. <u>1001</u>	

EQUIPMENT CHECKS		IDENTIFICATION NUMBERS	
☒ Pitot, Pretest	Meterbox <u>EN-2</u>	Meterbox Gamma <u>9831</u>	Reagent Box <u>NA</u>
☒ Pitot, Posttest	T/C Readout <u>F52</u>	T/C Probe <u>SAME</u>	Umbilical <u>U108</u>
☒ M3 Sampling Sys/Ted Bag	Sampling Box <u>NA</u>	Orsat Pump <u>NA</u>	Tedlar Bag <u>NA</u>
☒ Thermocouple @ <u>85</u> Pre	Nozzle(s) Actually Used: <u>3417B</u>	No. <u>3447B</u>	Pitot <u>SAME</u>
☒ Thermocouple @ <u>86</u> Post	No. <u>CAE</u>	Diameter <u>3447B</u>	Diameter <u>3447B</u>

FILTER NO.	TARE	NOZZLE SELECTION CRITERIA				FYRITE <u>NA</u>
		Delta Hg	Desired Dia.	Nozzle 1	Nozzle 2	
<u>PM329</u>	<u>2691</u>	<u>1.535</u>	<u>.340</u>	<u>.344</u>	<u>2</u>	
		<u>.6722</u>		<u>CAE</u>		
		<u>.5613</u>		<u>.0102</u>		
		<u>.6193</u>		<u>.0914</u>		
		<u>.0424</u>				
		<u>100</u>				
		<u>70</u>				
Est % H ₂ O	<u>2.0</u>					<u>CP 84</u>

Sample Point	Dwell Time, Minutes	Elapsed Time, Minutes	Dry Gas Meter Readings Cubic Feet	Pitot Reading, In. H ₂ O (ΔP)	Gas Meter Temp, °F	Stack Temp, °F	Orifice Setting, In. H ₂ O (ΔH)	Vacuum Gauge, In. Hg	Gas Temp Filter Box, °F	Impingement Exit, °F	Cyclone Temp, °F
1	10	0	318.749	.041	104	85	.6722	1.0	0/0	42	85
2	10	10	323.47	.041	105	86	.6722	1.0	2/240°	36	86
3	10	20	328.18	.041	105	85	.6722	1.0	2/260°	40	85
4	10	30	332.88	.041	105	86	.6722	1.0	2/260°	42	86
5	10	40	337.57	.041	106	86	.6722	1.0	2/260°	45	86
6	10	50	342.33	.041	106	86	.6722	1.0	2/260°	47	86
7		60	347.102								
8											
9											
10											
11											
12											

* REMOVE HEAD BEFORE
POSTTEST LEAK CHECK
F-1109 rev. 11-92

60 minutes 28.353 Vm 0.041 (ΔP) 105 tm 86 ts 0.012 ΔH

06-10-93

FIELD DATA AND RESULTS TABULATION

PLANT: Vulcan Materials, Maryville, TN

SAMPLING LOCATION: Screen

		W-1-S-M2-1	W-1-S-M2-2	
	Test Date	6/7/93	6/7/93	
	Run Start Time	800	XXXX	
	Run Finish Time	810	XXXX	
	Net Traversing Points	6	6	
Cp	Pitot Tube Coefficient	0.84	0.84	
Pbar	Barometric Pressure, Inches Hg	29.12	29.1	Average
Pg	Flue Gas Static Pressure, Inches H2O	-0.03	-0.03	-0.03
Ps	Absolute Flue Gas Pressure, Inches Hg	29.12	29.12	29.12
ts	Flue Gas Temperature, Degrees F	66	89	78
Delta-p	Average Velocity Head, Inches H2O	0.0455	0.0506	0.0480 *

* Represents the square of the average square root of the "Delta-p"

FIELD DATA AND RESULTS TABULATION

PLANT: Vulcan Materials, Maryville, TN

SAMPLING LOCATION: Screen

		W-1-S-M2-3	W-1-S-M2-4	
	Test Date	6/8/93	6/8/93	
	Run Start Time	xxxx	xxxx	
	Run Finish Time	xxxx	xxxx	
	Net Traversing Points	6	6	
Cp	Pitot Tube Coefficient	0.84	0.84	
Pbar	Barometric Pressure, Inches Hg	29.00	29.00	Average
Pg	Flue Gas Static Pressure, Inches H2O	-0.048	-0.048	-0.048
Ps	Absolute Flue Gas Pressure, Inches Hg	29.00	29.00	29.00
ts	Flue Gas Temperature, Degrees F	70	86	78
Delta-p	Average Velocity Head, Inches H2O	0.0430	0.0530	0.0479 *

* Represents the square of the average square root of the "Delta-p"

FIELD DATA AND RESULTS TABULATION

PLANT: Vulcan Materials, Maryville, TN

SAMPLING LOCATION: Screen

		W-1-S-M2-5 ----- 6/9/93	W-1-S-M2-6 ----- 6/9/93	
	Test Date			
	Run Start Time	xxxx	xxxx	
	Run Finish Time	xxxx	xxxx	
	Net Traversing Points	6	6	
Cp	Pitot Tube Coefficient	0.84	0.84	
Pbar	Barometric Pressure, Inches Hg	29.3	29.3	Average -----
Pg	Flue Gas Static Pressure, Inches H2O	-0.34	-0.34	-0.340
Ps	Absolute Flue Gas Pressure, Inches Hg	29.28	29.28	29.28
ts	Flue Gas Temperature, Degrees F	73	88	81
Delta-p	Average Velocity Head, Inches H2O	0.0510	0.0520	0.0515 *

* Represents the square of the average square root of the "Delta-p"

FIELD DATA AND RESULTS TABULATION

PLANT: Vulcan Materials, Maryville, TN

SAMPLING LOCATION: Screen

		W-1-S-M201A-1	W-1-S-M201A-2	W-1-S-M201A-3
Test Date		6/7/93	6/8/93	6/9/93
	Run Start Time	915	745	815
	Run Finish Time	1525	1352	1420
	Net Traversing/Sampling Points	6/1	6/1	6/1
Theta	Net Run Time, Minutes	360	360	375
Dia	Nozzle Diameter, Inches	0.341	0.341	0.341
Cp	Pitot Tube Coefficient	0.84	0.84	0.84
Y	Dry Gas Meter Calibration Factor	0.9831	0.9831	0.9831
Pbar	Barometric Pressure, Inches Hg	29.12	29.00	29.30
Delta H	Avg. Pressure Differential of Orifice Meter, Inches H ₂ O	0.6782	0.6720	0.6746
Vm	Volume of Metered Gas Sample, Dry ACF	171.558	168.220	175.918
tm	Dry Gas Meter Temperature, Degrees F	102	91	93
Vmstd	Volume of Metered Gas Sample, Dry SCF*	154.482	153.863	161.979
Vlc	Total Volume of Liquid Collected in Impingers & Silica Gel, mL	58.6	88.1	79.3
Vwstd	Volume of Water Vapor, SCF*	3.229	4.147	3.733
%H ₂ O	Moisture Content, Percent by Volume	2.05 **	2.62 **	2.25 **
%H ₂ O SAT	Moisture Sat. @ Flue Gas Conditions, %	3.32	3.33	3.64
Mfd	Dry Mole Fraction	0.980	0.974	0.977
%CO ₂	Carbon Dioxide, Percent by Volume, Dry	0	0	0
%O ₂	Oxygen, Percent by Volume, Dry	20.9	20.9	20.9
Md	Gas Molecular Weight, Lb/Lb-Mole, Dry	28.84	28.84	28.84
Ms	Gas Molecular Weight, Lb/Lb-Mole, Wet	28.61	28.55	28.59
Pg	Flue Gas Static Pressure, Inches H ₂ O	-0.03	-0.048	-0.34
Ps	Absolute Flue Gas Pressure, Inches Hg	29.12	29.00	29.28
<u>Volumetric Air Flow Rate</u>				
ts	Flue Gas Temperature, Degrees F	78	78	81
Delta-p	Average Velocity Head, Inches H ₂ O	0.048	0.0479	0.0515
vs	Flue Gas Velocity, Feet per Second	12.64	12.67	13.10
A	Stack/Duct Area, Square Inches	113.1	113.1	113.1
Qsd	Volumetric Air Flow Rate, Dry SCFM*	557	553	576
Qmsd	Volumetric Air Flow Rate, Dry SCMM*	15.8	15.7	16.3
Qaw	Volumetric Air Flow Rate, Wet ACFM	596	597	617
ton/hr	Production Rate, tons/hour	206.00	167.74	175.73

