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1.0 GENERAL

On April 7, 1987, Environmental Technology & Engineering Corporation personnel performed a stack emission test on a sand rescreening system at the Badger Mining Corporation St. Marie plant. The purpose of the test was to determine the compliance status of the emissions with the limit of 0.02 grains of particulate matter per dry standard cubic foot (gr/dscf) of exhaust gas. The opacity was also to be determined relative to the limit of 7 %. The limits were established by the State of Wisconsin Department of Natural Resources (DNR) in air pollution control permit number 85-LMW-412.

The sand rescreening system was processing approximately 20 tons of sand per hour throughout the test period. The particulate emissions were controlled by a venturi scrubber designed by Badger Mining. The process and scrubber operation were monitored by Tom Kramer of Badger Mining throughout the test period. The field tests, opacity observations, and corresponding laboratory analysis were performed by Lowell Huenink, Bill Dick and Mike Huenink. The test procedures, process and scrubber operation, and stack opacity were witnessed by Lynda Wiese of the DNR Southern District Office in Fitchburg.

The following sections of this report document the activities and results of the test program. The report presents all of the relevant data collected and discussions on the interpretation of the data are provided where appropriate. The report, therefore, includes much necessary detail. The results, however, have been summarized in the SUMMARY section at the beginning of this report for those readers not wishing to be burdened by the details.

2.0 RESULTS

2.1 Particulate Emissions

Isokinetic sampling for particulate matter was performed in accordance with the procedures outlined in EPA Method 17 - "Determination of Particulate Emissions from Stationary Sources (In-Stack Filtration Method)" - as published in the Federal Register. A brief summary of this method is included in section 3.0 of this report. The tests were performed in the final discharge stack at the location shown in Figure 2-1. The location of the test ports relative to flow disturbances and the location of the exact test points relative to the stack wall are also shown in Figure 2-1. The stack flow parameters recorded during testing and the weights of particulate collected were used to compute the emissions for each test of the three-test sequence. These data were then entered into a computer and printouts showing the detailed results are included as Tables 2-1, 2-2, and 2-3.

The emissions were found to be well below the limit of 0.02 grains of particulate matter per dry standard cubic foot (gr/dscf) of exhaust gas as specified by the State of Wisconsin Department of Natural Resources in air pollution control permit number 85-LMW-412. The numerical test results follow:

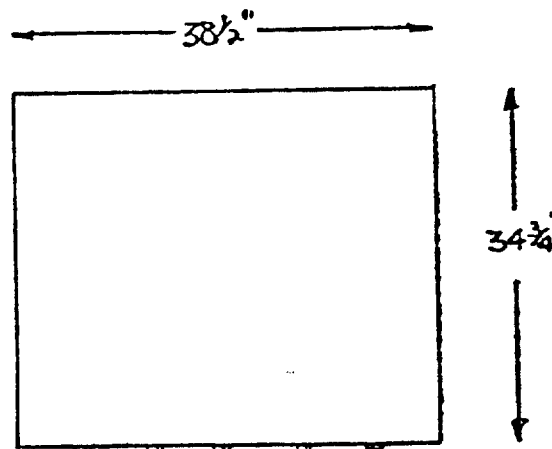
Test	Emissions	% of Allowable
1	0.0012	6.0
2	0.0009	4.5
3	0.0009	4.5
AVG	0.0010 gr/dscf	5.0

2.2 Opacity Observations

The opacity of the stack was observed by a certified smoke reader for three one-hour periods which coincided with the particulate emission tests. All individual measurements were well below the limit of 7 %. The opacity was observed at 0 % throughout test #1; 3 of the 240 observations in test #2 were 5 % and the remaining 237 were 0 %; and 2 of the 240 observations were 5 % in test #3 while the remaining 238 were 0 %. Copies of the field observation sheets are included in APPENDIX B.

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COMMENTS

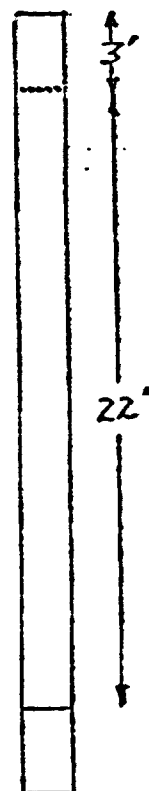


TEST SECTION

SAMPLING LOCATION

POINT	DISTANCE FROM STACK WALL
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1	4.3 "
2	13.0
3	21.7
4	30.4



