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SE - STK - 4852

Report to

CHARTER STEEL DIVISION

Saukville, Wisconsin

for

STACK EMISSION TESTS

ELECTRIC ARC FURNACE BAGHOUSE P01

WDNR AIR POLLUTION CONTROL PERMIT NO. 00-DCF-041

March 31 - April 2, 2003

by

ENVIRONMENTAL TECHNOLOGY & ENGINEERING CORPORATION

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ETE

RECEIVED

OCT 27 2003

AIR MANAGEMENT

SUMMARY

During the period of March 31 through April 2, 2003, Environmental Technology & Engineering Corp. personnel performed stack emissions testing at the Charter Steel facility located in Saukville, Wisconsin. The tests were performed on the electric arc furnace (EAF) baghouse as a provision of an Air Pollution Control Permit issued by the State of Wisconsin Department of Natural Resources. Tests were performed in order to determine compliance with the applicable particulate, PM10, and carbon monoxide emission limitations. All measured emissions and the permit limits are shown in the following table:

501, 601 Melt Shop

TEST NO.	PARTICULATE	PM10	CARBON MONOXIDE
1	1.95 lb/hr	1.77 lb/hr	163.03 lb/hr 2.01 lb/ton
2	2.04	1.86	118.63 1.65
3	2.01	1.84	161.89 1.86
AVERAGE	2.00 lb/hr	1.82 lb/hr	147.85 lb/hr 1.84 lb/ton
DNR LIMIT	6.05	5.56	3.50
% OF LIMIT	33.1 %	32.7 %	52.6 %

All tested parameters were well below the permit limitations.

1.0 GENERAL

During the period of March 31 through April 2, 2003, Environmental Technology & Engineering Corp. (ETE) personnel performed stack emissions testing at the Charter Steel facility located in Saukville, Wisconsin. The purpose of the testing was to determine the emissions from the electric arc furnace baghouse as a condition of an Air Pollution Control Permit issued by the State of Wisconsin Department of Natural Resources (WDNR).

Tests were performed over three consecutive days in order to determine the compliance status of the particulate matter, PM10, and carbon monoxide emissions with the limits set in the permit. Mark Haase of Charter Steel was responsible for assuring proper operating conditions throughout the testing. All testing was coordinated with Mark Haase. A copy of the melt rate during each test period is included in the APPENDIX to this report. The field tests, process, and baghouse operation were witnessed by Ron Dillahunt of the Wisconsin DNR. The field tests, corresponding laboratory analysis, and report preparation were performed by ETE personnel; Bill Dick was the test team leader.

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

2.0 RESULTS

Isokinetic sampling for particulate matter and PM10 was performed in accordance with a combination of the procedures outlined in EPA Method 17 and Method 201A. Particulate samples were also analyzed for condensibles in accordance with Method 202. Carbon monoxide samples were collected and analyzed in accordance with EPA Method 10. A brief summary of the methods is included in section 3.0 of this report.

The tests were performed in the final discharge at the location shown in Figure 2-1. Detailed results of the testing to determine particulate matter, PM10, and CO are included as Tables 2-1 through 2-3.

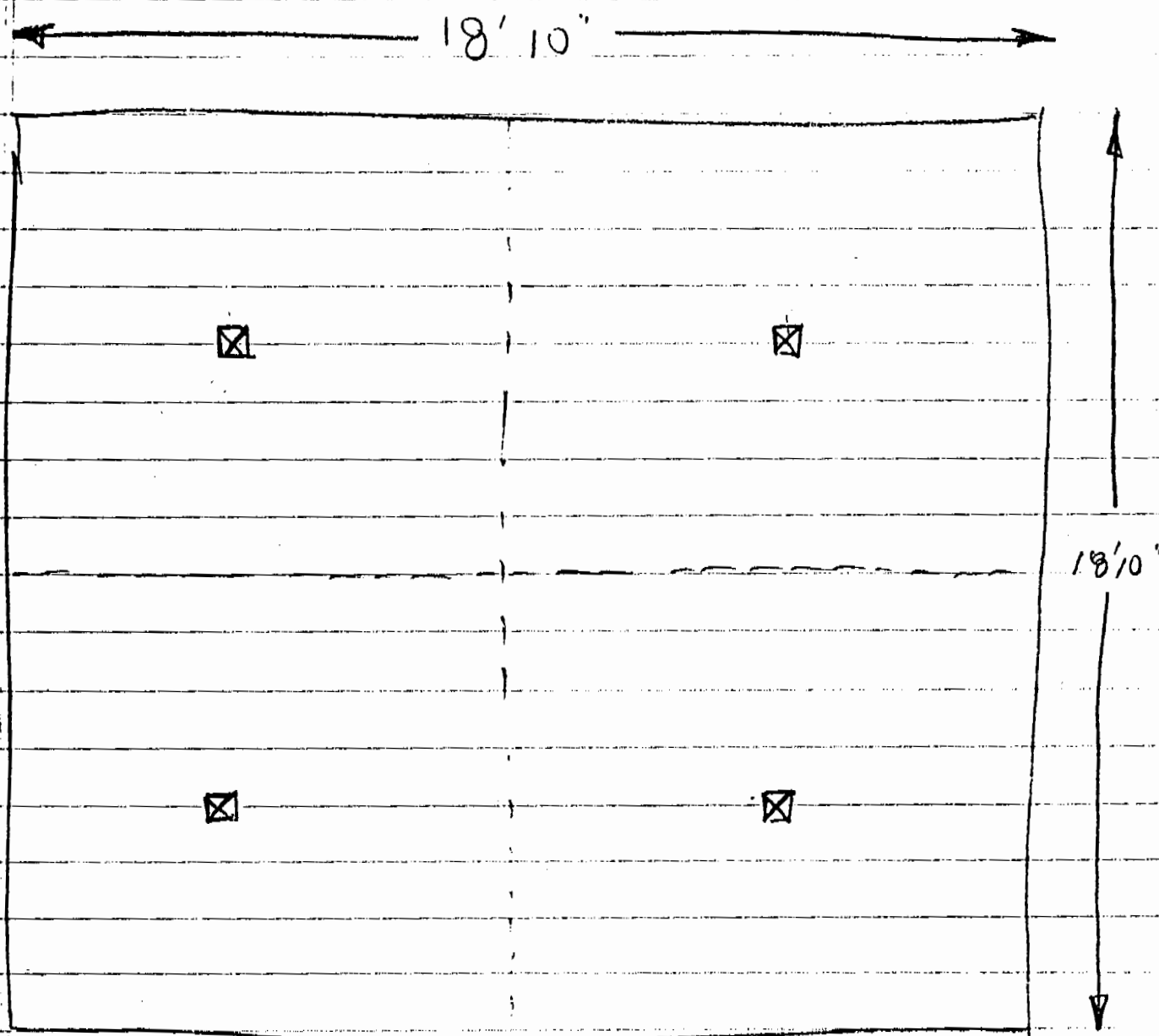
The results are summarized below:

TEST NO.	PARTICULATE	PM10	CARBON MONOXIDE
1	1.95 lb/hr	1.77 lb/hr	163.03 lb/hr 2.01 lb/ton
2	2.04	1.86	118.63 1.65
3	2.01	1.84	161.89 1.86
AVERAGE	2.00 lb/hr	1.82 lb/hr	147.85 lb/hr 1.84 lb/ton
DNR LIMIT	6.05	5.56	3.50
% OF LIMIT	33.1 %	32.7 %	52.6 %

All tested parameters were well below the permit limitations.

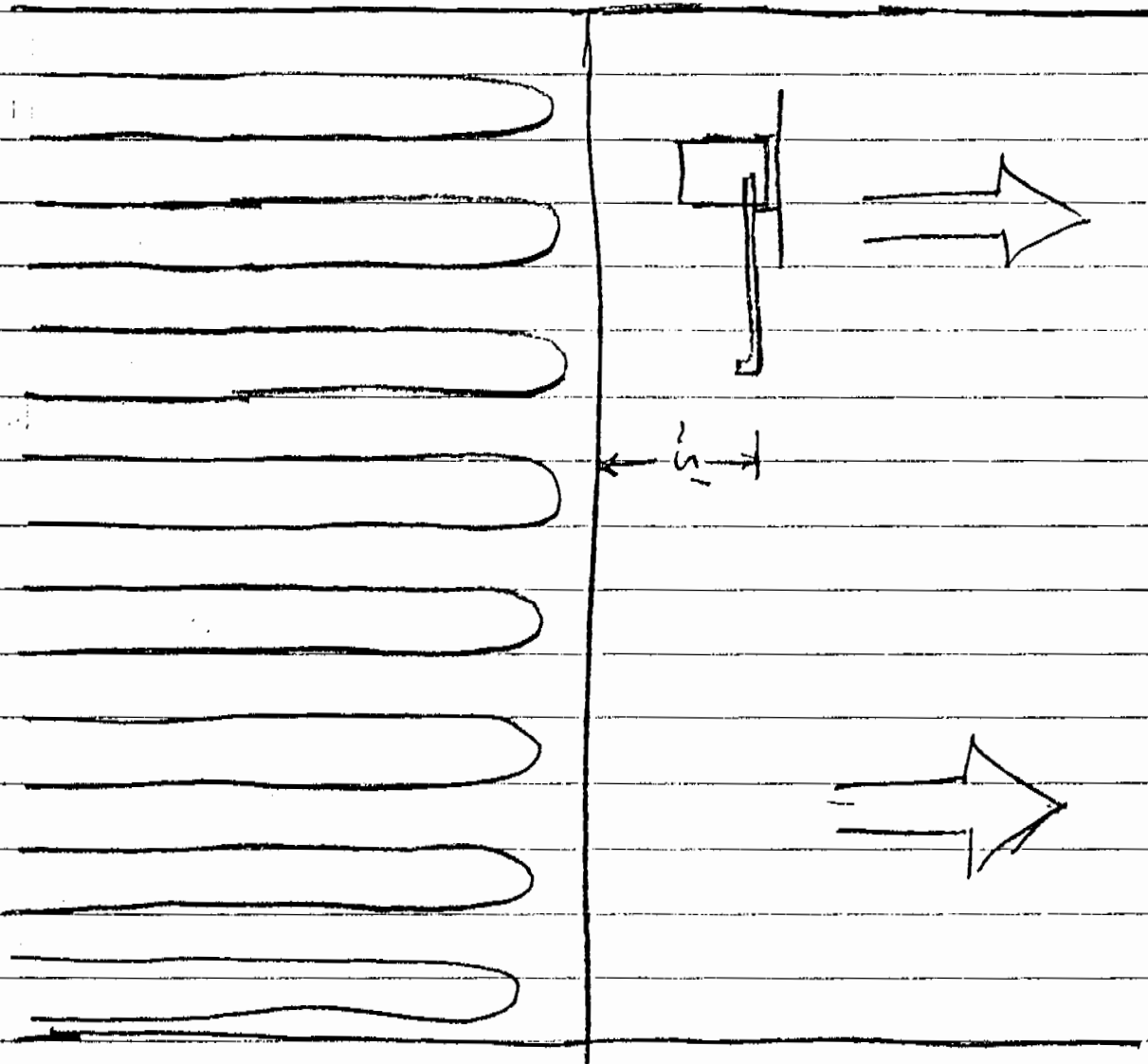
FIGURE 2-1A

CHARTER STEEL
BAGHOUSE COMPARTMENTS
PLAN VIEW



☒ SAMPLING LOCATION AT CENTER
OF EACH OF FOUR QUADRANTS.