* 68 ° F (20 ° C) -- 29.92 Inches of Mercury (Hg).

** Moisture used in calculations.

(Continued Next Page)

FIELD DATA AND RESULTS TABULATION

PLANT: Vulcan Materials, Maryville, TN

SAMPLING LOCATION: Screen

		W-1-S-M201A-1	W-1-S-M201A-2	W-1-S-M201A-3
<u>Percent Isokinetic</u>				
ts	Flue Gas Temperature, Degrees F	79	82	84
Delta-p	Average Velocity Head, Inches H ₂ O	0.050	0.040	0.055
vs	Flue Gas Velocity, Feet per Second	12.92	11.62	13.58
%I	Isokinetic Sampling Rate, Percent	93.5	105.1	90.1
<u>PM10 Calculations</u>				
ucyc	Stack Gas Viscosity	181.4	181.0	182.0
Qs	PM10 Flow, at Cyclone Conditions, ACFM	0.459	0.461	0.463
D50	Dia. of Particles in Cyclone, Microns	9.90	9.86	9.86
Particulate Catch,				
mg<D50	≤ 10 Microns, Milligrams	14.0	11.5	11.4
mg>D50	> 10 Microns, Milligrams	77.4	51.4	87.4
mg	Total Milligrams	91.4	62.9	98.8
Percent of Total Particulate,				
%<D50	≤ 10 Microns	15.3	18.3	11.5
%>D50	> 10 Microns	84.7	81.7	88.5
Particulate ≤ 10 Microns				
<u>Concentration, milligrams/DSCF*</u>				
mg/DSCF	Concentration in Gas Sample	0.0906	0.0747	0.0704
mg/DSCF,A	Concentration in Ambient Air	0.02181	0.02047	0.02338
mg/DSCF,adj	Adjusted Concentration in Gas Sample	0.0688	0.0543	0.0470
lb/hr	Emission Rate, lb/hr	0.00507	0.00397	0.00358
lb/ton	Emission Rate, lb/ton	2.46E-05	2.37E-05	2.04E-05
M	Screen Size Correction Factor	24	24	24
lb/ton,Tot	Emission Rate, lb/ton, Total	0.000591	0.000568	0.000489

* 68 ° F (20 ° C) -- 29.92 Inches of Mercury (Hg).

Post
Run →

ORSAT DATA					
Sampling Time	Analysis Time	CO ₂ (A) Reading	O ₂ (B) Reading	%O ₂ (B-A)	%CO+N ₂ (100-B)
Average					
Bag No. _____		Pump _____			

FYRITE DATA, % CO ₂				
--------------------------------	--	--	--	--

MOISTURE DATA (WET BULB/DRY BULB)					
Port	Time	Dry Bulb °F	Wet Bulb °F	Diff.	% H ₂ O

MOISTURE DATA (STOICHIOMETRIC)		
Free Water in Fuel, %		
Water from Fuel Combustion, %		
Ambient Water, %		
Relative Humidity, %		
Ambient Temperature, °F		
Total %		

VOLUMETRIC AIR FLOW RATES	
Dry at Standard Conditions, Q _{sd} =	SCFM
Wet at Stack Conditions, Q _{sw} =	ACFM

HORIZONTAL DUCT FLYASH/DUST BUILDUP >1" DEPTH?

Yes No If yes, see page 2 for instructions

- 1. $\bar{x}$ average is summation of absolute values divided by number of measurements and must be $\leq 20^\circ$.
- 2. ΔP average is square of average square root.

TRAVERSES			
Start-Finish Times:			
Pt. No.	Yaw °	ΔP H_2O	Temp °F
A-1		.051	70
2		.033	70
3		.037	70
4		.052	70
5		.048	70
6		.039	70
AVG →		.043	70
A-1		.052	86
2		.052	86
3		.049	86
4		.065	86
5		.061	86
6		.042	86
AVG →		.053	86
Avg =			

HORIZONTAL DUCT FLYASH/DUST BUILDUP >1" DEPTH?
Yes__ No__ If yes, see page 2 for instructions

ENTROPY

Plant Name VULCAN MATL - LIMESTONE Run No. WS1201-3
 City/State MARYVILLE, TENN Date 6/9/93
 Test Location SCREEN Personnel DWS / JS
 Barometric Pres. (Pbar) 29.3 In. Hg Static Pres. (Pg) -.34 In. H₂O
 Pitot/Orifice ID 4-42 Pitot Coef. (Cp) .84 Pres. Gauge Set ID ADM-1
 Thermocouple ID R234 Duct Length/Diameter _____ Width _____
 --Specify inches (") or feet (')--

VELOCITY TRAVERSES Start-Finish Times:		
Point No.	ΔP In. H ₂ O	Temp. °F
A-1	.056	73
2	.045	73
3	.049	73
4	.061	73
5	.055	73
6	.044	73
AVG.	.051	73
A-1	.047	88
2	.064	88
3	.041	88
4	.062	88
5	.060	88
6	.039	88
AVG.	.052	88
Avg.*		

ORSAT DATA					
Sampling Time	Analysis Time	CO ₂ (A) Reading	O ₂ (B) Reading	%O ₂ (B-A)	%CO+N ₂ (100-B)
Average					
Bag No. _____		Pump _____			

FYRITE DATA, % CO ₂					
--------------------------------	--	--	--	--	--

MOISTURE DATA (WET BULB/DRY BULB)					
Port	Time	Dry Bulb °F	Wet Bulb °F	Diff.	% H ₂ O

MOISTURE DATA (STOICHIOMETRIC)	
Free Water in Fuel, %	
Water from Fuel Combustion, %	
Ambient Water, %	
Relative Humidity, %	
Ambient Temperature, °F	
Total %	

VOLUMETRIC AIR FLOW RATES	
Dry at Standard Conditions, Q _{sd} =	SCFM
Wet at Stack Conditions, Q _{aw} =	ACFM

ADDITIONAL DATA

* ΔP average is square of average square root. See page 2 for field flow rate calculations.