BADGER MINING TEST 1 4-7-87 TABLE 2-1

BAROMETRIC PRESSURE, in Hg = 29.400
 TIP DIAMETER, in .3040
 STACK AREA, sq ft = 9.291
 SAMPLING TIME PER POINT, min = 3.50
 NUMBER OF POINTS = 20
 GAS METER VOLUME, acf = 74.25
 WATER COLLECTED, ml = 21.00
 PARTICULATE COLLECTED, grams = 0.0058
 CO₂ = 0.00 O₂ = 20.70 CO = 0.00 N₂ = 79.30

SAMPLING POINT	STACK TEMP deg F	PITOT DEL P inches	ORIFICE METER inches	GAS METER OUTLET T deg F	GAS VELOCITY fps
1	56	0.430	4.40	50	37.18
2	56	0.400	4.10	50	35.86
3	56	0.400	4.10	50	35.86
4	56	0.360	3.70	52	34.02
5	58	0.370	3.80	54	34.56
6	58	0.440	4.50	57	37.68
7	58	0.480	4.90	60	39.36
8	58	0.480	4.90	62	39.36
9	58	0.500	5.00	65	40.17
10	58	0.460	4.70	70	38.53
11	58	0.410	4.20	72	36.37
12	58	0.340	3.50	74	33.12
13	59	0.300	3.10	78	31.15
14	59	0.320	3.30	80	32.17
15	59	0.380	3.90	82	35.05
16	59	0.400	4.10	84	35.96
17	59	0.320	3.30	87	32.17
18	59	0.370	3.80	90	34.59
19	59	0.310	3.20	92	31.66
20	59	0.240	2.50	94	27.86
AVG VALUES	58		3.950	70	35.13

TOTAL GAS WITHDRAWN, scf = 75.85
 DRY GAS WITHDRAWN, scf = 74.86
 WATER VAPOR WITHDRAWN, scf = 0.99
 PERCENT WATER VAPOR = 1.30
 ACTUAL WET FLOW RATE, acfm = 19,585.46
 STANDARD DRY FLOW RATE, scfm = 19,351.27
 PARTICULATE CONCENTRATION, grains/scf = 0.0012
 PARTICULATE EMISSION RATE, lb/hr = 0.20
 PARTICULATE EMISSIONS, lb/1000 lb = 0.002
 PERCENT OF ISOKINETIC SAMPLING = 101.88

BADGER MINING TEST 2 4-7-87 TABLE 2-2

BAROMETRIC PRESSURE, in Hg = 29.400
 TIP DIAMETER, in .3040
 STACK AREA, sq ft = 9.291
 SAMPLING TIME PER POINT, min = 3.00
 NUMBER OF POINTS = 20
 GAS METER VOLUME, acf = 62.75
 WATER COLLECTED, ml = 16.00
 PARTICULATE COLLECTED, grams = 0.0036
 CO₂ = 0.00 O₂ = 20.70 CO = 0.00 N₂ = 79.30

SAMPLING POINT	STACK TEMP deg F	PITOT DEL P inches	ORIFICE METER inches	GAS METER OUTLET T deg F	GAS VELOCITY fps
1	60	0.320	3.30	95	32.19
2	60	0.350	3.60	95	33.66
3	60	0.340	3.50	98	33.18
4	60	0.270	2.80	98	29.57
5	60	0.270	2.80	100	29.57
6	60	0.320	3.30	100	32.19
7	60	0.360	3.70	102	34.14
8	60	0.370	3.80	102	34.61
9	60	0.480	4.90	102	39.42
10	60	0.450	4.60	104	38.17
11	60	0.370	3.80	104	34.61
12	60	0.340	3.50	106	33.18
13	61	0.390	4.00	108	35.57
14	61	0.430	4.40	110	37.35
15	61	0.460	4.70	110	38.63
16	61	0.500	5.10	110	40.28
17	61	0.460	4.70	110	38.63
18	61	0.440	4.50	110	37.78
19	61	0.400	4.10	112	36.02
20	61	0.390	4.00	112	35.57
AVG VALUES	60		3.955	104	35.22

TOTAL GAS WITHDRAWN, scf = 64.28
 DRY GAS WITHDRAWN, scf = 63.52
 WATER VAPOR WITHDRAWN, scf = 0.75
 PERCENT WATER VAPOR = 1.17
 ACTUAL WET FLOW RATE, acfm = 19,631.99
 STANDARD DRY FLOW RATE, scfm = 19,333.50
 PARTICULATE CONCENTRATION, grains/scf = 0.0009
 PARTICULATE EMISSION RATE, lb/hr = 0.15
 PARTICULATE EMISSIONS, lb/1000 lb = 0.002
 PERCENT OF ISOKINETIC SAMPLING = 100.95