Figure 2-1B

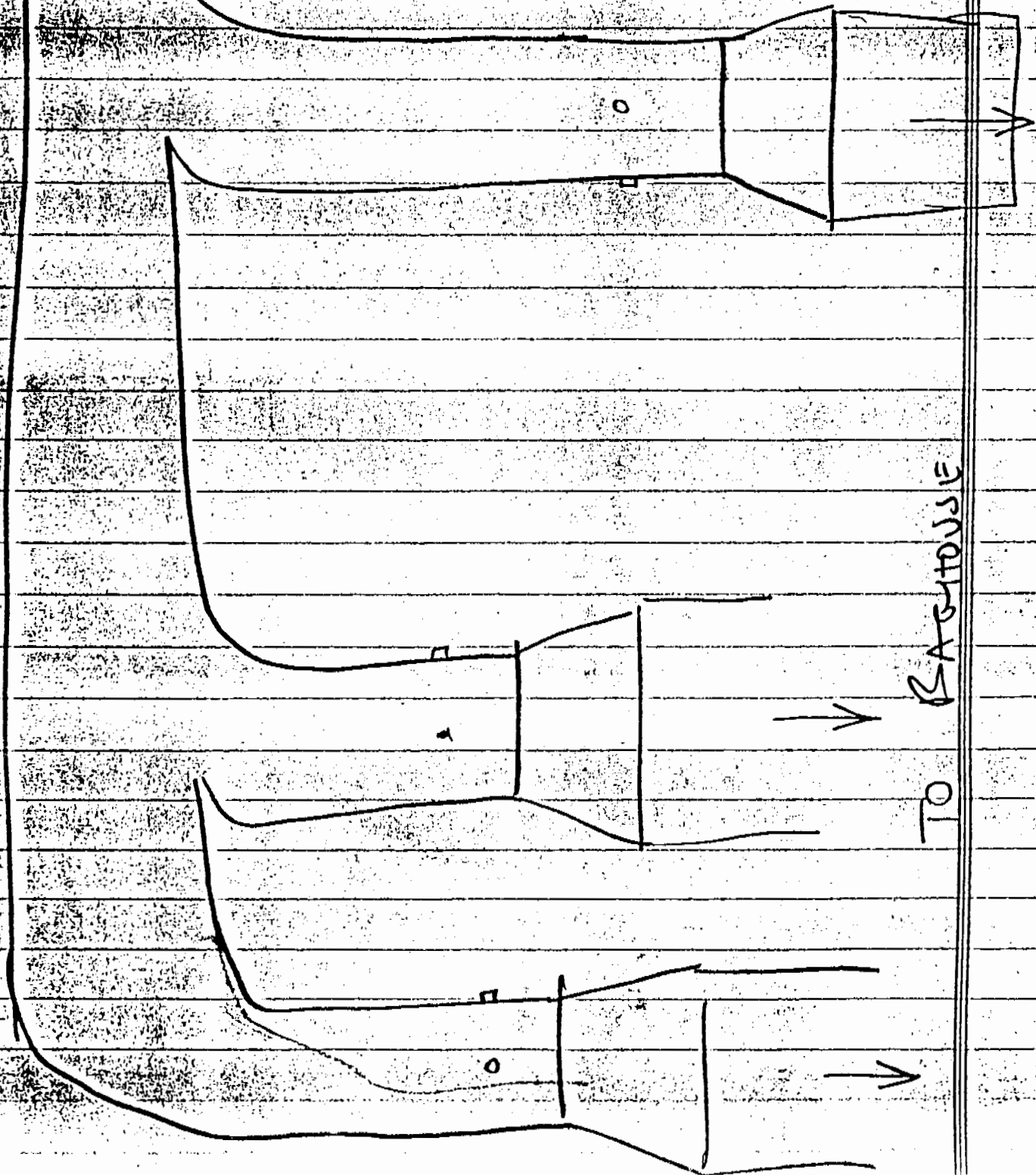


CHARACTER STEEL
BAGHOUSE COMPARTMENTS
ELEVATION

INLET VELOCITY
LOCATIONS

FROM
CONVECTION
POINT

$d = 7.6"$
EACH



CHARTER STEEL BAGHOUSE

31-Mar-03

TABLE 2-1

TEST NO.	1	
BAROMETRIC PRESSURE	29.25	IN HG
TIP DIAMETER	1.000	IN
STACK AREA	4256.330	FT2
SAMPLING TIME PER COMPARTMENT	20.0	MIN
NUMBER OF COMPARTMENTS	12	
METER VOLUME	187.88	FT3
PITOT COEFFICIENT	0.84	
METER COEFFICIENT	1.004	
PARTICULATE COLLECTED	0.0045	GRAMS
PM10 COLLECTED	0.0041	GRAMS
WATER COLLECTED	25	ML
STATIC PRESSURE	0	IN H2O
CARBON MONOXIDE	61	PPM
MELT RATE	81	TPH

ORSAT RESULTS

CO2
0.60%O2
20.40%CO
0.00%N2
79.00%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	122	0.0021	2.00	50	2.73
2	120	0.0021	2.00	61	2.72
3	160	0.0021	2.00	67	2.81
4	118	0.0021	2.00	72	2.72
5	132	0.0021	2.00	90	2.75
6	128	0.0021	2.00	110	2.74
7	121	0.0021	2.00	116	2.72
8	150	0.0021	2.00	108	2.79
9	116	0.0021	2.00	112	2.71
10	132	0.0021	2.00	113	2.75
11	125	0.0021	2.00	120	2.73
12	166	0.0021	2.00	122	2.83
AVERAGE	133		2.00	95	2.75

DRY STANDARD VOLUME	185.89	SCF
PERCENT WATER VAPOR	0.63	% VOL
FLOW RATE	702312	ACFM
	611530	DSCFM
	1039112	M3/HR
PARTICULATE CONCENTRATION	0.0004	GR/DSCF
PARTICULATE EMISSION RATE	1.95	LB/HR
PM10 EMISSION RATE	1.77	LB/HR
LB PART PER 1000 LB GAS	0.0007	
ISOKINETIC PERCENT	98.9	
CARBON MONOXIDE EMISSION RATE	163.03	LB/HR
CARBON MONOXIDE EMISSIONS	2.01	LB/TON

CHARTER STEEL BAGHOUSE

1-Apr-03

TABLE 2-2

TEST NO.	2	
BAROMETRIC PRESSURE	29.00	IN HG
TIP DIAMETER	1.000	IN
STACK AREA	4256.330	FT2
SAMPLING TIME PER COMPARTMENT	20.0	MIN
NUMBER OF COMPARTMENTS	12	
METER VOLUME	186.13	FT3
PITOT COEFFICIENT	0.84	
METER COEFFICIENT	1.004	
PARTICULATE COLLECTED	0.0046	GRAMS
PM10 COLLECTED	0.0042	GRAMS
WATER COLLECTED	25	ML
STATIC PRESSURE	0	IN H2O
CARBON MONOXIDE	43	PPM
MELT RATE	72	TPH

ORSAT RESULTS

CO2
0.60%O2
20.20%CO
0.00%N2
79.20%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	144	0.0023	2.00	100	2.91
2	131	0.0023	2.00	106	2.87
3	136	0.0023	2.00	107	2.89
4	150	0.0023	2.00	110	2.92
5	120	0.0023	2.00	112	2.85
6	162	0.0023	2.00	114	2.95
7	138	0.0023	2.00	122	2.89
8	156	0.0023	2.00	130	2.94
9	165	0.0023	2.00	142	2.96
10	154	0.0023	2.00	146	2.93
11	151	0.0023	2.00	148	2.92
12	134	0.0023	2.00	150	2.88
AVERAGE	145		2.00	124	2.91

DRY STANDARD VOLUME	183.22	SCF
PERCENT WATER VAPOR	0.64	% VOL
FLOW RATE	742839	ACFM
	631246	DSCFM
	1072613	M3/HR
PARTICULATE CONCENTRATION	0.0004	GR/DSCF
PARTICULATE EMISSION RATE	2.04	LB/HR
PM10 EMISSION RATE	1.86	LB/HR
LB PART PER 1000 LB GAS	0.0007	
ISOKINETIC PERCENT	94.4	
CARBON MONOXIDE EMISSION RATE	118.63	LB/HR
CARBON MONOXIDE EMISSIONS	1.65	LB/TON

CHARTER STEEL BAGHOUSE

2-Apr-03

TABLE 2-3

TEST NO.	3	
BAROMETRIC PRESSURE	29.20	IN HG
TIP DIAMETER	1.000	IN
STACK AREA	4256.330	FT2
SAMPLING TIME PER COMPARTMENT	20.0	MIN
NUMBER OF COMPARTMENTS	12	
METER VOLUME	193.67	FT3
PITOT COEFFICIENT	0.84	
METER COEFFICIENT	1.004	
PARTICULATE COLLECTED	0.0048	GRAMS
PM10 COLLECTED	0.0044	GRAMS
WATER COLLECTED	24	ML
STATIC PRESSURE	0	IN H2O
CARBON MONOXIDE	63	PPM
MELT RATE	87	TPH

ORSAT RESULTS

CO2
0.60%O2
20.20%CO
0.00%N2
79.20%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	122	0.0020	2.00	82	2.66
2	148	0.0020	2.00	88	2.72
3	131	0.0020	2.00	90	2.68
4	128	0.0020	2.00	90	2.68
5	122	0.0020	2.00	90	2.66
6	155	0.0020	2.00	94	2.74
7	127	0.0020	2.00	98	2.67
8	134	0.0020	2.00	101	2.69
9	164	0.0020	2.00	102	2.76
10	120	0.0020	2.00	104	2.66
11	113	0.0020	2.00	102	2.64
12	114	0.0020	2.00	100	2.64
AVERAGE	132		2.00	95	2.68

DRY STANDARD VOLUME	191.29	SCF
PERCENT WATER VAPOR	0.59	% VOL
FLOW RATE	685433	ACFM
	587969	DSCFM
	999077	M3/HR
PARTICULATE CONCENTRATION	0.0004	GR/DSCF
PARTICULATE EMISSION RATE	2.01	LB/HR
PM10 EMISSION RATE	1.84	LB/HR
LB PART PER 1000 LB GAS	0.0008	
ISOKINETIC PERCENT	105.8	
CARBON MONOXIDE EMISSION RATE	161.89	LB/HR
CARBON MONOXIDE EMISSIONS	1.86	LB/TON

3.0 METHODS

3.1 Particulate and PM10

The equipment used to sample was the Western Precipitation Division of the Joy Manufacturing Company Emission Parameter Analyzer. Samples were collected in accordance with EPA Method 17(particulate) and Method 201A (PM10). In addition, the condensible particulate was determined using EPA Method 202.