METHOD 201A (PM-10) FIELD DATA

Plant Name	VULCAN	WATL -	LIMESTONE	Run Number	WET-1-SCREEN-201-
City/State	MAVIVUE	TENN		Time Start	0915
Sampling Location	SCREEN			Time Stop	1525
Date	6/1/93	Team Leader	TIB	Techs	DWS
*Train Leak Check Vacuum, In. Hg	10			Job Number	50119
Train Leak Rate, Cubic Ft./Min.	001			Barometric Pressure, In. Hg	29.12
				Static Pressure, In. H ₂ O	-0.03

EQUIPMENT CHECKS		IDENTIFICATION NUMBERS	
✓ Pitot, Pretest		Meterbox	EN-2
✓ Pitot, Posttest		T/C Readout	F-52
NA M3 Sampling Sys/Ted Bag		Sampling Box	NA
✓ Thermocouple @ 66 Pre		Nozzle(s) Actually Used:	344, 341
Thermocouple @ Post		No. CAE	Diameter
		Meterbox Gamma	.9831
		T/C Probe	R129
		Orsat Pump	NA
		Reagent Box	NA
		Umbilical	U108
		Tedlar Bag	NA
		Pitot	4-42
		Diameter	-

NOZZLE SELECTION CRITERIA	
Desired Dia.	.335
Nozzle 1	.344
Nozzle 2	CAE
Diameter	.0902
Nozzle Number	.0916
Delta Pmin	
Delta Pmax	
Est % H ₂ O	1.0
CP	.84

Sample Point	Dwell Time, Minutes	Elapsed Time, Minutes	Dry Gas Meter Readings Cubic Feet	Pitot Reading, In. H ₂ O (ΔP)	Gas Meter Temp, °F	Stack Temp, °F	Orifice Setting, In. H ₂ O (ΔH)	Vacuum Gauge, In. Hg	WIND		Cyclone Temp, °F
									Filter Box, °F/√	Imping Exit, °F	
1	15	0	745.200	.05	77	66	.6782	1.0	0/0	58	66
2	15	15	752.38		84	72			0/0	58	72
3	30	30	759.16		85	73			0/0	58	73
4	45	45	766.13		90	73			0/0	58	73
5	60	60	773.25		93	74			0/0	58	74
6	75	75	780.37		94	74			1/320	58	74
7	90	90	787.58		95	75			0/0	58	75
8	105	105	794.57		98	76			2/210	58	76
9	120	120	801.67		100	77			2/180	58	77
10	135	135	808.73		104	78			0/0	58	78
11	150	150	815.81		105	80			0/0	58	80
12	165	165	822.94		107	80			0/0	58	80

* REMOVE HEAD BEFORE POSTTEST LEAK CHECK

METHOD 201A (PM-10) FIELD DATA (continued)

Plant Name		VULCAN		MATERIAL - LIMESTONES		Run Number		WST M201A-1	
City/State		MAXVILLE		TENN.		Time Start		0915	
Sampling Location		SCREEN				Time Stop		1525	

Sample Point	Dwell Time, Minutes	Elapsed Time, Minutes	Dry Gas Meter Readings Cubic Feet	Pitot Reading, In. H ₂ O (ΔP)	Gas Meter Temp, °F	Stack Temp, °F	Orifice Setting, In. H ₂ O (ΔH)	Vacuum Gauge, In. Hg	WINDS		Cyclone Temp, °F
									Filter Box, °F	Imping Exit, °F	
13	A-3	15	830.12	.05	107	81	.6782	1.0	0/0	59	81
14		195	837.30		108	82			1/240	60	82
15		210	844.25		109	82			0/0	56	82
16		225	851.42		110	83			4/250	52	83
17		240	858.85		111	83			1/240	50	83
18		255	866.14		112	83			5/270	48	84
19		270	873.41		110	84			4/210	48	84
20		285	880.72		110	84			4/210	48	84
21		300	888.02		107	86			0/0	48	86
22		315	895.31		107	86			5/230	48	86
23		330	902.36		107	83			4/230	49	83
24		345	909.61		110	85			0/0	49	85
25		360	916.858								
26											
27											
28											
29											
30											
31											
32											
33											
34											
35											
36											
37											
38											
39											
40											

* REMOVE HEAD BEFORE POSTTEST LEAK CHECK

F-1109 rev. 11-92

minutes 360 Vm 171.558 $\frac{0.05}{(\Delta P)^2}$ 102-77 102-77 6.6982 ΔH

METHOD 201A (PM-10) FIELD DATA

Plant Name <u>VULCAN</u> MATL. <u>— LIMESTONE</u>		Run Number <u>WS1-201A-2</u>	
City/State <u>MARYVILLE, TENN.</u>		Time Start <u>0745</u>	
Sampling Location <u>SCREEN</u>		Time Stop <u>1352</u>	
Date <u>6/8/83</u> Team Leader <u>TJB</u> Techs <u>DALS</u>		Job Number <u>50117</u>	
*Train Leak Check Vacuum, In. Hg <u>10</u>		Barometric Pressure, In. Hg <u>29.0</u>	
Train Leak Rate, Cubic Ft./Min. <u>.001</u>		Static Pressure, In. H ₂ O <u>-.048</u>	

EQUIPMENT CHECKS		IDENTIFICATION NUMBERS	
☒ Pitot, Pretest	Meterbox <u>EM-2</u>	Meterbox Gamma <u>.9831</u>	Reagent Box <u>NA</u>
☒ Pitot, Posttest	T/C Readout <u>F-52</u>	T/C Probe <u># SAMS</u>	Umbilical <u>U108</u>
☒ M3 Sampling Sys/Ted Bag	Sampling Box <u>NA</u>	Orsat Pump <u>NA</u>	Tedlar Bag <u>NA</u>
☒ Thermocouple @ 70 Pre	Nozzle(s) Actually Used: <u>341 113</u>		Pitot <u>SAMS</u>
☒ Thermocouple @ Post	No. <u>CAE</u> Diameter <u>.344</u>	No. <u></u>	Diameter <u></u>

FILT. NO. <u>PM267</u>		NOZZLE SELECTION CRITERIA	
TARE <u>2.720</u>		Desired Dia. <u>.339</u>	
Delta Hg <u>1.935</u>		Nozzle 1 <u>.344</u>	
Delta Ht <u>.6720</u>		Diameter <u>CAE</u>	
Delta Ht+50 <u>.5411</u>		Nozzle Number <u>.0101</u>	
Delta Ht-50 <u>.8193</u>		Delta P min <u>.0913</u>	
Delta Pavg <u>.043</u>		Delta Pmax <u></u>	
Meter Temp. <u>150</u>		Cp <u>.84</u>	
Stack Temp. <u>70</u>			