BADGER MINING TEST 3 4-7-87 TABLE 2-3

BAROMETRIC PRESSURE, in Hg = 29.400
 TIP DIAMETER, in .3040
 STACK AREA, sq ft = 9.291
 SAMPLING TIME PER POINT, min = 3.00
 NUMBER OF POINTS = 20
 GAS METER VOLUME, acf = 63.61
 WATER COLLECTED, ml = 17.00
 PARTICULATE COLLECTED, grams = 0.0038
 CO2 = 0.00 O2 = 20.70 CO = 0.00 N2 = 79.30

SAMPLING POINT	STACK TEMP deg F	PITOT DEL P inches	ORIFICE METER inches	GAS METER OUTLET T deg F	GAS VELOCITY fps
1	62	0.480	4.90	90	39.50
2	62	0.450	4.60	92	38.25
3	62	0.400	4.10	92	36.06
4	62	0.320	3.30	92	32.25
5	62	0.360	3.70	94	34.21
6	62	0.410	4.20	94	36.51
7	62	0.440	4.50	94	37.82
8	62	0.490	5.00	94	39.91
9	62	0.500	5.10	94	40.32
10	62	0.430	4.40	96	37.39
11	62	0.380	3.90	96	35.15
12	62	0.340	3.50	98	33.25
13	62	0.290	3.00	98	30.71
14	62	0.310	3.20	100	31.75
15	62	0.370	3.80	100	34.68
16	62	0.400	4.10	100	36.06
17	63	0.310	3.20	102	31.78
18	63	0.350	3.60	102	33.77
19	63	0.320	3.30	102	32.29
20	63	0.250	2.60	102	28.54
AVG VALUES	62		3.900	97	35.01

TOTAL GAS WITHDRAWN, scf = 65.13
 DRY GAS WITHDRAWN, scf = 64.33
 WATER VAPOR WITHDRAWN, scf = 0.80
 PERCENT WATER VAPOR = 1.23
 ACTUAL WET FLOW RATE, acfm = 19,516.52
 STANDARD DRY FLOW RATE, scfm = 19,142.50
 PARTICULATE CONCENTRATION, grains/scf = 0.0009
 PARTICULATE EMISSION RATE, lb/hr = 0.15
 PARTICULATE EMISSIONS, lb/1000 lb = 0.002
 PERCENT OF ISOKINETIC SAMPLING = 103.25

3.0 METHOD OF TEST

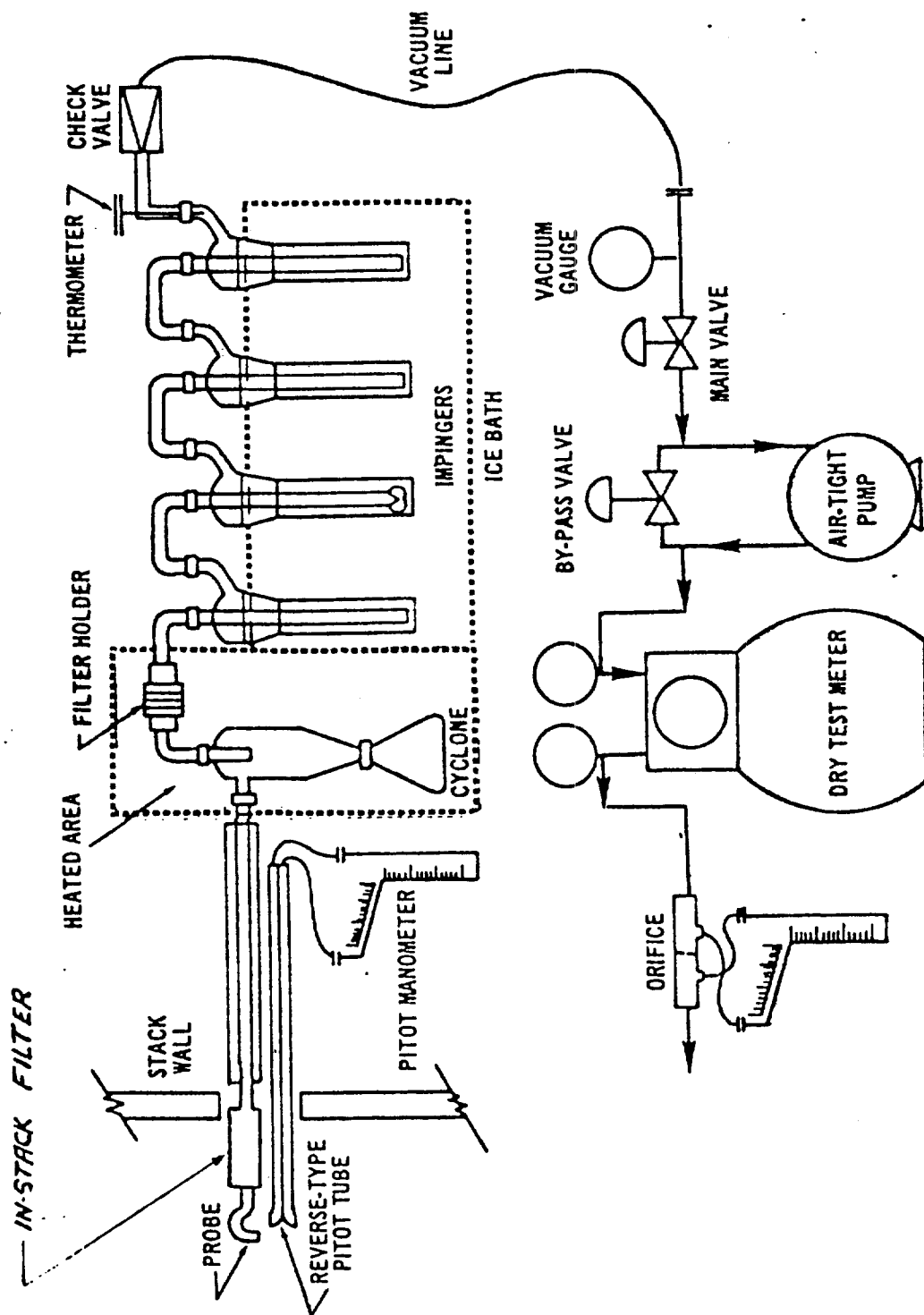
The equipment used to sample was the Western Precipitation Division of the Joy Manufacturing Company Emission Parameter Analyzer. Samples were collected and analyzed in accordance with procedures outlined in the Federal Register, Volume 42, Number 160, August 18, 1977, Method 17 - Determination of Particulate Emissions from Stationary Sources (In-Stack Filtration Method).