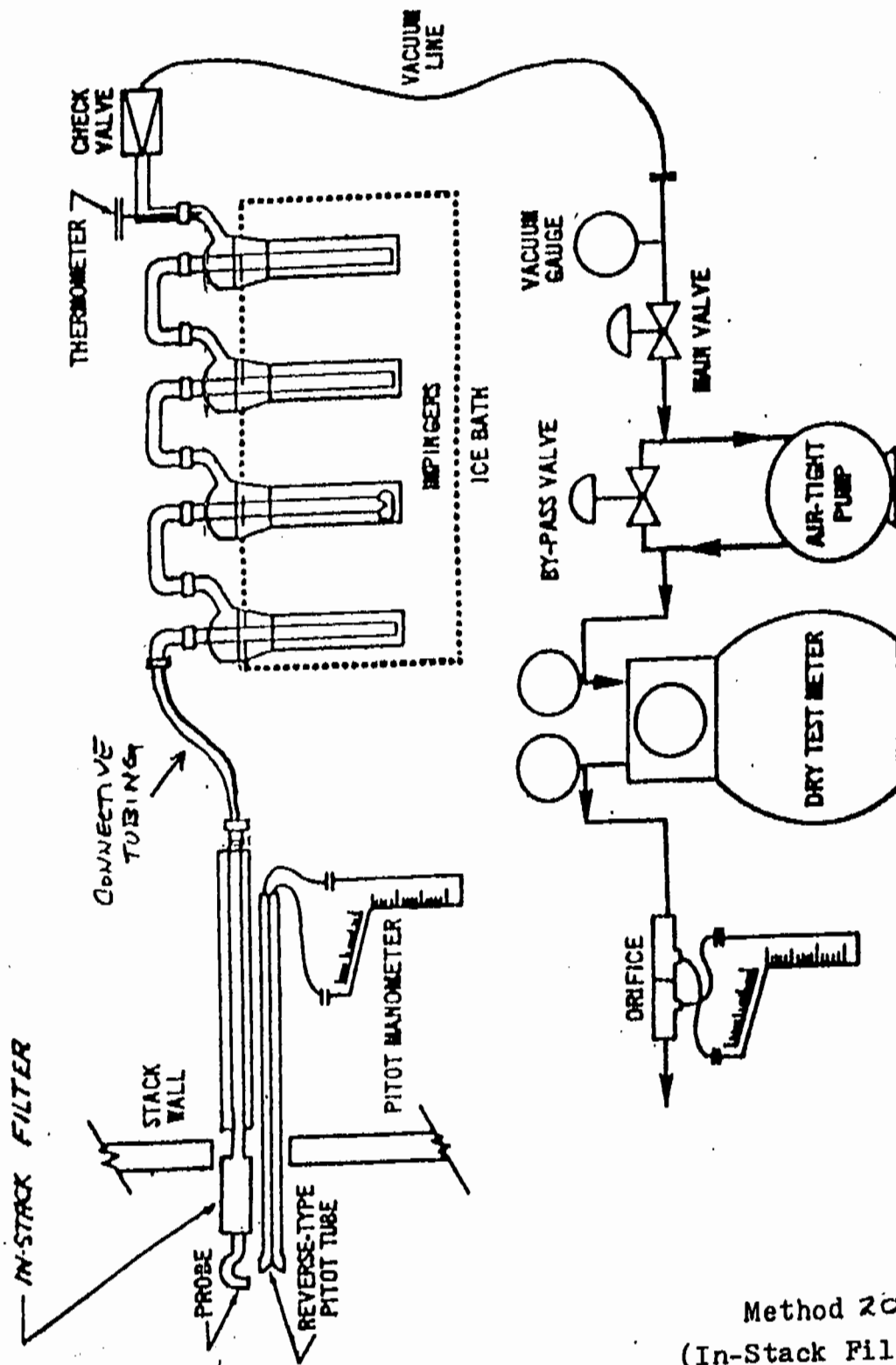
The sampling train consisted of a probe tip, a cascade impactor head with a series of seven plates and corresponding filters. A series of four impingers followed in an ice bath. The first was a modified Greenburg-Smith impinger with 100 ml of nitric acid/hydrogen peroxide solution; the second was a Greenburg-Smith impinger with 100 ml of the same solution; the third was a modified Greenburg Smith impinger dry; and 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 velocity traverse at the three baghouse inlet ducts 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 calculate the total system airflow. The velocities in the test compartments were then calculated from the air flow and the compartment areas. A probe tip was selected to optimize a sampling rate for a cut size of 10 microns through the impactor.

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.

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 impinger contents were then analyzed for condensible particulate in accordance with Method 202 procedures. The probe tip washings and impactor filters were weighed for the determination of front half particulate matter. This weight was combined with the condensible weight gain to determine the total particulate. The PM10 weight gain was determined to be the sum of the filter weight fraction greater than 10 microns plus the condensible weight gain.



Method 202
(In-Stack Filter)

Particulate sampling train.

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

3.2 Carbon Monoxide

Sampling for carbon monoxide was performed in accordance with the procedures outlined in EPA Method 10 -- "Determination of Carbon Monoxide Emissions from Stationary Sources" - as published in the Federal Register. Time integrated bag samples were extracted from the exhaust gas stream and analyzed for carbon monoxide concentration using a Horiba nondispersive infrared analyzer (NDIR). The analyzer was calibrated with span gas and zero gas prior to and following each hour of testing. The calibration gas was introduced into a tedlar bag through the sampling apparatus, similar to the exhaust gas sampled. The calibration span gases for the analyzer were 84 and 217 ppm CO in nitrogen.

4.0 CALIBRATIONS

4.1 Particulate & PM10

The probe tip, pitot tube, dry gas meter, and orifice were calibrated prior to the test according to standard procedures published by the EPA. The values obtained were:

DATE	PARAMETER	VALUE
March 4, 2003	Probe Tip Diameter	1.00"
	Pitot Coefficient	0.84
	Dry Gas Meter	1.004
	Orifice Factor	1.751

4.2 Carbon Monoxide

The following calibration gases were used in the analysis of the samples:

HIGH CALIBRATION	LOW CALIBRATION
84 ppm	45 ppm

APPENDIX A

Field and Laboratory Data

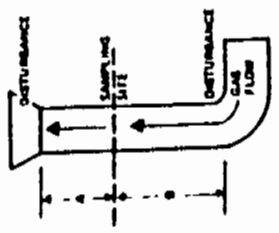
PARTICULATE FIELD DATA

PLANT CHAPPA
 DATE 3-31-03
 LOCATION SACKVILLE
 OPERATOR WJD
 STACK NO. CAF-BAGHOUSE
 RUN NO. 1
 SAMPLE BOX NO. 1
 METER BOX NO. 1

AMBIENT TEMPERATURE 110
 BAROMETRIC PRESSURE 29.75
 ASSUMED MOISTURE, % 1
 PROBE LENGTH, in. 4A
 NOZZLE DIAMETER, in. 0.6
 STACK DIAMETER, in. 20.0
 PROBE HEATER SETTING 2
 HEATER BOX SETTING 2

METER & H. 1.7515
 C FACTOR 0.6
 PROCESS WEIGHT RATE 0.2
 ORSAT RESULTS CO2 0.6
CO 20.0
N2

LEAK CHECKS
 Pre OK
 Pitot OK
 Post OK
 Pitot OK

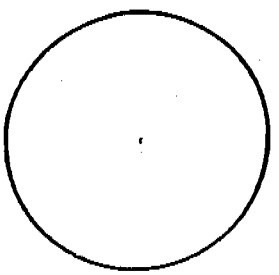
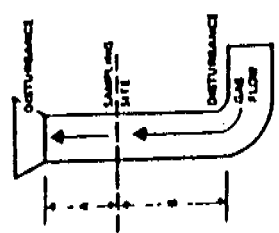


CROSS SECTION

TRAVERSE POINT NUMBER	SAMPLING TIME (nl. min.)	STATIC PRESSURE (in. H ₂ O)	STACK TEMPERATURE (T _s), °F	VELOCITY HEAD (V.P.), (1/P _s)	VELOCITY (ft/min)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in. H ₂ O)	GAS SAMPLE VOLUME (V _m), (ft ³)	GAS SAMPLE TEMPERATURE AT DRY GAS METER (T _{m, dry}), °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 (ft/min)
12	0850		122/110/100/130	172	2.00		155.00	50			40	5	
11	910		130/123/110/116	170	2.00		71.4	61					
10	30		144/160/163/172	160	2.00		87.4	67					
9	0750		124/122/110/112	115	2.00		203.3	72			40	5	
8	1010		114/112/100/118	132	2.00		19.3	90					
7	30		120/118/106/150	123	2.00		35.0	110					
6	5		156/170/110/100	121	2.00		80.3	110					
5	1105/1124/1130		136/150/147/143	150	2.00		66.0	108			40		
4	1159/1200/1227		120/114/113/110	114	2.00		81.2	113				5	
3	1215.5		116/123/134/152	132	2.00		87.2	113					
2	35		116/152/113/115	120	2.00		312.6	120			40		
1	155		132/110/114/150	146	2.00		28.0	122					
	1315						342.00						
							(157.88)						

PARTICULATE FIELD DATA

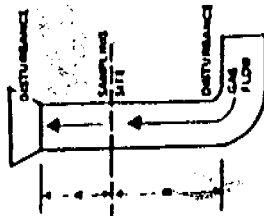
PLANT CHARTER METER ΔH. _____
 DATE 6-1-73 C FACTOR _____
 LOCATION FAURVILLE PROCESS WEIGHT RATE _____
 OPERATOR NJD ORSAT RESULTS _____
 STACK NO. 6 DE FAVORVILLE CO2 86 Pre 00
 RUN NO. 2 CO 200 Pitot 0.02
 SAMPLE BOX NO. 1 N2 0.04
 METER BOX NO. 1 HEATER BOX SETTING _____
 HEATER BOX SETTING _____