Sample Point	Dwell Time, Minutes	Elapsed Time, Minutes	Dry Gas Meter Readings Cubic Feet	Pitot Reading, In. H ₂ O (ΔP)	Gas Meter Temp, °F	Stack Temp, °F	Orifice Setting, In. H ₂ O (ΔH)	Vacuum Gauge, In. Hg	WIND		Cyclone Temp, °F
									Dir	Speed	
1	15.0	0	917.373	.04	85	73	.6720	1.0	0/0	50	73
2		15	924.32		90	75			0/0	50	75
3		30	931.26		94	76			2/250	54	76
4		45	938.23		95	76			2/230	55	76
5		60	945.18		98	78			2/250	49	78
6		75	952.29		100	79			2/220	51	79
7		90	959.37		90	80			2/230	51	80
8		105	966.42		89	81			2/220	51	81
9		120	973.43		87	82			2/200	49	82
10		135	980.44		86	83			2/210	49	83
11		150	987.44		84	83			2/200	50	83
12		165	994.45		89	83			0/0	51	83

* REMOVE HEAD BEFORE POSTTEST LEAK CHECK

METHOD 201A (PM-10) FIELD DATA (continued)

Plant Name		VULCAN MANU. — Limestone		Run Number		WS1-201A-2					
City/State		MARTINSBURG, TENN.		Time Start		0745					
Sampling Location		SAGEB		Time Stop		1352					
Sample Point	Dwell Time, Minutes	Elapsed Time, Minutes	Dry Gas Meter Readings Cubic Feet	Pitot Reading, In. H ₂ O (ΔP)	Gas Meter Temp, °F	Stack Temp, °F	Orifice Setting, In. H ₂ O (ΔH)	Vacuum Gauge, In. Hg	Wind Filter Box, °F	Impingement Exit, °F	Cyclone Temp, °F
13	A-6	15.0	1001.45	.04	89	84	.672	1.0	2/270°	56	84
14		195	1008.44		89	85			2/270°	56	85
15		210	1015.44		89	85			2/270°	55	85
16		225	1022.45		90	85			2/270°	57	85
17		240	1029.41		90	85			2/270°	56	85
18		255	1036.48		90	85			4/260°	54	85
19		270	1043.53		90	86			2/280°	55	86
20		285	1050.56		90	85			4/280°	54	85
21		300	1057.55		92	85			3/270°	56	85
22		315	1064.53		92	85			2/260°	50	85
23		330	1071.59		93	85			5/220°	49	85
24		345	1078.47		93	86			4/220°	49	86
25		360	1085.593								
26											
27											
28											
29											
30											
31											
32											
33											
34											
35											
36											
37											
38											
39											
40											

* REMOVE HEAD BEFORE
POSTTEST LEAK CHECK
F-1109 rev. 11-92

360 minutes Vm 168.220 (ΔP)² 0.04 91 tm 82 ts ΔH 0.672

METHOD 201A (PM-10) FIELD DATA

Plant Name <u>VULCAN MATL - LIMESTONE</u>	Run Number <u>W51-201-3</u>
City/State <u>MARYVILLE, TENN</u>	Time Start <u>0815</u>
Sampling Location <u>SCREEN</u>	Time Stop <u>1420</u>
Date <u>6/2/93</u>	Job Number <u>52119</u>
Team Leader <u>TJB</u>	Barometric Pressure, In. Hg <u>29.3</u>
Technician <u>DWS</u>	Static Pressure, In. H ₂ O <u>-34</u>
*Train Leak Check Vacuum, In. Hg <u>10</u>	
Train Leak Rate, Cubic Ft./Min. <u>.001</u>	

EQUIPMENT CHECKS		IDENTIFICATION NUMBERS	
☒ Pitot, Pretest	Meterbox <u>EN-2</u>	Meterbox Gamma <u>983</u>	Reagent Box <u>NA</u>
☒ Pitot, Posttest	T/C Readout <u>F-52</u>	T/C Probe <u>SA-5</u>	Umbilical <u>V108</u>
☒ M3 Sampling Sys/Ted Bag	Sampling Box <u>NA</u>	Orsat Pump <u>NA</u>	Tedlar Bag <u>NA</u>
☒ Thermocouple @ 73 Pre	Nozzle(s) Actually Used: <u>CAE</u>	Orsat Pump <u>NA</u>	Pitot <u>SA-5</u>
☒ Thermocouple @ 86 Post	No. <u>CAE</u> Diameter <u>.328</u>	Orsat Pump <u>NA</u>	Diameter <u>NA</u>

FILTER NO. <u>PM9</u>	Delta Hg <u>1.935</u>	NOZZLE SELECTION CRITERIA		FYRITE <u>NA</u>
	Delta H _t <u>.6744</u>	Desired Dia. <u>.325</u>	Nozzle 1 <u>.328</u>	
	Delta H _{t+50} <u>.5638</u>	Diameter	Nozzle 2 <u>NA</u>	
	Delta H _{t-50} <u>.8215</u>	Nozzle Number		
	Delta P avg <u>.0515</u>	Delta P min		
	Meter Temp. <u>100</u>	Delta P max		
Est % H ₂ O <u>2.0</u>	Stack Temp. <u>73</u>			Cp <u>.84</u>

Sample Point	Dwell Time, Minutes	Elapsed Time, Minutes	Dry Gas Meter Readings Cubic Feet	Pitot Reading, In. H ₂ O (ΔP)	Gas Meter Temp, °F	Stack Temp, °F	Orifice Setting, In. H ₂ O (ΔH)	Vacuum Gauge, In. Hg	Wash Gas Temp, °F	Impingement Exit, °F	Cyclone Temp, °F
1	15.0	0	85.867	.055	85	80	.6744	1.0	0/0	55	80
2		15	92.72		90	79			3/200°	54	79
3		30	97.53		94	80			2/200°	50	80
4		45	106.94		96	80			6/200°	48	80
5		60	114.01		100	82			5/200°	48	82
6		75	121.08		100	82			3/240°	44	82
7		90	128.15		102	83			2/230°	44	83
8		105	135.23		105	84			4/220°	42	84
9		120	142.32		92	82			5/220°	40	82
10		135	149.38		90	84			4/210°	40	84
11		150	156.42		89	84			3/220°	40	84
12		165	163.43		87	84			5/210°	42	84

* REMOVE HEAD BEFORE POSTTEST LEAK CHECK

F-1109 rev. 11-92

METHOD 201A (PM-10) FIELD DATA (continued)

Plant Name	VULCAN NATL. - LIMESTONE	Run Number	W512013
City/State	MAEYVILLE, TENN.	Time Start	0815
Sampling Location	SCREEN	Time Stop	1920

Sample Point	Dwell Time, Minutes	Elapsed Time, Minutes	Dry Gas Meter Readings Cubic Feet	Pitot Reading, In. H ₂ O (ΔP)	Gas Meter Temp, °F	Stack Temp, °F	Orifice Setting, In. H ₂ O (ΔH)	Vacuum Gauge, In. Hg	Gas Temp, Fitter Box, °F	Imping Exit, °F	Cyclone Temp, °F
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											
31											
32											
33											
34											
35											
36											
37											
38											
39											
40											

* REMOVE HEAD BEFORE POSTTEST LEAK CHECK
F-1109 rev. 11-92

375 minutes 175.918 Vm 0.055 (ΔP)² 93 tm 84 ts 0.0196 ΔH

Appendix B.