The sampling train consisted of a stainless steel probe tip followed by an in-stack tared thimble, a heated stainless steel lined probe, a heated glass cyclone and flask, and a heated filter holder with a tared back-up filter. A series of four impingers followed in an ice bath. The first was a modified Greenburg-Smith impinger with 100 ml of distilled water; the second was a Greenburg-Smith impinger with 100 ml of distilled water; the third was a modified Greenburg-Smith impinger dry; the fourth was also a modified Greenburg-Smith impinger containing a tared quantity of Silica Gel. The gas then passed through a vacuum pump, calibrated dry gas meter, and a calibrated orifice. A schematic drawing of the sampling train is included.

The temperatures of the stack gas stream, as well as strategic locations within the sampling devices, were monitored by RTDs and read directly from a gauge on the control unit.

The initial gas stream velocity was obtained from a preliminary traverse using an "S" type pitot tube. The initial moisture was estimated from previous tests of similar processes. This data, along with the stack temperature, was used to set a nomograph so that rapid calculations of isokinetic sampling conditions could be made.

The principle of the method was to collect the sample representative of the exhaust by adjusting the sample collection velocity to match the exhaust gas stream velocity at the point of collection. The velocity at the point of collection was measured with an "S" type pitot tube attached to the probe and the collection velocity was matched to the stack gas velocity by adjusting the flow as indicated by the calibrated orifice.



Particulate sampling train.

At the completion of the test, the impinger contents were measured and weighed for determination of the actual moisture content of the exhaust gas stream. The probe tip and thimble holder preceding the thimble were washed with acetone and placed in a tared beaker and evaporated at room temperature. The thimble and beaker were then desiccated to the tared humidity conditions and weighed. The combined weight of the thimble catch and the washing residue was used for the determination of emission rates and emission concentrations.

A computer was used to calculate the stack velocities, emission concentrations, emission rates and volumetric flow rates using the field and laboratory data.

4.0 CALIBRATIONS

The probe tip, pitot tube, dry gas meter, and orifice were calibrated prior to the test according to procedures outlined in the Maintenance, Calibration, and Operation of Isokinetic Source-Sampling Equipment as published by the EPA. The values obtained were:

Probe tip diameter $d = 0.304"$

Pitot tube coeff. $C_p = 0.85$

Orifice coeff. $H_0 = 1.86$

The dry gas meter presently installed in the control box is a temperature compensating meter. The correction factor for this dry gas meter is represented by:

$$\text{Gama} = 1.016 + (T_d - 70) \times .00012$$

where: T_d = Dry Gas Meter Temperature

The most recent calibration was performed February 20, 1987.