TRAVERSE POINT NUMBER	SAMPLING TIME (M) MIN	STATIC PRESSURE (in. H ₂ O)	STACK TEMPERATURE (T _s), °F	VELOCITY HEAD (V _p) (ft/s) ²	VELOCITY (ft/s)	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), °F	OUTLET (T _m), °F	SAMPLE BOX TEMPERATURE °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER °F	PUMP VACUUM in. Hg gauge	VELOCITY ft/s
1	0830		168/150/128/128	144	12.0	2.00	346.00	100			40	5	
2	50		128/132/132/128	131	2.00	2.00	62.1	106					
3	0910		140/152/128/128	134	2.00	2.00	70.5	107					
4	30		146/152/152/140	150	2.00	2.00	96.0	110			47	5	
5	50		124/128/116/117	120	2.00	2.00	409.7	112					
6	1010		172/168/160/160	142	2.00	2.00	23.5	114					
7	30		140/134/142/132	135	2.00	2.00	40.9	112			45	5	
8	50		178/172/169/160	150	2.00	2.00	56.4	130					
9	1110		170/174/170/170	140	2.00	2.00	71.2	142					
10	30		172/164/170/138	154	2.00	2.00	80.8	144					
11	50		136/160/154/154	151	2.00	2.00	501.8	148					
12	1210		157/138/116/130	134	2.00	2.00	17.0	150			50	5	
13	1230						532.13						
							(156.13)						

PARTICULATE FIELD DATA

PLANT CLARK METER AM. _____
 DATE 4-7-03 C FACTOR _____
 LOCATION SAXVILLE PROCESS WEIGHT RATE _____
 OPERATOR WJD ORSAT RESULTS _____
 STACK NO. CAF Pre OK
 RUN NO. 3 Pitot OK
 SAMPLE BOX NO. 1 Post OK
 METER BOX NO. 1 Pitot OK
 HEATER BOX SETTING _____



CROSS SECTION

TRAVERSE POINT NUMBER	SAMPLING TIME (a), min.	STATIC PRESSURE (in. H ₂ O)	STACK TEMPERATURE (T _s), °F	VELOCITY HEAD (V _p), (1/2 V _p ²)	VELOCITY (ft/min)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in. H ₂ O)	ACTUAL DESIRED	GAS SAMPLE VOLUME (V _m), ft ³	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET (T _m), °F	OUTLET (T _m), °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER °F	PUMP VACUUM in. Hg gauge	VELOCITY ft/min
12	0820		108/14/10/136	172	200			533.00		82	40	S	
11	40		140/140/15/11.4	143	200			46.2		88			
10	0900		136/128/20/146	13	200			65.8		90			
9	20		116/112/160/140	123	200			82.0		90	42	S	
8	40		132/122/110/122	122	200			97.9		90			
7	1010		135/120/108/152	135	200			614.2		94			
6	20		130/130/172/135	171	200			29.9		93			
5	40		130/105/122/110	134	200			46.1		101	45	S	
4	1100		116/116/116/110	110	142	200		62.0		102			
3	20		118/120/118/124	120	200			78.0		106			
2	40		118/110/114/110	113	200			94.0		102			
1	1200		122/104/122/114	114	142	200		710.0		100	50	S	
	1120							726.67					
								193.67					

LABORATORY DATA SHEET
PARTICULATE WITH METHOD 202 BACKHALF ANALYSIS

JOB NAME CLARK STEEL DATE OF TEST 3-31-03
JOB NO. 2911 TEST ENGINEER WJO
RUN NO. 1 STACK EAT- BAYHOUSE
SAMPLE BOX 1 FILTER NUMBER SET R
BEAKERS: FH Acetone - BH MetCl 1 BH Water A

WATER COLLECTED

<u>Impinger No.</u>	<u>Final Wt (g)</u>	<u>Initial Wt (g)</u>	<u>Water Collected (g)</u>
<u>1</u>	<u>102</u>	<u>100</u>	<u>2</u>
<u>2</u>	<u>103</u>	<u>100</u>	<u>3</u>
<u>3</u>	<u>100</u>	<u>100</u>	<u>0</u>
<u>Sil Gel</u>	<u>710</u>	<u>690</u>	<u>20</u>
		<u>WATER TOTAL -</u>	<u>25</u>

PARTICULATE COLLECTED

	<u>Blank</u>	<u>Final Wt (g)</u>	<u>Tare Wt (g)</u>	<u>Net Wt Gain (g)</u>
<u>Filter</u>				
<u>FH Wash</u>				
			<u>FRONT HALF TOTAL -</u>	<u>0.0026</u>
<u>1 Extract</u>	<u>.0003</u>	<u>68.5772</u>	<u>68.5764</u>	<u>0.0005</u>
<u>A Water</u>	<u>.0003</u>	<u>119.0670</u>	<u>119.0653</u>	<u>0.0014</u>
			<u>BACK HALF TOTAL -</u>	<u>0.0019</u>
			<u>TOTAL PARTICULATE -</u>	<u>0.0045</u>

Comments:

LABORATORY DATA SHEET
PARTICULATE WITH METHOD 202 BACKHALF ANALYSIS

JOB NAME CITRUS STEEL DATE OF TEST 2-1-03
 JOB NO. 2911 TEST ENGINEER VJO
 RUN NO. 2 STACK EAT- BAGOUE
 SAMPLE BOX 1 FILTER NUMBER SET U
 BEAKERS: FH Acetone - BH MetCl 2 BH Water B

WATER COLLECTED

Impinger No.	Final Wt (g)	Initial Wt (g)	Water Collected (g)
<u>1</u>	<u>116</u>	<u>100</u>	<u>16</u>
<u>2</u>	<u>103</u>	<u>100</u>	<u>3</u>
<u>3</u>	<u>100</u>	<u>100</u>	<u>0</u>
Sil Gel	<u>72f</u>	<u>718</u>	<u>6</u>

WATER TOTAL - _____

PARTICULATE COLLECTED

	Blank	Final Wt (g)	Tare Wt (g)	Net Wt Gain (g)
Filter				
FH Wash				

FRONT HALF TOTAL -

0.002f

2 Extract	<u>.0003</u>	<u>89.1536</u>	<u>89.1530</u>	<u>0.0005</u>
B Water	<u>.0003</u>	<u>120.8594</u>	<u>120.857f</u>	<u>0.0017</u>

BACK HALF TOTAL -

0.0022

TOTAL PARTICULATE -

0.0046

Comments:

LABORATORY DATA SHEET
PARTICULATE WITH METHOD 202 BACKHALF ANALYSIS

JOB NAME CITRUS STEEL DATE OF TEST 4.2.03
 JOB NO. 2911 TEST ENGINEER WJD
 RUN NO. 3 STACK EAT- BAKHOUSE
 SAMPLE BOX 1 FILTER NUMBER SPT 2
 BEAKERS: FH Acetone - BH MetCl 3 BH Water C

WATER COLLECTED

Impinger No.	Final Wt (g)	Initial Wt (g)	Water Collected (g)
<u>1</u>	<u>102</u>	<u>100</u>	<u>2</u>
<u>2</u>	<u>109</u>	<u>100</u>	<u>9</u>
<u>3</u>	<u>104</u>	<u>100</u>	<u>4</u>
Sil Gel	<u>733</u>	<u>724</u>	<u>9</u>
WATER TOTAL -			<u>25</u>

PARTICULATE COLLECTED

	Blank	Final Wt (g)	Tare Wt (g)	Net Wt Gain (g)
Filter				
FH Wash				
FRONT HALF TOTAL -				<u>0.0025</u>
Extract	<u>.0003</u>	<u>68.6521</u>	<u>68.6512</u>	<u>0.0006</u>
Water	<u>.0003</u>	<u>110.2520</u>	<u>110.2500</u>	<u>0.0017</u>
BACK HALF TOTAL -				<u>0.0023</u>
TOTAL PARTICULATE -				<u>0.0048</u>

Comments:

CHARTER STEEL
EAF BAGHOUSE

3/31 - 4/2/03

3/31/03

TEST 1
PM10 DATA

STAGE	FINAL grams	TARE grams	GAIN grams	CUMULATIVE grams	CUT SIZE microns	% GREATER THAN	% LESS THAN	CUT SIZE microns
0	0.1518	0.1514	0.0004	0.0004	10.0	0.154	0.846	10.0
1	0.1362	0.1358	0.0004	0.0008	6.2	0.308	0.692	6.2
3	0.1531	0.1528	0.0003	0.0011	2.8	0.423	0.577	2.8
4	0.1365	0.1362	0.0003	0.0014	1.8	0.538	0.462	1.8
5	0.1504	0.1500	0.0004	0.0018	0.9	0.692	0.308	0.9
7	0.1352	0.1348	0.0004	0.0022	0.4	0.846	0.154	0.4
F	0.2041	0.2037	0.0004	0.0026	0.0	1.000	0.000	0.0
Solid	Total PM	0.0026	grams	Condensibles	grams	Total PM10	grams	
Solid	PM10	0.0022	0.0019	(PM10)	0.0041	Total PM	0.0045	

TEST 2
PM10 DATA

4/1/03

STAGE	FINAL grams	TARE grams	GAIN grams	CUMULATIVE grams	CUT SIZE microns	% GREATER THAN	% LESS THAN	CUT SIZE microns
0	0.1518	0.1514	0.0004	0.0004	10.0	0.167	0.833	10.0
1	0.1372	0.1370	0.0002	0.0006	6.2	0.250	0.750	6.2
3	0.1535	0.1532	0.0003	0.0009	2.8	0.375	0.625	2.8
4	0.1372	0.1370	0.0002	0.0011	1.8	0.458	0.542	1.8
5	0.1526	0.1522	0.0004	0.0015	0.9	0.625	0.375	0.9
7	0.1373	0.1370	0.0003	0.0018	0.4	0.750	0.250	0.4
F	0.2080	0.2074	0.0006	0.0024	0.0	1.000	0.000	0.0
Solid	Total PM	0.0024	grams	Condensibles	grams	Total PM10	grams	
Solid	PM10	0.0020	0.0022	(PM10)	0.0042	Total PM	0.0046	

TEST 3
PM10 DATA

4/2/03

STAGE	FINAL grams	TARE grams	GAIN grams	CUMULATIVE grams	CUT SIZE microns	% GREATER THAN	% LESS THAN	CUT SIZE microns
0	0.1509	0.1505	0.0004	0.0004	10.0	0.160	0.840	10.0
1	0.1427	0.1424	0.0003	0.0007	6.2	0.280	0.720	6.2
3	0.1502	0.1498	0.0004	0.0011	2.8	0.440	0.560	2.8
4	0.1430	0.1428	0.0002	0.0013	1.8	0.520	0.480	1.8
5	0.1488	0.1486	0.0002	0.0015	0.9	0.600	0.400	0.9
7	0.1421	0.1419	0.0002	0.0017	0.4	0.680	0.320	0.4
F	0.2081	0.2073	0.0008	0.0025	0.0	1.000	0.000	0.0
Solid	Total PM	0.0025	grams	Condensibles	grams	Total PM10	grams	
Solid	PM10	0.0021	0.0023	(PM10)	0.0044	Total PM	0.0048	