Example Calculation of PM10 Emission Factors

Variables

Q_{S-A} = Actual gas sampled by M201A train; ACF
 Q_{S-STD} = Gas sampled by M210A train; SCF_{Dry}
 Q_{F-A} = Gas flow rate through hood and fan; ACF/Min
 Q_{F-STD} = Gas flow rate through hood and fan; SCF_{Dry}/Min
 Q_{AMB-A} = Gas flow rate through ambient PM10 monitor; ACF/Min
 $Q_{AMB-STD}$ = Gas flow rate through ambient PM10 monitor; SCF_{Dry}/Min
 T_s = Standard temperature, 528 Degrees °R
 T_T = Meter box gas temperature, $(460^\circ R + x^\circ F)$
 T_{STK} = Stack Temperature, $(460^\circ R + x^\circ F)$
 P_B = Barometric pressure during test, inches Hg.
 P_{BS} = Standard Atmospheric Pressure, 29.92 inches Hg.
 W_F = Total PM10 catch weight in M201A train, mg
 W_{AMB} = Total PM10 catch weight in M201A ambient sampler, mg
 X = Moisture in flue gas, %(volume)

1. Calculation of gas volume (standard) sampled in M201A;

$$Q_{S-STD} = (Q_{S-A})(T_s/T_T)(P_B/P_{BS})((1-X)/1)$$

2. Concentration of PM10 in gas sampled; C_{PM10}

$$C_{PM10} = (W_F/Q_{S-STD})$$

3. Calculation of gas volume(standard) sampled in ambient sampler;

$$Q_{AMB-STD} = (Q_{AMB-A})(0.33FT^2)(T_s/T_{STK})(P_B/P_{BS})(T_{TEST})((1-X)/1)$$

4. Calculation of ambient PM10 concentration

$$C_{PM10AMB} = W_{AMB}/Q_{AMB-STD}$$

5. Calculation of adjusted PM10 concentration in M201A gas sampled

$$C_{PM10AMB}^A = (C_{PM10} - *C_{PM10AMB})$$

6. Calculation of total gas flow rate from deister

$$Q_{F-STD} = (Q_{F-A})(28 \text{ Sample Points})(T_s/T_{STK})(P_B/P_{BS})(60\text{Min}/\text{Hr})(1-X)/1$$

7. Calculation of total PM10 emissions

$$E_{PM10} = (C_{PM10AMB}^A)(Q_{F-STD})(\text{Grams}/1000)(\text{Pounds}/454\text{Grams})$$

8. Calculation of Deister processing rate

$$P_D = \text{Deister Rate} = (P/2)$$

9. Calculation of PM10 Emission factors

$$E_f = (E_{PM10}/P_D)$$

Appendix C.

SAMPLING EQUIPMENT AUDIT

Plant Name Vulcan Materials Job No. 50119
 City/State Maryville, Tenn. Team Leader JRW
 Test Location Crusher

BAROMETER
 Barometer (Van) No. _____ Checked OK? (✓) _____ Shop Auditor _____
 Entropy In-House Ref. Barometer _____ "Hg vs Van Barometer _____ "Hg
 Date Compared _____ Dev. _____ "Hg (Max. Allowable Dev.: ± 0.1 "Hg)
 Test Loc. Elevation _____ Ft. Date _____ Field Auditor _____
 Above Ground (Van) _____
 Field Barometric Pressure Reduced for Test Location Elevation by _____ "Hg

Ref. Therm. Initial Ambient Temp., °F 70 Allowable Deviation From Ambient _____ Date 6/7/93 Auditor JRW ✓ OK
 Ambient Temperature, °F _____
THERMOMETERS
 Dry Gas Meter ± 5.4 °F 71 (Meterbox I.D. NU-7) ✓
 Impinger Exit ± 2.0 °F 70 ✓
 Filter Box ± 5.4 °F N.A.

THERMOCOUPLES ✓ top Ret. Temp 78 ✓

TC No. / °F	OK	TC No. / °F	OK	TC No. / °F	OK	TC No. / °F	OK	TC No. / °F	OK
<u>R284 / 72</u>	✓	<u>R218 / 78</u>	✓	<u>1</u>	✓	<u>1</u>	✓	<u>1</u>	✓
(Including Temp. Change and Direction)		(Including Temp. Change and Direction)		(Including Temp. Change and Direction)		(Including Temp. Change and Direction)		(Including Temp. Change and Direction)	
Auditor <u>JRW</u>		Auditor <u>JRW</u>		Auditor _____		Auditor _____		Auditor _____	

Allowable Deviation from Ambient: ± 8.0°F * (or ± 2.0°F) **
 * ± 8.0 °F = ± 1.5% of ambient absolute temperature.
 ** (± 2.0 °F if used in saturated or water droplet-laden gas stream.)

ISOKINETIC METERBOX I.D. NU-7 Gamma (Y) 0.9850 ΔH_e 1.728
 As Applicable (check): Zero Magnehelics? ☒ Zero/Level Manometer? ☐
 Barometric Pressure (P_{bar}) 29.12 Auditor JRW Date 6/7/93

Dry Gas Meter Reading (Cubic Ft.)	Meter Temperature (°F)	Lower and Upper Limits for Audit Gamma
Final <u>810.057</u>	Final <u>87</u>	0.96 * Y = <u>0.9456</u>
Initial <u>802.402</u>	Initial <u>79</u>	1.04 * Y = <u>1.0244</u>
Dry Gas Volume Metered (Cubic Ft.)	Average Meter Temp. (°F)	Run Time (Base = 10)
V _m = <u>7.657</u>	T _m = <u>83</u>	(Minutes) <u>10</u> (Seconds) <u>0</u>

$$Y_c = \frac{[10 + (0 / 60)]}{7.657} * \left[\frac{0.0319 (\frac{83}{29.12} + 460)}{29.12} \right]^{.5} = \frac{1.0073}{\text{Audit Gamma}}$$

Audit Gamma Acceptable (between lower & upper limits)? (✓) Yes ☒ No ☐
 Ideal Sampling Rate = 0.75

Positive Pressure Leak Check OK? Yes N.A. No N.A.

SAMPLING EQUIPMENT AUDIT

Plant Name VULCAN MATL. Job No. 50119
 City/State MARYVILLE TENN. Auditor(s) DWS
 Test Loc. SCREEN Date 6/7/93

BAROMETER
 Entropy In-House Ref. Barometer _____ "Hg vs Field Barometer _____ "Hg
 Date Compared _____ Dev. _____ "Hg (Max. Allowable Dev.: ± 0.1 "Hg)
 Field Barometric Pressure Corrected for Test Location Elevation? (v) _____
 (Note: deduct 0.1" Hg from local NWS STATION pressure for each 100' of test location elevation; example: $29.6 - (300'/100 * 0.1) = 29.3$ "Hg.)

Ref. Therm. Initial Ambient Temp., °F <u>66</u>	Allowable Deviation From Ambient	Ambient Temperature, °F	Audit OK (v)
THERMOMETERS *			
Dry Gas Meter	± 5.4 °F	(Meterbox No. _____)	_____
Impinger Exit	± 2.0 °F	_____	_____
Filter Box	± 5.4 °F	_____	_____

* Adjust thermometer until acceptable. If it cannot be adjusted, use as back-up. If no backup, record ambient temperature indicated by unadjusted thermometer and label with correction factor (indicate):

THERMOCOUPLES Allowable Deviation from Ambient: ± 8.0 °F* (± 2.0 °F)**

TC No. / °F <u>✓</u>	TC No. / °F <u>✓</u>	TC No. / °F <u>✓</u>	TC No. / °F <u>✓</u>	TC No. / °F <u>✓</u>
_____ / _____	_____ / _____	_____ / _____	_____ / _____	_____ / _____

* ± 8.0 °F = $\pm 1.5\%$ of ambient absolute temperature.
 ** (± 2.0 °F if used in saturated or water droplet-laden gas stream.)