APPENDIX A

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS

Part I. Dry Molecular Weight (M_d) lb/lb-mole

To obtain the dry molecular weight, use the formula:

$$M_d = .44 (\%CO_2) + .32 (\%O_2) + .282 (\%N_2) + .28 (\%CO)$$

Part II. Wet Molecular Weight (M_s) lb/lb-mole

The wet molecular weight (M_s) is calculated from the dry molecular weight (M_d) and the percent water vapor content (B_{wo}) using the formula:

$$M_s = M_d (1 - B_{wo}) + 18 B_{wo}$$

Part III. Water Vapor Content (B_{wo})

The water vapor fraction is calculated directly from the volume of water captured in the condenser (impinger) portion of the sampling train as follows:

$$V_{w\text{std}} = 0.04707 (V_f - V_i)$$

where:

$V_{w\text{std}}$ is volume of water vapor collected (standard conditions), cubic feet.

V_f is final volume of impinger contents, ml.

V_i is initial volume of impinger contents, ml.

$$B_{wo} = \frac{V_{w\text{std}}}{V_{m\text{std}} + V_{w\text{std}}}$$

where:

$V_{m\text{std}}$ is volume of gas through the dry gas meter (standard conditions), cubic feet.

Part IV. Absolute Stack Pressure (P_s) in. Hg

$$P_s = P_b + \frac{P_g}{13.6}$$

where:

P_b is barometric pressure, in. Hg

P_g is stack gauge pressure, in. of water

13.6 is specific gravity of mercury

Part V. Average Stack Gas Velocity (V_s) feet per second

The average stack gas velocity (V_s) is determined using the following formula:

$$V_s = K_p C_p \sqrt{\Delta p}_{avg} \sqrt{\frac{T_{s avg}}{P_s M_s}}$$

where:

K_p 85.49, unit conversion factor

C_p 0.85, correction factor for "S" type pitot tube

$\sqrt{\Delta p}_{avg}$ Average of the square roots of the velocity head of the stack gas stream

$T_{s avg}$ Average stack gas temperature in degrees Rankine

P_s Absolute Stack Pressure

M_s Wet molecular weight of stack gases

Part VI. Stack Gas Discharge Rate (Q_s) cubic feet per hour

The volumetric discharge rate is determined using the following equation:

$$Q_s = 3600 (1 - B_{wo}) (V_s) A \left[\frac{T_{std} P_s}{T_{s \text{ avg}} P_{std}} \right]$$

where:

A	Cross sectional area of stack, square feet
T_{std}	528° Rankine
P_{std}	29.92 inches of mercury
B_{wo}	Percent water vapor content, decimal form
V_s	Average stack gas velocity, ft/sec
$T_{s \text{ avg}}$	Average stack gas temperature, ° Rankine
P_s	Absolute stack pressure, in. of Hg.

Part VII. Dry Gas Volume ($V_{m \text{ std}}$) cubic feet

The dry gas volume measured through the dry gas meter is corrected to standard conditions using the formula:

$$V_{m \text{ std}} = (V_m - (AL - .02)\theta) \left[\frac{P_b + \frac{\Delta H}{13.6}}{P_{std}} \right] \gamma$$

where:

T_m	Average dry gas meter temperature, ° Rankine
ΔH	Average pressure drop across orifice meter, in. H_2O
13.6	Specific gravity of mercury
V_m	Volume of dry gas metered
AL	Post test leak rate, cubic feet per minute
θ	Total time of test, minutes
γ	Calibration factor for dry gas meter

Part VIII. Concentration of Particulate (C_s) grams per cubic foot

The concentration of particulate (C_s) in the stack gas stream is calculated as follows:

$$C_s = \frac{M_n}{V_{m \text{ std}}} \quad \text{or} \quad C'_s = \frac{M_n}{V_{m \text{ std}}} \times 15.43, \text{ grains/ft}^3$$

where:

M_n Total particulate captured, grams
 $V_{m \text{ std}}$ Dry gas volume at standard conditions
15.43 grains per gram

Part IX. Emission Rate (ER) pounds per hour

The emission rate (ER) is calculated from the particulate mass rate by area (PMRA) and the particulate mass rate by concentration (PMRC) as follows:

$$\text{PMRA} = \frac{M_n A 60}{\theta A_n 453.59} \quad \text{and} \quad \text{PMRC} = \frac{C_s Q_s}{453.59}$$

$$\text{ER} = \frac{\text{PMRA} + \text{PMRC}}{2}$$

where:

M_n Total particulate captured, grams
 A Stack area, square feet
60 minutes per hour
 θ Total sampling time, minutes
 A_n Area of sampling nozzle (probe tip), square feet
453.59 grams per pound
 C_s Concentration of particulate, grams per cubic foot
 Q_s Stack gas discharge rate, cubic feet per hour

Part X . Emission Concentration (EC) lb particulate per 1000 lb gas

To obtain the emission concentration (EC) use the following formula:

$$EC = \frac{ER \ 386,700 \ (1 - B_{wo})}{Q_s \ M_s}$$

where:

ER Emission Rate, lb per hour

386,700 Cubic feet per lb-mole x 1000

B_{wo} Water vapor content, volume fraction

Q_s Stack gas discharge rate, cubic feet per hour

M_s Wet molecular weight of stack gas, lb per lb-mole

Part XI . Emission Concentration Corrected to 12 % CO_2 (ECC) lb particulate per 1000 lb gas

$$ECC = \frac{EC \times 12}{\%CO_2}$$

where:

EC Emission concentration, lb part. per 1000 lb gas

$\%CO_2$ Percent carbon dioxide in gas stream, %

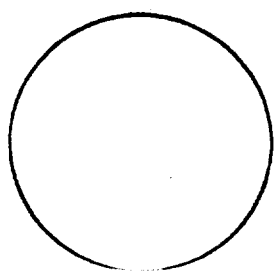
Part XII. Isokinetic Sampling Percentage (I) %

$$I = \frac{PMRA}{PMRC}$$

APPENDIX B

FIELD AND LABORATORY
DATA SHEETS

PLANT	DATE	LOCATION	OPERATOR	STACK NO.	RUN NO.	SAMPLE BOX NO.	METER BOX NO.
Essex Mining	4-7-87	ST. MARIE	JJA		1	1	
AMBIENT TEMPERATURE	BAROMETRIC PRESSURE	ASSUMED MOISTURE, %	PROBE LENGTH, in.	NOZZLE DIAMETER, in.	STACK DIAMETER, in.	PROBE HEATER SETTING	HEATER BOX SETTING
50		2	4 ft	5/16	34 3/4 x 38		



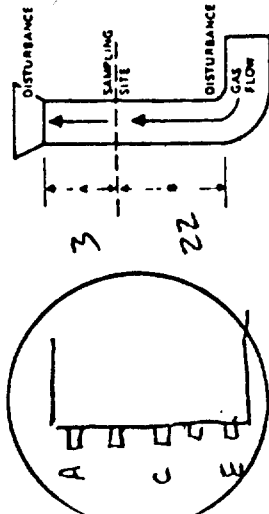
CROSS SECTION

REVERSE POINT NUMBER	SAMPLING TIME (H), min.	STATIC PRESSURE (in. H ₂ O)	STACK TEMPERATURE (T _s), °F	VELOCITY HEAD (V _p) (1/2 V _p ²)		PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in. H ₂ O)	GAS SAMPLE VOLUME (V _m), ft ³	GAS SAMPLE TEMPERATURE AT DRY GAS METER		SAMPLE BOX TEMPERATURE °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER °F	PUMP VACUUM in. Hg	VELOCITY ft/s
				(V _p) (1/2 V _p ²)	ACTUAL DESIRED			INLET (T _{m1}), °F	OUTLET (T _{m2}), °F				
1	9:41:50		56	.43	4.4		4755.00		50				
2			56	.40	4.1		59.1		50				
3	48	-0.2	56	.40	4.1		62.9		50				
4			56	.36	3.7		66.7		52				
5	55		58	.37	3.8		70.3		54				
6			58	.44	4.5		74.1		57			10	
7	02		58	.48	4.9		78.1		60			11	
8			58	.48	4.9		82.2		62				
9	09		58	.50	5.0		86.4		65			11	
10			58	.46	4.7		90.6		70				
11	16		58	.41	4.2		94.7		72				
12			58	.34	3.5		98.5		74			7	
13	23		59	.30	3.1		02.1		78				
14			59	.32	3.3		5.3		80				
15	30		59	.38	3.9		8.7		82				
16			59	.40	4.1		12.4		84				
17	37	-0.2	59	.32	3.3		16.1		87				
18			59	.37	3.8		19.4		90				
19	44		59	.31	3.2		23.0		92				
20			59	.24	2.5		26.3		94				
							29.25						

PARTICULATE FIELD DATA

PLANT BADGER MINING AMBIENT TEMPERATURE 60 METER Hg. 1.016
 DATE 3-7-87 BAROMETRIC PRESSURE 2 C FACTOR 1.84
 LOCATION ST. MARIE ASSUMED MOISTURE, % 2 PROCESS WEIGHT RATE
 OPERATOR SLH PROBE LENGTH, in. 4 ft ORSAT RESULTS
 STACK NO. SCREEN 5203322 NOZZLE DIAMETER, in. 5/16 CO₂ Ar
 RUN NO. 2 STACK DIAMETER, in. 34 3/4 x 38 1/2 CO 02
 SAMPLE BOX NO. 1 PROBE HEATER SETTING T-440 N₂ 02
 METER BOX NO. 3.0/pt PRE V/L OR PORT LK OR