FLOW DATA SHEET

CLIENT	Charter Steel
PROCESS	EAF Baghouse Inlet Ducts
DATE	3.31.03
BAROMETRIC PRESSURE	29.75
PITOT COEFF.	0.84
DIAMETER	90 " each

DUCT	SOUTH		CENTER		NORTH	
PORT	1	2	1	2	1	2
POINT	DEL P	DEL P	DEL P	DEL P	DEL P	DEL P
1	2.50	2.45	3.50	.95	2.65	2.20
2	2.50	2.50	3.50	1.00	2.90	2.60
3	2.20	2.50	2.95	1.15	2.90	2.30
4	2.25	2.50	2.85	1.40	2.75	2.30
5	2.30	2.40	2.70	1.50	2.65	2.55
6	2.20	2.40	2.60	2.00	2.60	2.55
7	2.15	2.65	1.55	2.35	2.75	2.60
8	3.05	3.00	1.25	2.90	2.20	2.70
9	3.10	3.10	1.50	3.00	2.00	2.55
10	3.00	3.10	1.10	3.00	1.75	2.60
11	3.00	3.00	1.00	2.50	1.70	2.45
12	1.90	2.65	1.00	1.75	1.10	1.65
TEMP	146		136		138	
STATIC	-5.0		-5.0		-4.9	

FLOW DATA SHEET

CLIENT	Charter Steel
PROCESS	EAF Baghouse Inlet Ducts
DATE	4-1-03
BAROMETRIC PRESSURE	29.00
PITOT COEFF.	0.84
DIAMETER	90 " each

DUCT	SOUTH		CENTER		NORTH	
PORT	1	2	1	2	1	2
POINT	DEL P	DEL P	DEL P	DEL P	DEL P	DEL P
1	2.20	2.10	3.25	1.00	2.75	2.45
2	2.30	2.55	3.15	1.00	3.05	2.75
3	2.35	2.60	3.00	1.30	2.85	2.80
4	2.30	2.50	3.00	1.50	2.85	2.90
5	2.30	2.45	2.90	1.55	2.70	3.00
6	2.75	2.50	2.75	2.00	2.70	2.85
7	2.55	2.90	1.60	2.75	2.35	2.10
8	2.90	3.00	1.35	3.00	2.25	2.50
9	3.20	3.15	1.00	3.00	2.10	2.65
10	3.20	3.20	1.15	3.10	1.90	2.70
11	3.10	3.15	1.00	2.75	1.75	2.50
12	2.00	2.20	0.95	2.00	1.15	1.70
TEMP	122		132		120	
STATIC	-5.0		-5.1		-5.1	

FLOW DATA SHEET

CLIENT	Charter Steel
PROCESS	EAF Baghouse Inlet Ducts
DATE	4-2-03
BAROMETRIC PRESSURE	29.80
PITOT COEFF.	0.84
DIAMETER	90 " each

DUCT	SOUTH		CENTER		NORTH	
PORT	1	2	1	2	1	2
POINT	DEL P	DEL P	DEL P	DEL P	DEL P	DEL P
1	1.90	2.90	2.60	1.25	2.20	1.85
2	1.95	2.55	2.70	1.50	2.35	2.10
3	2.10	2.60	2.80	1.80	2.35	2.15
4	2.00	2.75	2.65	1.85	2.25	2.15
5	2.00	2.20	2.70	1.90	2.20	2.10
6	2.10	2.00	2.90	2.10	2.10	2.00
7	2.45	2.50	1.75	3.00	1.85	2.00
8	2.70	2.70	1.50	3.15	1.85	2.20
9	2.45	2.70	1.10	3.20	1.70	2.30
10	2.40	2.80	1.00	3.10	1.50	2.40
11	2.30	2.70	1.00	2.75	1.25	2.15
12	2.00	2.50	1.70	2.40	1.00	2.00
TEMP	150		148		156	
STATIC	-4.8			-4.8	-4.8	

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.

CHARTER BAGHOUSE
SOUTH INLET DUCT

1

3/31/03

DIAMETER
STACK AREA
STACK TEMPERATURE
PITOT COEFFICIENT
PERCENT WATER

90
44.18
140
0.84
1

BAR PRESSURE IN HG
STATIC PRESSURE IN H2O
STACK PRESSURE IN HG

29.25
-5
28.88

ORSAT CONSTITUENTS

O2	20.7
CO2	0
CO	0
N2	79.3

MOLECULAR WEIGHT DRY
MOLECULAR WEIGHT WET
NUMBER OF POINTS

28.99
28.88
24

POINT

DELTA P

VELOCITY

1	2.00	86.14
2	2.00	86.14
3	2.20	90.34
4	2.25	91.36
5	2.30	92.37
6	2.20	90.34
7	2.15	89.31
8	3.05	106.37
9	3.10	107.24
10	3.00	105.50
11	3.00	105.50
12	1.95	85.05
13	2.45	95.34
14	2.50	96.31
15	2.50	96.31
16	2.50	96.31
17	2.40	94.36
18	2.40	94.36
19	2.65	99.15
20	3.00	105.50
21	3.10	107.24
22	3.10	107.24
23	3.00	105.50
24	2.65	99.15

AVERAGE VELOCITY, AFPS

97.18

FLOW RATE

ACFM
DSCFM
M3/HR

257608
216645
368123

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.

CHARTER BAGHOUSE
CENTER INLET DUCT

1

3/31/03

DIAMETER
STACK AREA
STACK TEMPERATURE
PITOT COEFFICIENT
PERCENT WATER

90
44.18
136
0.84
1

BAR PRESSURE IN HG
STATIC PRESSURE IN H2O
STACK PRESSURE IN HG

29.25
-5
28.88

ORSAT CONSTITUENTS

O2	20.7
CO2	0
CO	0
N2	79.3

MOLECULAR WEIGHT DRY
MOLECULAR WEIGHT WET
NUMBER OF POINTS

28.99
28.88
24

POINT

DELTA P

VELOCITY

1	3.00	105.14
2	3.00	105.14
3	2.95	104.26
4	2.85	102.48
5	2.70	99.75
6	2.60	97.88
7	1.55	75.58
8	1.25	67.87
9	1.00	60.71
10	1.10	63.67
11	1.00	60.71
12	1.00	60.71
13	0.95	59.17
14	1.00	60.71
15	1.15	65.10
16	1.40	71.83
17	1.50	74.35
18	2.00	85.85
19	2.35	93.06
20	2.90	103.38
21	3.00	105.14
22	3.00	105.14
23	2.50	95.98
24	1.75	80.31

AVERAGE VELOCITY, AFPS

83.50

FLOW RATE

ACFM
DSCFM
M3/HR

221326
187381
318399

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.

CHARTER BAGHOUSE
NORTH INLET DUCT

1

3/31/03

DIAMETER
STACK AREA
STACK TEMPERATURE
PITOT COEFFICIENT
PERCENT WATER

90
44.18
139
0.84
1

BAR PRESSURE IN HG
STATIC PRESSURE IN H2O
STACK PRESSURE IN HG

29.25
-4.9
28.89

ORSAT CONSTITUENTS

O2	20.7
CO2	0
CO	0
N2	79.3

MOLECULAR WEIGHT DRY
MOLECULAR WEIGHT WET
NUMBER OF POINTS

28.99
28.88
24

POINT

DELTA P

VELOCITY

1	2.65	99.06
2	2.90	103.62
3	2.90	103.62
4	2.75	100.91
5	2.65	99.06
6	2.60	98.12
7	2.25	91.28
8	2.20	90.26
9	2.00	86.06
10	1.75	80.50
11	1.70	79.34
12	1.10	63.82
13	2.20	90.26
14	2.60	98.12
15	2.30	92.28
16	2.30	92.28
17	2.55	97.17
18	2.55	97.17
19	2.60	98.12
20	2.70	99.99
21	2.55	97.17
22	2.60	98.12
23	2.45	95.25
24	1.65	78.16

AVERAGE VELOCITY, AFPS

92.90

FLOW RATE

ACFM
DSCFM
M3/HR

246265
207504
352590

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.

CHARTER BAGHOUSE
SOUTH INLET DUCT

2

4/1/03

DIAMETER
STACK AREA
STACK TEMPERATURE
PITOT COEFFICIENT
PERCENT WATER

90
44.18
122
0.84
1

BAR PRESSURE IN HG
STATIC PRESSURE IN H2O
STACK PRESSURE IN HG

29.00
-5
28.63

ORSAT CONSTITUENTS

O2	20.7
CO2	0
CO	0
N2	79.3

MOLECULAR WEIGHT DRY
MOLECULAR WEIGHT WET
NUMBER OF POINTS

28.99
28.88
24

POINT

DELTA P

VELOCITY

1	2.20	89.36
2	2.30	91.37
3	2.35	92.36
4	2.30	91.37
5	2.30	91.37
6	2.25	90.37
7	2.55	96.21
8	2.90	102.60
9	3.20	107.78
10	3.20	107.78
11	3.10	106.08
12	2.00	85.21
13	2.50	95.26
14	2.55	96.21
15	2.60	97.15
16	2.50	95.26
17	2.45	94.31
18	2.50	95.26
19	2.90	102.60
20	3.00	104.36
21	3.15	106.93
22	3.20	107.78
23	3.15	106.93
24	2.80	100.82

AVERAGE VELOCITY, AFPS

98.11

FLOW RATE

ACFM
DSCFM
M3/HR

260073
223531
379823

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.

CHARTER BAGHOUSE
CENTER INLET DUCT

2

4/1/03

DIAMETER
STACK AREA
STACK TEMPERATURE
PITOT COEFFICIENT
PERCENT WATER

90
44.18
132
0.84
1

BAR PRESSURE IN HG
STATIC PRESSURE IN H2O
STACK PRESSURE IN HG

29.00
-5.1
28.63

ORSAT CONSTITUENTS

O2	20.7
CO2	0
CO	0
N2	79.3

MOLECULAR WEIGHT DRY
MOLECULAR WEIGHT WET
NUMBER OF POINTS

28.99
28.88
24

POINT

DELTA P

VELOCITY

1	3.25	109.56
2	3.15	107.86
3	3.00	105.26
4	3.00	105.26
5	2.90	103.49
6	2.75	100.78
7	1.60	76.87
8	1.35	70.61
9	1.00	60.77
10	1.15	65.17
11	1.00	60.77
12	0.95	59.23
13	1.00	60.77
14	1.00	60.77
15	1.30	69.29
16	1.50	74.43
17	1.55	75.66
18	2.00	85.95
19	2.75	100.78
20	3.00	105.26
21	3.00	105.26
22	3.10	107.00
23	2.75	100.78
24	2.00	85.95

AVERAGE VELOCITY, AFPS

85.73

FLOW RATE

ACFM
DSCFM
M3/HR

227250
191971
326197

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.CHARTER BAGHOUSE
NORTH INLET DUCT

2

4/1/03

DIAMETER
STACK AREA
STACK TEMPERATURE
PITOT COEFFICIENT
PERCENT WATER90
44.18
120
0.84
1BAR PRESSURE IN HG
STATIC PRESSURE IN H2O
STACK PRESSURE IN HG29.00
-5.1
28.63

ORSAT CONSTITUENTS

O2 20.7
CO2 0
CO 0
N2 79.3MOLECULAR WEIGHT DRY
MOLECULAR WEIGHT WET
NUMBER OF POINTS28.99
28.88
24

POINT

DELTA P

VELOCITY

1	2.75	99.75
2	3.05	105.05
3	2.85	101.55
4	2.85	101.55
5	2.70	98.84
6	2.70	98.84
7	2.35	92.21
8	2.25	90.23
9	2.10	87.17
10	1.90	82.92
11	1.75	79.58
12	1.15	64.51
13	2.45	94.16
14	2.75	99.75
15	2.80	100.66
16	2.90	102.44
17	3.00	104.19
18	2.85	101.55
19	2.50	95.11
20	2.50	95.11
21	2.65	97.92
22	2.70	98.84
23	2.50	95.11
24	1.70	78.43

AVERAGE VELOCITY, AFPS

94.40

FLOW RATE

ACFM
DSCFM
M3/HR250215
215744
366592

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.