ISOKINETIC METERBOX I.D. EN-2 Gamma (Y) .9831 ΔH_0 1.935
 As Applicable (check): Zero Magnehelics? _____ Zero/Level Manometer? ✓
 Barometric Pressure (P_{bar}) 29.12 Auditor DWS Date 6/7/93

Dry Gas Meter Reading (Cubic Ft.)	Meter Temperature (°F)	Lower and Upper Limits for Audit Gamma
Final <u>745.200</u>	Final <u>75</u>	$0.96 * Y =$ <u>.9438</u>
Initial <u>737.374</u>	Initial <u>66</u>	$1.04 * Y =$ <u>1.0224</u>

Dry Gas Volume Metered (Cubic Ft.)	Average Meter Temp. (°F)	Run Time (Base = 10)	
		(Minutes)	(Seconds)
V _m = <u>7.83</u>	T _m = <u>71</u>	<u>10</u>	<u>0</u>

0.75 = Ideal Sampling Rate

$$Y_c = \frac{[\text{Min.} + (\text{Sec.} / 60)]}{V_m} * \left[\frac{\{[(29.92) / (460 + 68) * (0.75)^2] * (T_m + 460)\}}{P_{bar}} \right]^{.5}$$

$$Y_c = \frac{[\text{10} + (\text{0} / 60)]}{7.83} * \left[\frac{0.0319 (\text{71} + 460)}{29.12} \right]^{.5} = \underline{.9741}$$

Audit Gamma

Audit Gamma Acceptable (between lower & upper limits)? (v) ✓ Yes No

Appendix D.

RECORD OF CUSTODY, CONTAINER NO. _____

Client EPA

Job No. 50119

Plant Name Vulcan, Materials

City/State Maryville, TENN

Sampling Method(s) 201A (EPA, NIOSH, etc.)

Container Type (V) Reagent Box ☒ Cooler ☐ Other (specify) _____

Seal ID	Date	Time	*	Full Signature	Reason for Breaking Seal**
1694	6/10	12:49	S	Todd J. Bruggell	
			B		
			S		
			B		
			S		
			B		
			S		
			B		
			S		
			B		
			S		
			B		
			S		
			B		
			S		
			B		

* S = Sealed By; B = Broken By

** Use "REMARKS" Section if more space needed.

Received by Sample Custodian**

Signature _____

Date _____

Time _____

**Seal Intact?

Yes ☒ No ☐

As Applicable:

All liquid levels at mark (check)? YES ☐ NO ☐ (Estimate loss if not at mark; describe in "REMARKS")

As Applicable:

TUBE SAMPLES put in freezer by _____ Date _____ Time _____

CONDENSATE SAMPLES put in refrige. by _____ Date _____ Time _____

REMARKS _____

FIELD SAMPLE RECOVERY QUALITY CONTROL

Box No. 0209 Assembly Date 6/1/93 Assembled By 1211

Client Vulcan Materials Job No. 5019

Plant Vulcan Materials Maryville City/State Maryville, TENN

Sampling Loc. CRUSHER Method 201A

Individual Tare Of Reagent 200 (Ml)(gm) Of DT

Individual Tare Of Reagent _____ (Ml)(gm) Of _____

Individual Tare Of Reagent _____ (Ml)(gm) Of _____

Individual Tare Of Sil. Gel 200 Gm _____ other (specify) _____

Run Number	Run Date	Filter or XAD Number	Tare, grams	Liquid Tare at Mark? @	Init.	Sample Recov. Date	%Sil. Gel Spent	Liquid Level Marked?	Init.
DRY-1-CRUSHER-M201A	6/10	PM334	2715	✓	TTB	6/10	10	✓	TTB

Filter Appearance*

brev

Reagents Appearance*

clear

2	6/10	PM333	2684	✓	TTB	6/10	10	✓	TTB
---	------	-------	------	---	-----	------	----	---	-----

Filter Appearance*

11

Reagents Appearance*

11

3	6/10	PM331	2711	✓	TTB	6/10	10	✓	TTB
---	------	-------	------	---	-----	------	----	---	-----

Filter Appearance*

h

Reagents Appearance*

11

--	--	--	--	--	--	--	--	--	--

Filter Appearance*

Reagents Appearance*

* Use "REMARKS" section if needed.

@ All liquid levels at mark? (check) YES _____ NO _____ (estimate loss if not at mark; use "REMARKS" section).

REMARKS _____

RECORD OF CUSTODY, CONTAINER NO. _____

Client EPA Job No. 5019
 Plant Name Vulcan Materials
 City/State Maryville, TENN.
 Sampling Method(s) M201A (EPA, NIOSH, etc.)
 Container Type (V) Reagent Box R Cooler Other (specify)

Seal ID	Date	Time	*	Full Signature	Reason for Breaking Seal**
	N	7	A	S	
			B		
1036	6/10	12:44	S	Todd T. Bugell	
			B		
			S		
			B		
			S		
			B		
			S		
			B		
			S		
			B		
			S		
			B		

* S = Sealed By; B = Broken By

** Use "REMARKS" Section if more space needed.

Received by Sample Custodian**

[Signature]
Signature

6-22-93
Date

1212
Time

**Seal Intact?

Yes (X) No

As Applicable:

All liquid levels at mark (check)? YES NO (Estimate loss if not at mark; describe in "REMARKS")

As Applicable:

TUBE SAMPLES put in freezer by Date Time

CONDENSATE SAMPLES put in refrige. by Date Time

REMARKS

FIELD SAMPLE RECOVERY QUALITY CONTROL

Box No. 0207 Assembly Date 6/1/93 Assembled By 12 12
 Client EPA Job No. 5019
 Plant Vulcan Materials City/State Marvill, Tenn
 Sampling Loc. SCREEN DRY Method M204
 Individual Tare Of Reagent 200 (Ml) (gm) Of DI
 Individual Tare Of Reagent _____ (Ml) (gm) Of _____
 Individual Tare Of Reagent _____ (Ml) (gm) Of _____
 Individual Tare Of Sil. Gel 200 Gm _____ other (specify) _____

Run Number	Run Date	Filter or XAD		Liquid Tare at Mark? @	Init.	Sample Recov. Date	%Sil. Gel Spent	Liquid Level Marked?	Init.
		Number	Tare, grams						
DRY-1-SCREEN-M204-1	6/10	PM202	2704	✓	TB	6/10	10	✓	TB
				Filter Appearance* <u>Grey</u>					
				Reagents Appearance* <u>Clear</u>					
2	6/10	PM332	2655	✓	TB	6/10	10	✓	TB
				Filter Appearance* <u>"</u>					
				Reagents Appearance* <u>"</u>					
3	6/10	PM329	2691	✓	TB	6/10	10	✓	TB
				Filter Appearance* <u>"</u>					
				Reagents Appearance* <u>"</u>					
				Filter Appearance* _____					
				Reagents Appearance* _____					

* Use "REMARKS" section if needed.