SCHEMATIC OF STACK



CROSS SECTION

INVERSE POINT NUMBER	SAMPLING TIME (H), min.	STATIC PRESSURE (in. H ₂ O)	STACK TEMPERATURE (T _s), °F	VELOCITY HEAD (V _s) (1/2 V _s ²)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in. H ₂ O)	GAS SAMPLE VOLUME (V _m), ft ³	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET (T _{m,i}), °F	OUTLET (T _{m,out}), °F	SAMPLE BOX TEMPERATURE °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER °F	PUMP VACUUM in. Hg gauge	VELOCITY f/s
1	11:00:00		60	.32	3.3	4830.00	95	95				
2			60	.35	3.6	32.9	95	95				
3		-0.2	60	.34	3.5	35.9	98	98				
4			60	.27	2.8	38.9	98	98				
5			60	.27	2.8	41.5	100	100				
6			60	.32	3.3	44.2	100	100				
7			60	.36	3.7	47.1	102	102				
8			60	.37	3.8	50.1	102	102				
9			60	.48	4.9	53.2	102	102				
10			60	.45	4.6	56.7	104	104				
11			60	.37	3.8	60.1	104	104				
12			60	.34	3.5	63.2	106	106			7	
13			61	.39	4.0	66.2	108	108				
14			61	.43	4.4	69.3	110	110				
15			61	.46	4.7	72.6	110	110				
16			61	.50	5.1	76.1	110	110				
17			61	.46	4.7	79.6	110	110				
18			61	.44	4.5	83.0	110	110				
19			61	.40	4.1	86.3	112	112				
20			61	.39	4.0	89.6	112	112				
21						92.15						
TOTAL												

62.76

PARTICULATE FIELD DATA

$$r = 1.016$$

PLANT DROGER MINING AMBIENT TEMPERATURE 60 MEIER ΔH. 1.84

DATE 4-7-87 BAROMETRIC PRESSURE _____ C FACTOR _____

LOCATION ST. MARIE ASSUMED MOISTURE, % 2 PROCESS WEIGHT RATE _____

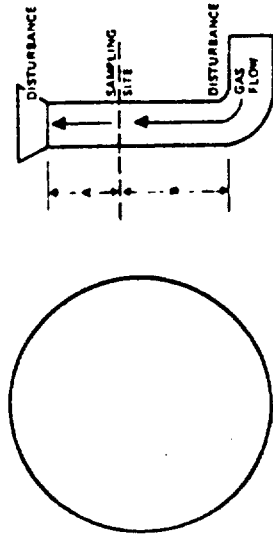
OPERATOR SJH PROBE LENGTH, in. 4 ft ORSAT RESULTS CO2 AIR

STACK NO. SCREEN SERVOBER NOZZLE DIAMETER, in. 5/16 O2

RUN NO. 3 STACK DIAMETER, in. 34 1/4 X 30 1/2 CO

_____ _____ N2

T-448
PRE LK OIL
3.0 min/pt



SCHEMATIC OF STACK

CROSS SECTION

TRAVERSE POINT NUMBER	SAMPLING TIME (H), min.	STATIC PRESSURE (in. H ₂ O)	STACK TEMPERATURE (T _s), °F	VELOCITY HEAD (V _p) ($\propto \frac{TP_s}{P}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in. H ₂ O) (ΔH)	GAS SAMPLE VOLUME (V _m), ft ³	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET (T _{m,i}), °F	OUTLET (T _{m,out}), °F	SAMPLE BOX TEMPERATURE -°F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER °F	PUMP VACUUM in Hg gauge	VELOCITY f.p.s
A 1	17:40:30		62	.48	4.9	98.9		90				
2			62	.45	4.6	97.5		92				
3			62	.40	4.1	91.1		92				
4			62	.32	3.3	84.4		92				
B 5			62	.36	3.7	87.3		94				
6			62	.41	4.2	90.5		94				
7			62	.44	4.5	93.8		94				
8			62	.49	5.0	97.2		94				
C 9			62	.50	5.1	20.8		94				
10			62	.43	4.4	24.4		96				
11			62	.38	3.9	27.8		96				
12			62	.34	3.5	31.1		98				
D 13			62	.29	3.0	34.1		98				
14			62	.31	3.2	36.8		100				
15			62	.37	3.8	39.7		100				
16			62	.40	4.1	42.9		100				
E 17			63	.31	3.2	46.1		102				
18			63	.35	3.6	49.1		102				
19			63	.32	3.3	52.1		102				
20			63	.25	2.6	55.0		102				
						57.1						

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME BADGER MINING
JOB NO. 87-778