CHARTER BAGHOUSE
SOUTH INLET DUCT
3 4/2/03

DIAMETER 90
STACK AREA 44.18
STACK TEMPERATURE 150
PITOT COEFFICIENT 0.84
PERCENT WATER 1

BAR PRESSURE IN HG 29.20
STATIC PRESSURE IN H2O -4.8
STACK PRESSURE IN HG 28.85

ORSAT CONSTITUENTS

O2 20.7
CO2 0
CO 0
N2 79.3

MOLECULAR WEIGHT DRY 28.99
MOLECULAR WEIGHT WET 28.88
NUMBER OF POINTS 24

POINT	DELTA P	VELOCITY
1	1.90	84.71
2	1.95	85.81
3	2.10	89.05
4	2.00	86.91
5	2.00	86.91
6	2.10	89.05
7	2.45	96.19
8	2.70	100.98
9	2.65	100.04
10	2.40	95.20
11	2.50	97.16
12	2.00	86.91
13	2.40	95.20
14	2.55	98.13
15	2.40	95.20
16	2.25	92.18
17	2.20	91.15
18	2.00	86.91
19	2.50	97.16
20	2.70	100.98
21	2.70	100.98
22	2.80	102.83
23	2.70	100.98
24	2.50	97.16

AVERAGE VELOCITY, AFPS 94.07

FLOW RATE

ACFM 249361
DSCFM 206019
M3/HR 350068

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.CHARTER BAGHOUSE
CENTER INLET DUCT

3

4/2/03

DIAMETER
STACK AREA
STACK TEMPERATURE
PITOT COEFFICIENT
PERCENT WATER90
44.18
142
0.84
1BAR PRESSURE IN HG
STATIC PRESSURE IN H2O
STACK PRESSURE IN HG29.20
-4.8
28.85

ORSAT CONSTITUENTS

O2 20.7
CO2 0
CO 0
N2 79.3MOLECULAR WEIGHT DRY
MOLECULAR WEIGHT WET
NUMBER OF POINTS28.99
28.88
24

POINT

DELTA P

VELOCITY

1	2.60	98.44
2	2.70	100.31
3	2.80	102.15
4	2.65	99.38
5	2.70	100.31
6	2.90	103.96
7	1.75	80.76
8	1.40	72.23
9	1.10	64.03
10	1.00	61.05
11	1.00	61.05
12	0.75	52.87
13	1.25	68.25
14	1.50	74.77
15	1.80	81.90
16	1.85	83.03
17	1.90	84.15
18	2.10	88.47
19	3.00	105.74
20	3.15	108.35
21	3.20	109.21
22	3.00	105.74
23	2.75	101.24
24	2.00	86.33

AVERAGE VELOCITY, AFPS

87.24

FLOW RATE

ACFM
DSCFM
M3/HR231242
193589
328946

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.CHARTER BAGHOUSE
NORTH INLET DUCT

3

4/2/03

DIAMETER
STACK AREA
STACK TEMPERATURE
PITOT COEFFICIENT
PERCENT WATER90
44.18
156
0.84
1BAR PRESSURE IN HG
STATIC PRESSURE IN H2O
STACK PRESSURE IN HG29.20
-4.8
28.85

ORSAT CONSTITUENTS

O2 20.7
CO2 0
CO 0
N2 79.3MOLECULAR WEIGHT DRY
MOLECULAR WEIGHT WET
NUMBER OF POINTS28.99
28.88
24

POINT

DELTA P

VELOCITY

1	2.20	91.59
2	2.35	94.67
3	2.35	94.67
4	2.25	92.63
5	2.20	91.59
6	2.10	89.49
7	1.85	83.99
8	1.85	83.99
9	1.70	80.52
10	1.40	73.07
11	1.25	69.04
12	1.00	61.75
13	1.85	83.99
14	2.10	89.49
15	2.15	90.55
16	2.15	90.55
17	2.10	89.49
18	2.00	87.33
19	2.00	87.33
20	2.20	91.59
21	2.30	93.65
22	2.40	95.67
23	2.15	90.55
24	2.00	87.33

AVERAGE VELOCITY, AFPS

86.86

FLOW RATE

ACFM
DSCFM
M3/HR230230
188361
320063

CHARTER STEEL
 2003 BAGHOUSE EAF STACK TESTS
 INLET FLOWS
 MARCH 31 - APRIL 2, 2003

TEST	SOUTH	CENTER	NORTH	TOTAL	
1	216645	187381	207504	611530 1039112	DSCFM M3/HR
2	223531	191971	215744	631246 1072613	DSCFM M3/HR
3	206019	193589	188361	587969 999077	DSCFM M3/HR
			AVERAGE	610248 1036934	DSCFM M3/HR

Subject: Charter Steel Production

Date: Thu, 10 Apr 2003 08:41:44 -0500

From: "Haase, Mark" <HaaseM@chartersteel.com>

To: "ETE-Bill Dick (E-mail)" <wjedick@execpc.com>

Bill- Here are the production numbers:

Run #1 (3/31/2003) = 81 tph

Run #2 (4/1/2003) = 72 tph

Run #3 (4/2/2003) = 87 tph

-Mark Haase
Charter Steel
262-268-2334

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APPENDIX B

Sample Calculations

PARTICULATE SAMPLE CALCULATION FORMULA

1. **DRY MOLECULAR WEIGHT (Md)** lb/lb-mole

$$Md = .44*\% \text{ CO}_2 + .32*\% \text{ O}_2 + .28*\% \text{ N}_2 + .28*\% \text{ CO}$$

2. **WATER VAPOR PERCENT (%H₂O)**

$$Vw \text{ std} = 0.04707*(V_f - V_i)$$

where: Vw std = standard cubic feet of water vapor

V_f = Final volume of impingers, ml

V_i = Initial volume of impingers, ml

$$\% \text{H}_2\text{O} = Vw \text{ std} * 100 / (Vm \text{ std} + Vw \text{ std})$$

where Vm std = standard cubic feet of gas sampled

3. **WET MOLECULAR WEIGHT (Ms)** lb/lb-mole

$$Ms = Md*(1 - \% \text{H}_2\text{O}/100) + 18*\% \text{H}_2\text{O}/100$$

4. **STACK PRESSURE (Ps)** in. Hg.

$$Ps = Pb + Pg/13.6$$

where: Pb = barometric pressure (uncorrected), in. Hg

Pg = stack gauge pressure, in. H₂O

13.6 = specific gravity of mercury (Hg)

5. **AVERAGE STACK VELOCITY (vs)** feet per second

$$Vs = Kp * Cp * DELP * (Tsavg / (Ps * Ms))^{0.5}$$

where: Kp = 85.49 unit conversion

Cp = 0.84, pitot tube calibration factor

DELP = average of square root of velocity head, in. H₂O

Tsavg = average stack temperature, deg R (460+F)

Ps = stack pressure

Ms = wet molecular weight

6. **STACK GAS FLOW RATE (Qs)** std. cubic feet per minute

$$Q_s = 60 \cdot (1 - \%H_2O/100) \cdot V_s \cdot A \cdot (528 \cdot P_s / T_{savg} / 29.92)$$

where: A = stack area, ft²
528 = std temperature, deg R
29.92 = std pressure, in. Hg

7. **DRY GAS VOLUME (Vmstd)** dry std. cubic feet

$$V_{m \text{ std}} = GAMAC \cdot (P_b + DELH / 13.6) / 29.92$$

where: GAMAC = dry gas meter calibration factor corrected for
meter temperature $(GAMA + (T_m - 70) \cdot .00012)$

Vm = volume of dry gas metered, cubic feet

Tm = average meter temperature, degrees F

DELH = average orifice pressure drop, in. H₂O

8. **PARTICULATE CONCENTRATION (cs)** grains per dry standard
cubic foot

$$C_s = M_n \cdot 15.43 / V_{m \text{ std}}$$

where: Mn = particulate captured, grams

15.43 = grains per gram

9. **EMISSION RATE (ER)** pounds per hour

$$PMRA = M_n \cdot A \cdot 60 / (t \cdot A_n \cdot 453.6) \quad \text{AREA METHOD lb/hr}$$

$$PMRC = C_s \cdot Q_s \cdot 60 / (15.43 \cdot 453.6) \quad \text{CONC. METHOD lb/hr}$$

$$ER = (PMRA + PMRC) / 2$$

where: An = area of sampling nozzle, square feet

10. **EMISSION CONCENTRATION (EC)** lb/1000 lb exhaust gas

$$EC = ER \cdot 386700 \cdot (1 - \%H_2O/100) / (Q_s \cdot 60 \cdot M_s)$$

where: 386700 = cubic feet per lb mole * 1000

11. **ISOKINETIC SAMPLING PERCENTAGE (I)**

$$I = PMRA / PMRC$$

0053
SE-STK-1268

Report to

CHARTER STEEL DIVISION

Saukville, Wisconsin

for

STACK EMISSION TESTS

ELECTRIC ARC FURNACE BAGHOUSE P01

WDNR AIR POLLUTION CONTROL PERMIT NO.