@ All liquid levels at mark? (check) YES _____ NO _____ (estimate loss if not at mark; use "REMARKS" section).

REMARKS _____

RECORD OF CUSTODY, CONTAINER NO. 50119

Client Vulcan Materials

Job No. 50119

Plant Name Marville

City/State Marville, Tenn

Sampling Method(s) M201A (EPA, NIOSH, etc.)

Container Type (V) Reagent Box P Cooler Other (specify)

Seal ID	Date	Time	*	Full Signature	Reason for Breaking Seal**
<u>415</u>	<u>6/1/93</u>	<u>10:30</u>	<u>S</u>	<u>Mary Mallon</u>	
	<u>6/7/93</u>	<u>06:45</u>	<u>B</u>	<u>Ch. Traino</u>	<u>Todd J. Bezell</u>
<u>682</u>	<u>6/9/93</u>	<u>14:32</u>	<u>S</u>	<u>Todd Bezell</u>	
			<u>B</u>		
			<u>S</u>		
			<u>B</u>		
			<u>S</u>		
			<u>B</u>		
			<u>S</u>		
			<u>B</u>		
			<u>S</u>		
			<u>B</u>		
			<u>S</u>		
			<u>B</u>		
			<u>S</u>		
			<u>B</u>		

* S = Sealed By; B = Broken By ** Use "REMARKS" Section if more space needed.

Received by Sample Custodian**

[Signature]
Signature

6-7-93
Date

1709
Time

**Seal Intact?

Yes No

As Applicable:

All liquid levels at mark (check)? YES NO (Estimate loss if not at mark; describe in "REMARKS")

As Applicable:

TUBE SAMPLES put in freezer by Date Time

CONDENSATE SAMPLES put in refrige. by Date Time

REMARKS

FIELD SAMPLE RECOVERY QUALITY CONTROL

Box No. 0567 Assembly Date 6/1/93 Assembled By 122 122
 Client Vulcan Materials Job No. 50119
 Plant Maryville City/State Maryville, Tenn
 Sampling Loc. Crusher (WET) Method 201A
 Individual Tare Of Reagent 200 (Ml) (gm) Of 200
 Individual Tare Of Reagent _____ (Ml) (gm) Of _____
 Individual Tare Of Reagent _____ (Ml) (gm) Of _____
 Individual Tare Of Sil. Gel 200 Gm _____
 other (specify) _____

Run Number	Run Date	Filter or XAD		Liquid Tare at Mark? @	Init.	Sample Recov. Date	%Sil. Gel Spent	Liquid Level Marked?	Init.
		Number	Tare, grams						
1	6/7	PM148	.2710	✓	TIB	6/7	50	✓	TIB
				Filter Appearance*					
				<u>Lgt Gray</u>					
				Reagents Appearance*					
				<u>Clear</u>					
2	6/8	PM8	.2184	✓	TIB	6/8	60	✓	TIB
				Filter Appearance*					
				"					
				Reagents Appearance*					
				"					
3	6/9	PM205	.2728	✓	TIB	6/9	70	✓	TIB
				Filter Appearance*					
				"					
				Reagents Appearance*					
				"					
				Filter Appearance*					
				Reagents Appearance*					

* Use "REMARKS" section if needed.

@ All liquid levels at mark? (check) YES _____ NO _____ (estimate loss if not at mark; use "REMARKS" section).

REMARKS _____

RECORD OF CUSTODY, CONTAINER NO. 501A

Client Vulcan Materials Job No. 501A
 Plant Name Maryville
 City/State Maryville, TENN
 Sampling Method(s) 201A (EPA, NIOSH, etc.)
 Container Type (V) Reagent Box R Cooler Other (specify)

Seal ID	Date	Time	*	Full Signature	Reason for Breaking Seal**
N/A			S		
	6/7	0900	B	Todd Broyell	chg/Trans
1695	6/9	1456	S	Todd Broyell	
			B		
			S		
			B		
			S		
			B		
			S		
			B		
			S		
			B		
			S		
			B		

* S = Sealed By; B = Broken By ** Use "REMARKS" Section if more space needed.

Received by Sample Custodian**

[Signature]
Signature

6-22-93
Date

1210
Time

**Seal Intact?

Yes No

As Applicable:

All liquid levels at mark (check)? YES NO (Estimate loss if not at mark; describe in "REMARKS")

As Applicable:

TUBE SAMPLES put in freezer by Date Time

CONDENSATE SAMPLES put in refrige. by Date Time

REMARKS

FIELD SAMPLE RECOVERY QUALITY CONTROL

Box No. C238 Assembly Date 6/1/93 Assembled By 12-12
 Client Vulcan Materials Job No. 5019
 Plant Maryville City/State Maryville, Tenn
 Sampling Loc. Screen (WET) Method ZD1A
 Individual Tare Of Reagent 200 (Ml)(gm) Of DT
 Individual Tare Of Reagent _____ (Ml)(gm) Of _____
 Individual Tare Of Reagent _____ (Ml)(gm) Of _____
 Individual Tare Of Sil. Gel 200 Gm _____
 other (specify) _____

Run Number	Run Date	Filter or XAD Number	Tare, grams	Liquid Tare at Mark? @	Init.	Sample Recov. Date	%Sil. Gel Spent	Liquid Level Marked?	Init.
WET 1-SCREEN-MARYVILLE	6/7	PM292	2763	✓	TIB	6/7	65	✓	TIB
				Filter Appearance*					
				<u>Light Gray</u>					
				Reagents Appearance*					
				<u>Clear</u>					
2	6/8	PM267	2720	✓	TIB	6/8	50	✓	TIB
				Filter Appearance*					
				"					
				Reagents Appearance*					
				"					
3		PM9	2199	✓	TIB	6/9	50	✓	TIB
				Filter Appearance*					
				"					
				Reagents Appearance*					
				"					
Filter Appearance* Reagents Appearance*									

* Use "REMARKS" section if needed.

@ All liquid levels at mark? (check) YES ___ NO ___ (estimate loss if not at mark; use "REMARKS" section).

REMARKS _____

SAMPLING LOG

RECORD OF CUSTODY	Present / Absent / Complete / Incomp.	Job No. 50119	Date 6-22-93	BOOK 5
INVENTORY SHEETS	Present / Absent / Complete / Incomp.	Plant Limestone Crushing		PAGE 147
FIELD SAMPLE RECOV QC	Present / Absent / Complete / Incomp.	City/State Maryville, TN		
OTHER/REMARKS		Proj Mgr Htb	Field Supvr	Page 1

Ice Present? Yes / No (N/A) Remarks							Page		Of	
Cont. No.	Run No. or Sample I.D.	Matrix or Component	Type of Container	Received at EEI Date	Me-thod	Total Conts.	No. of Boxes	No. of Coolers		
	Wet-1-Screen-201A-1	di H ₂ O	750 glass		Cont No. _____					
		Nozzle Rgr	500		Seal No. _____					
		Flt acolor	500							
		filter	250							
	-2	same			Cont No. _____					
	-3				Seal No. _____					
	Wet-1-Crush-201A-1				Cont No. _____					
	-2				Seal No. _____					
	-3									
	Dry-1-Screen-201A-1				Cont No. _____					
	-2				Seal No. _____					
	-3									
	Dry-1-Crush-201A-1				Cont No. _____					
	-2				Seal No. _____					
	-3									
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					
					Cont No. _____					
					Seal No. _____					