DATE OF TEST 4-7-87
TEST ENGINEER LJH

RUN NO. 1 STACK RE SCREENING SURVEY

Sample Box 1 Filter T-402 Wash Bottle -
Beaker No. 14

WATER COLLECTED

Impinger No.	Final Wt. g	Initial Wt. g	Collected grams
<u>1</u>	<u>110</u>	<u>100</u>	<u>10</u>
<u>2</u>	<u>101</u>	<u>100</u>	<u>1</u>
<u>3</u>	<u>1</u>	<u>0</u>	<u>1</u>
<u>SIL GEL</u>	<u>653</u>	<u>644</u>	<u>9</u>
TOTAL			<u><u>21</u></u>

PARTICULATE COLLECTED

	Final Wt. g	Tare Wt. g	Collected grams
Filter	<u>1.1019</u>	<u>1.0973</u>	<u>0.0046</u>
Washings	<u>95.2810</u>	<u>95.2798</u>	<u>0.0012</u>
TOTAL			<u><u>0.0058</u></u>

WATER COLLECTED 21 GRAMS

PARTICULATE COLLECTED 0.0058 GRAMS

0.0012 gr/dust (6%)

NOTES:

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME BADGER MINING
JOB NO. 87-778

DATE OF TEST 4-7-87
TEST ENGINEER LWH

RUN NO. 2 STACK RESCREENING SURVEY

Sample Box 1 Filter T440 Wash Bottle
Beaker No. 15

WATER COLLECTED

<u>Impinger No.</u>	<u>Final Wt. g</u>	<u>Initial Wt. g</u>	<u>Collected grams</u>
<u>1</u>	<u>105</u>	<u>100</u>	<u>5</u>
<u>2</u>	<u>104</u>	<u>100</u>	<u>4</u>
<u>3</u>	<u>1</u>	<u>0</u>	<u>1</u>
<u>SIL GEL</u>	<u>659</u>	<u>653</u>	<u>6</u>
		TOTAL	<u><u>16</u></u>

PARTICULATE COLLECTED

	<u>Final Wt. g</u>	<u>Tare Wt. g</u>	<u>Collected grams</u>
Filter	<u>1.0869</u>	<u>1.0849</u>	<u>0.0020</u>
Washings	<u>100.6777</u>	<u>100.6761</u>	<u>0.0016</u>
		TOTAL	<u><u>0.0036</u></u>

WATER COLLECTED 16 GRAMS

PARTICULATE COLLECTED 0.0036 GRAMS

NOTES:

0.0009 g/dscf 10

LABORATORY DATA SHEET
PARTICULATE & WATER COLLECTED

JOB NAME BADGER MINING
JOB NO. 87-778

DATE OF TEST 4-7-87
TEST ENGINEER LH

RUN NO. 3 STACK RESCREENING SCREEN

Sample Box 1 Filter T-448 Wash Bottle _____
Beaker No. 23

WATER COLLECTED

Impinger No.	Final Wt. g	Initial Wt. g	Collected grams
<u>1</u>	<u>107</u>	<u>100</u>	<u>7</u>
<u>2</u>	<u>103</u>	<u>100</u>	<u>3</u>
<u>3</u>	<u>1</u>	<u>0</u>	<u>1</u>
<u>SIL GEL</u>	<u>665</u>	<u>659</u>	<u>6</u>
TOTAL			<u><u>17</u></u>

PARTICULATE COLLECTED

	Final Wt. g	Tare Wt. g	Collected grams
Filter	<u>1.1482</u>	<u>1.1442</u>	<u>0.0020</u>
Washings	<u>98.5582</u>	<u>98.5564</u>	<u>0.0018</u>
TOTAL			<u><u>0.0038</u></u>

WATER COLLECTED 17 GRAMS

PARTICULATE COLLECTED GRAMS

0.0009 g/direct

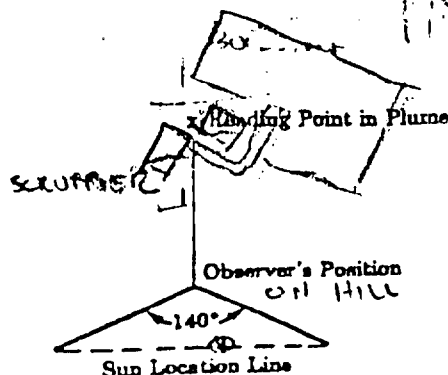
NOTES:

Summary of Average Opacity (From Computer Program)

[illegible]

Allowable Source Opacity

Sketch of Observer, Discharge, and Sun Location.



Summary of Average Opacity (From Computer Program)

[illegible]

SMOKE FORM

Name of Company		Date	SEC MIN																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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Summary of Average Opacity (From Computer Program)

[illegible]

Allowable Source Opacity

Signature of Observer	Name of Observer (Please print)
<i>[Signature]</i>	<i>[Printed Name]</i>

Sketch of Observer, Discharge, and Sun Location.