246044700-P01

April 12 – 14, 2005

by

ENVIRONMENTAL TECHNOLOGY & ENGINEERING CORPORATION

13000 West Bluemound Road

Elm Grove, Wisconsin 53122

Phone 262-784-2434

Fax 262-784-2436

ETE

RECEIVED

JUN 07 2005

AIR MANAGEMENT

SUMMARY

During the period of April 12-14, 2005, Environmental Technology & Engineering Corp. personnel performed stack emissions testing at the Charter Steel facility located in Saukville, Wisconsin. The tests were performed on the electric arc furnace (EAF) baghouse as a provision of an Air Pollution Control Permit issued by the State of Wisconsin Department of Natural Resources. Tests were performed in order to determine compliance with the applicable particulate, PM10, and carbon monoxide emission limitations. All measured emissions and the permit limits are shown in the following table:

TEST NO.	PARTICULATE	PM10	CARBON MONOXIDE
1	1.86 lb/hr	1.70 lb/hr	269.04 lb/hr 3.02 lb/ton
2	1.93	1.77	147.32 1.59
3	2.05	1.87	170.65 1.92
AVERAGE	1.95 lb/hr	1.78 lb/hr	195.67 lb/hr 2.18 lb/ton
DNR LIMIT	6.05	5.56	3.50
% OF LIMIT	32.2 %	32.0 %	62.2 %

All tested parameters were well below the permit limitations.

1.0 GENERAL

During the period of April 12-14, 2005, Environmental Technology & Engineering Corp. (ETE) personnel performed stack emissions testing at the Charter Steel facility located in Saukville, Wisconsin. The purpose of the testing was to determine the emissions from the electric arc furnace baghouse as a condition of an Air Pollution Control Permit issued by the State of Wisconsin Department of Natural Resources (WDNR).

Tests were performed over three consecutive days in order to determine the compliance status of the particulate matter, PM10, and carbon monoxide emissions with the limits set in the permit. Mark Haase of Charter Steel was responsible for assuring proper operating conditions throughout the testing. All testing was coordinated with Mark Haase. A copy of the melt rate during each test period is included in the APPENDIX to this report. Ron Dillahunt of the Wisconsin DNR witnessed the field tests, process, and baghouse operation. ETE personnel performed the field tests, corresponding laboratory analysis, and report preparation; Bill Dick was the test team leader.

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

2.0 RESULTS

Isokinetic sampling for particulate matter and PM10 were performed in accordance with a combination of the procedures outlined in EPA Method 17 and Method 201A.

Particulate samples were also analyzed for condensibles in accordance with Method 202. Carbon monoxide samples were collected and analyzed in accordance with EPA Method 10. A brief summary of the methods is included in section 3.0 of this report.

The tests were performed in the final discharge at the location shown in Figure 2-1. Detailed results of the testing to determine particulate matter, PM10, and CO Tables 2-1 through 2-3.

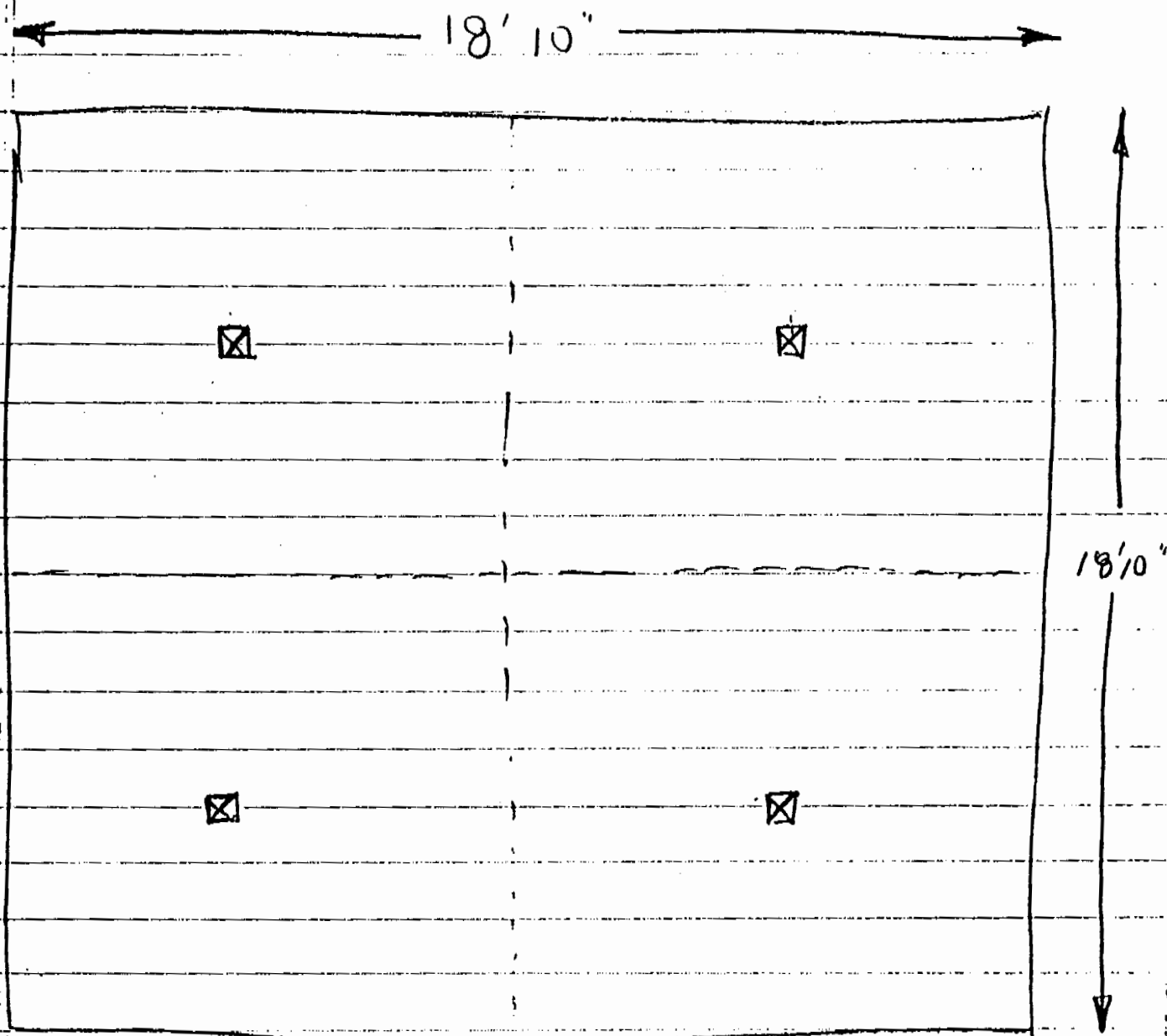
The results are summarized below:

TEST NO.	PARTICULATE	PM10	CARBON MONOXIDE
1	1.86 lb/hr	1.70 lb/hr	269.04 lb/hr 3.02 lb/ton
2	1.93	1.77	147.32 1.59
3	2.05	1.87	170.65 1.92
AVERAGE	1.95 lb/hr	1.78 lb/hr	195.67 lb/hr 2.18 lb/ton
DNR LIMIT	6.05	5.56	3.50
% OF LIMIT	32.2 %	32.0 %	62.2 %

All tested parameters were well below the permit limitations.

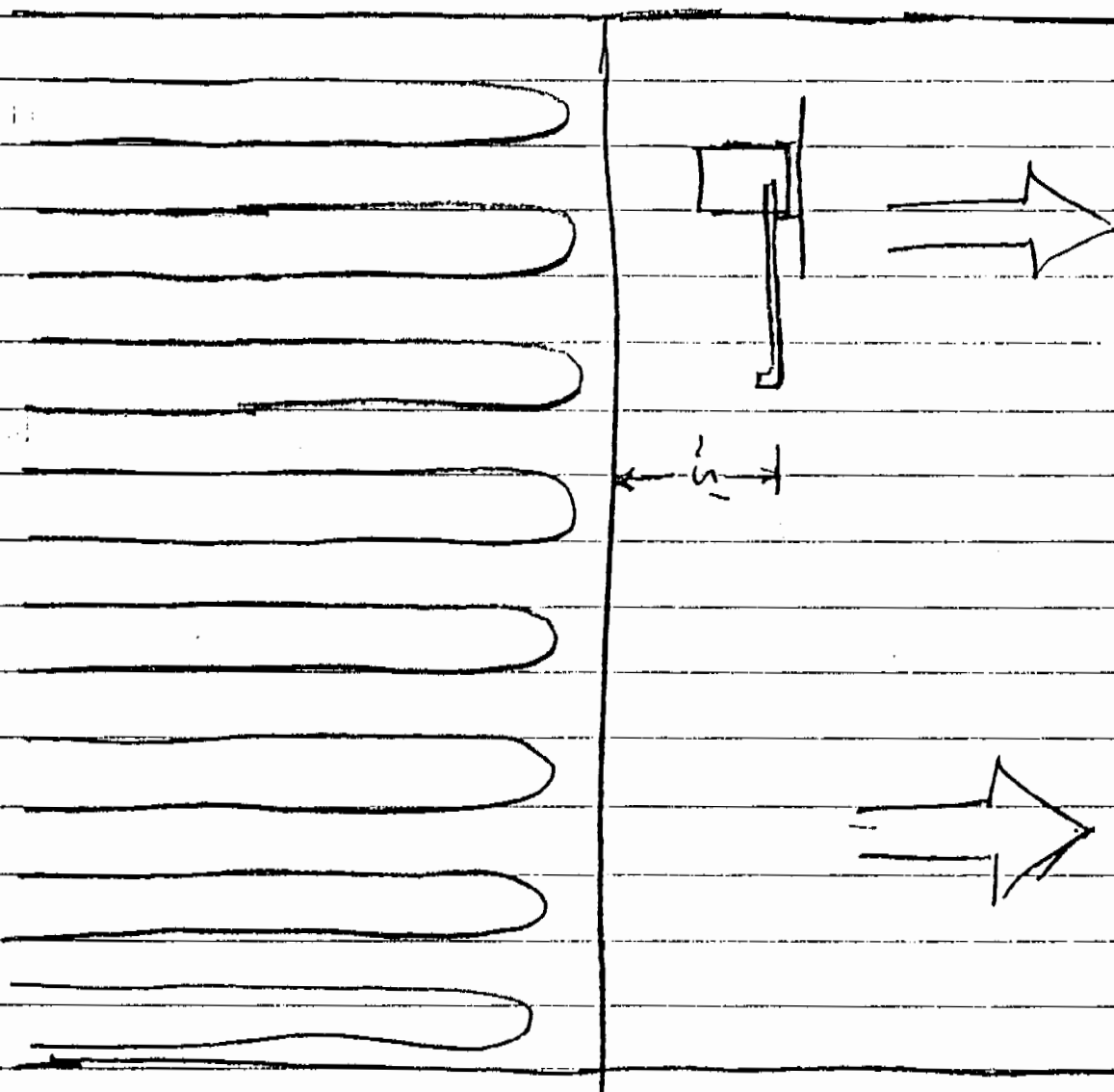
Figure 2-1A

CHARTER STEEL
BAYHOUSE COMPARTMENTS
PLAN VIEW



☒ SAMPLING LOCATION AT CENTER
OF EACH OF FOUR QUADRANTS.