SAMPLE PACKING LOG

RECORD OF CUSTODY Present / Absent / Complete / Incomp.
 INVENTORY SHEETS Present / Absent / Complete / Incomp.
 FIELD SAMPLE RECOV QC Present / Absent / Complete / Incomp.
 OTHER/REMARKS

Job No. 5019 Date 6-22-93 BOOK 5
 Plant Limestone Crushing Plant PAGE 145
 City/State Maryville, TN
 Proj Mgr ttb Field Supvr 1

Ice Present? Yes / No (N/A) Remarks samps hand delivered by ttb

Cont. No.	Run No. or Sample I.D.	Matrix or Component	Type of Container	Received at EEI Date	Me-thod	hivol	Total Conts.	No. of Boxes	No. of Coolers
	1-AMB-WET-1	hivol filler	#5955500	6-22	Cont No.				
	-2		499		Seal No.				
	-3		498		Cont No.				
	1-AMB-DRY-1		497		Seal No.				
	2-AMB-DRY-1		494		Cont No.				
	2-AMB-WET-1		496		Seal No.				
	-2		495		Cont No.				
					Seal No.				
					Cont No.				
					Seal No.				
					Cont No.				
					Seal No.				
					Cont No.				
					Seal No.				
					Cont No.				
					Seal No.				
					Cont No.				
					Seal No.				
					Cont No.				
					Seal No.				
					Cont No.				
					Seal No.				
					Cont No.				
					Seal No.				

Remarks (cont) (comp)

Appendix E.

MOISTURE ANALYTICAL RESULTS

Plant Name Vukan materials Job No. 5019
 City/State Maryville, TENN Sampling Loc. Crusher, Dry

Run Number

DRY-CRUSHER-MZDA-1

2

3

Sampling Date

6/10/93

"

"

Analysis Date

6/10/93

"

"

Analyst

TJB

"

"

<u>Reagent 1 (200mls)</u>			
Final Weight, g	<u>563.7</u>	<u>571.4</u>	<u>582.4</u> <i>JK</i>
Tared Weight, g	<u>552.8</u>	<u>559.0</u>	<u>586.6</u>
Water Catch, g	<u>10.9</u>	<u>12.4</u>	<u>-4.2</u>
<u>Reagent 2 ()</u>			
Final Weight, g			
Tared Weight, g			
Water Catch, g			
<u>Reagent 3 ()</u>			
Final Weight, g			
Tared Weight, g			
Water Catch, g			
<u>CONDENSED WATER, g</u>			
<u>Silica Gel</u>			
Final Weight, g	<u>187.41927</u>	<u>211.9</u>	<u>222.2</u>
Tared Weight, g	<u>187.4</u>	<u>206.9</u>	<u>217.5</u>
<u>ADSORBED WATER, g</u>	<u>5.3</u>	<u>5.0</u>	<u>4.7</u>
<u>TOTAL WATER COLLECTED, g</u>	<u>16.2</u>	<u>17.4</u>	<u>-0.5</u> <i>4.7</i>

Balance No. 43 Type (J) Triple Beam ☒ Electronic ☐ Reagent Box No. 0209

Balance located in stable, draft-free area (J)? Yes ☒ No ☐ (If "No", explain below.)

Comments _____

Plant Name Vulcan Materials Job No. 50119
City/State Marvillie, Tenn Sampling Loc. Crusher - WET

Job No. 5011a

Sampling Loc. Crusher - WET

WET-1-CRUSHER-MT20A

2

3

10-7-93

6/8/93

6/9/93

10-7-93

6/8/93

6/9/93

1RLW

JB

Balance No. 43 Type (☒) Triple Beam ☒ Electronic _____ Reagent Box No. 0567

Balance located in stable, draft-free area (☒)? Yes _____ No _____ (If "No", explain below.)

Comments _____

MOISTURE ANALYTICAL RESULTS

Plant Name Vulcan Materials Job No. 50119
 City/State Maryville, Tenn Sampling Loc. SCREEN - DRY

Run Number

DRY-1-SCREEN-M201A-

2

3

Sampling Date

Analysis Date

Analyst

<u>Reagent 1 (200mLS)</u>			
Final Weight, g	<u>596.0</u>	<u>592.3</u>	<u>584.6</u>
Tared Weight, g	<u>586.8</u>	<u>584.1</u>	<u>574.2</u>
Water Catch, g	<u>9.2</u>	<u>8.2</u>	<u>10.4</u>
<u>Reagent 2 ()</u>			
Final Weight, g			
Tared Weight, g			
Water Catch, g			
<u>Reagent 3 ()</u>			
Final Weight, g			
Tared Weight, g			
Water Catch, g			
<u>CONDENSED WATER, g</u>			
<u>Silica Gel</u>			
Final Weight, g	<u>190.3</u>	<u>205.7</u>	<u>208.7</u>
Tared Weight, g	<u>185.2</u>	<u>198.7</u>	<u>204.4</u>
<u>ADSORBED WATER, g</u>	<u>5.1</u>	<u>7.0</u>	<u>4.3</u>
<u>TOTAL WATER COLLECTED, g</u>	<u>14.3</u>	<u>15.2</u>	<u>14.7</u>

Balance No. 43 Type ☒ Triple Beam ☐ Electronic Reagent Box No. 0207

Balance located in stable, draft-free area ☒ Yes ☐ No (If "No", explain below.)

Comments

MOISTURE ANALYTICAL RESULTS

 Plant Name Vukan Materials

 Job No. 50119

 City/State Maryville, Tenn

 Sampling Loc. SCREEN - WET

Run Number

WET-1-Screen-MZAH
2
3

Sampling Date

6-7-93
6/8/93
6/9/93

Analysis Date

6-7-93
6/8/93
6/9/93

Analyst

JB
JRW
TJB

<u>Reagent 1 (200mls)</u>			
Final Weight, g	<u>634.2</u>	<u>644.9</u>	<u>637.4</u>
Tared Weight, g	<u>583.4</u>	<u>580.6</u>	<u>583.4</u>
Water Catch, g	<u>50.8</u>	<u>64.3</u>	<u>54.0</u>
<u>Reagent 2 ()</u>			
Final Weight, g			
Tared Weight, g			
Water Catch, g			
<u>Reagent 3 ()</u>			
Final Weight, g			
Tared Weight, g			
Water Catch, g			
<u>CONDENSED WATER, g</u>			
<u>Silica Gel</u>			
Final Weight, g	<u>226.1</u>	<u>214.1</u>	<u>233.3</u>
Tared Weight, g	<u>208.3</u>	<u>190.3</u>	<u>208.0</u>
<u>ADSORBED WATER, g</u>	<u>17.8</u>	<u>23.8</u>	<u>25.3</u>
<u>TOTAL WATER COLLECTED, g</u>	<u>68.6</u>	<u>88.1</u>	<u>79.3</u>

 Balance No. 43 Type ☒ Triple Beam ☒ Electronic

 Reagent Box No. 0238

 Balance located in stable, draft-free area ☒ Yes ☐ No (If "No", explain below.)

Comments