Figure 2-13

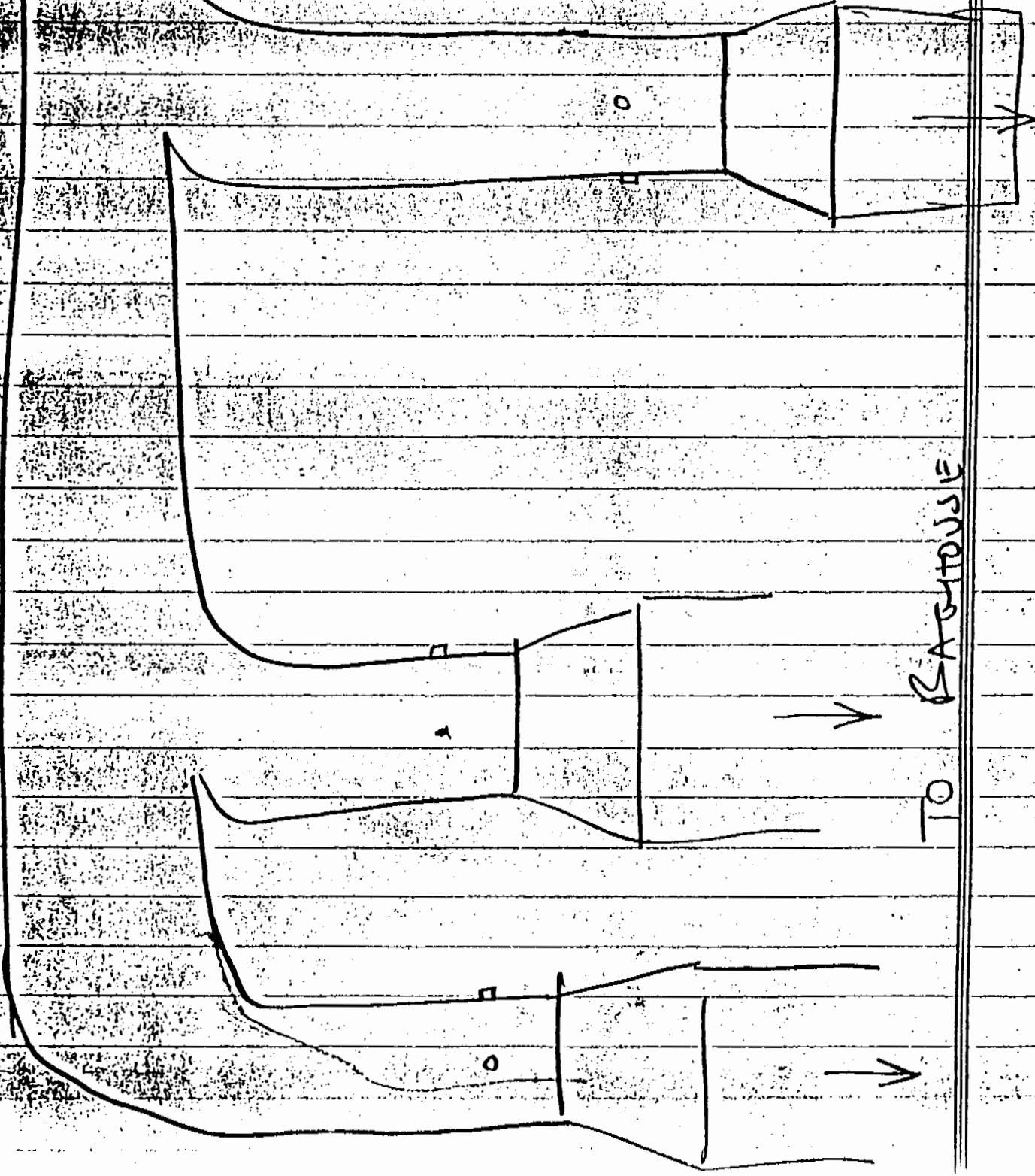


CHARTEL STEEL
BAGHOUSE COMPARTMENTS
ELEVATION

INLET VELOCITY LOCATIONS

FROM
COLLECTION
POINT

2-76
ENTR



CHARTER STEEL BAGHOUSE

12-Apr-05

TABLE 2-1

TEST NO.	1	
BAROMETRIC PRESSURE	29.25	IN HG
TIP DIAMETER	1.025	IN
STACK AREA	4256.330	FT2
SAMPLING TIME PER COMPARTMENT	20.0	MIN
NUMBER OF COMPARTMENTS	12	
METER VOLUME	182.29	FT3
PITOT COEFFICIENT	0.84	
METER COEFFICIENT	1.003	
PARTICULATE COLLECTED	0.0047	GRAMS
PM10 COLLECTED	0.0043	GRAMS
WATER COLLECTED	16	ML
STATIC PRESSURE	0	IN H2O
CARBON MONOXIDE	118	PPM
MELT RATE	89	TPH

ORSAT RESULTS

CO2
0.40%O2
20.40%CO
0.00%N2
79.20%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	118	0.0022	2.00	58	2.78
2	128	0.0022	2.00	68	2.80
3	178	0.0022	2.00	82	2.92
4	132	0.0022	2.00	100	2.81
5	118	0.0022	2.00	108	2.78
6	147	0.0022	2.00	112	2.85
7	153	0.0022	2.00	120	2.86
8	138	0.0022	2.00	126	2.83
9	124	0.0022	2.00	130	2.80
10	179	0.0022	2.00	136	2.92
11	128	0.0022	2.00	138	2.80
12	154	0.0022	2.00	140	2.87
AVERAGE	141		2.00	110	2.84

DRY STANDARD VOLUME	180.50	SCF
PERCENT WATER VAPOR	0.42	% VOL
FLOW RATE	724291	ACFM
	521692	DSCFM
	886459	M3/HR
PARTICULATE CONCENTRATION	0.0004	GR/DSCF
PARTICULATE EMISSION RATE	1.86	LB/HR
PM10 EMISSION RATE	1.70	LB/HR
LB PART PER 1000 LB GAS	0.0008	
ISOKINETIC PERCENT	107.1	
CARBON MONOXIDE EMISSION RATE	269.04	LB/HR
CARBON MONOXIDE EMISSIONS	3.02	LB/TON

CHARTER STEEL BAGHOUSE

13-Apr-05

TABLE 2-2

TEST NO.	2	
BAROMETRIC PRESSURE	29.40	IN HG
TIP DIAMETER	1.025	IN
STACK AREA	4256.330	FT2
SAMPLING TIME PER COMPARTMENT	20.0	MIN
NUMBER OF COMPARTMENTS	12	
METER VOLUME	182.56	FT3
PITOT COEFFICIENT	0.84	
METER COEFFICIENT	1.003	
PARTICULATE COLLECTED	0.0048	GRAMS
PM10 COLLECTED	0.0044	GRAMS
WATER COLLECTED	15	ML
STATIC PRESSURE	0	IN H2O
CARBON MONOXIDE	62	PPM
MELT RATE	92.5	TPH

ORSAT RESULTS

CO2
0.40%O2
20.40%CO
0.00%N2
79.20%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	137	0.0019	2.00	100	2.62
2	137	0.0019	2.00	102	2.62
3	158	0.0019	2.00	110	2.67
4	147	0.0019	2.00	111	2.64
5	165	0.0019	2.00	112	2.68
6	165	0.0019	2.00	113	2.68
7	170	0.0019	2.00	110	2.69
8	131	0.0019	2.00	102	2.61
9	146	0.0019	2.00	99	2.64
10	162	0.0019	2.00	100	2.67
11	152	0.0019	2.00	92	2.65
12	165	0.0019	2.00	92	2.68
AVERAGE	153		2.00	104	2.65

DRY STANDARD VOLUME	181.55	SCF
PERCENT WATER VAPOR	0.39	% VOL
FLOW RATE	677791	ACFM
	543678	DSCFM
	923818	M3/HR
PARTICULATE CONCENTRATION	0.0004	GR/DSCF
PARTICULATE EMISSION RATE	1.93	LB/HR
PM10 EMISSION RATE	1.77	LB/HR
LB PART PER 1000 LB GAS	0.0008	
ISOKINETIC PERCENT	103.4	
CARBON MONOXIDE EMISSION RATE	147.32	LB/HR
CARBON MONOXIDE EMISSIONS	1.59	LB/TON

CHARTER STEEL BAGHOUSE

14-Apr-05

TABLE 2-3

TEST NO.	3	
BAROMETRIC PRESSURE	29.55	IN HG
TIP DIAMETER	1.000	IN
STACK AREA	4256.330	FT2
SAMPLING TIME PER COMPARTMENT	20.0	MIN
NUMBER OF COMPARTMENTS	12	
METER VOLUME	180.01	FT3
PITOT COEFFICIENT	0.84	
METER COEFFICIENT	1.003	
PARTICULATE COLLECTED	0.0046	GRAMS
PM10 COLLECTED	0.0042	GRAMS
WATER COLLECTED	9	ML
STATIC PRESSURE	0	IN H2O
CARBON MONOXIDE	62	PPM
MELT RATE	89	TPH

ORSAT RESULTS

CO2
0.50%O2
20.30%CO
0.00%N2
79.20%

POINT	STACK TEMP DEG F	DELTA P IN H2O	ORIFICE DEL P IN H2O	METER TEMP DEG F	VELOCITY AFPS
1	201	0.0020	2.00	108	2.82
2	148	0.0020	2.00	110	2.70
3	161	0.0020	2.00	116	2.73
4	162	0.0020	2.00	120	2.73
5	148	0.0020	2.00	124	2.70
6	152	0.0020	2.00	128	2.71
7	157	0.0020	2.00	130	2.72
8	160	0.0020	2.00	134	2.73
9	129	0.0020	2.00	135	2.66
10	151	0.0020	2.00	137	2.71
11	149	0.0020	2.00	139	2.71
12	162	0.0020	2.00	140	2.73
AVERAGE	157		2.00	127	2.72

DRY STANDARD VOLUME	180.42	SCF
PERCENT WATER VAPOR	0.23	% VOL
FLOW RATE	695383	ACFM
	629805	DSCFM
	1070165	M3/HR
PARTICULATE CONCENTRATION	0.0004	GR/DSCF
PARTICULATE EMISSION RATE	2.05	LB/HR
PM10 EMISSION RATE	1.87	LB/HR
LB PART PER 1000 LB GAS	0.0007	
ISOKINETIC PERCENT	93.2	
CARBON MONOXIDE EMISSION RATE	170.65	LB/HR
CARBON MONOXIDE EMISSIONS	1.92	LB/TON

3.0 METHODS

3.1 Particulate and PM10

The equipment used to sample was the Western Precipitation Division of the Joy Manufacturing Company Emission Parameter Analyzer. Samples were collected in accordance with EPA Method 17(particulate) and Method 201A (PM10). In addition, the condensible particulate was determined using EPA Method 202.

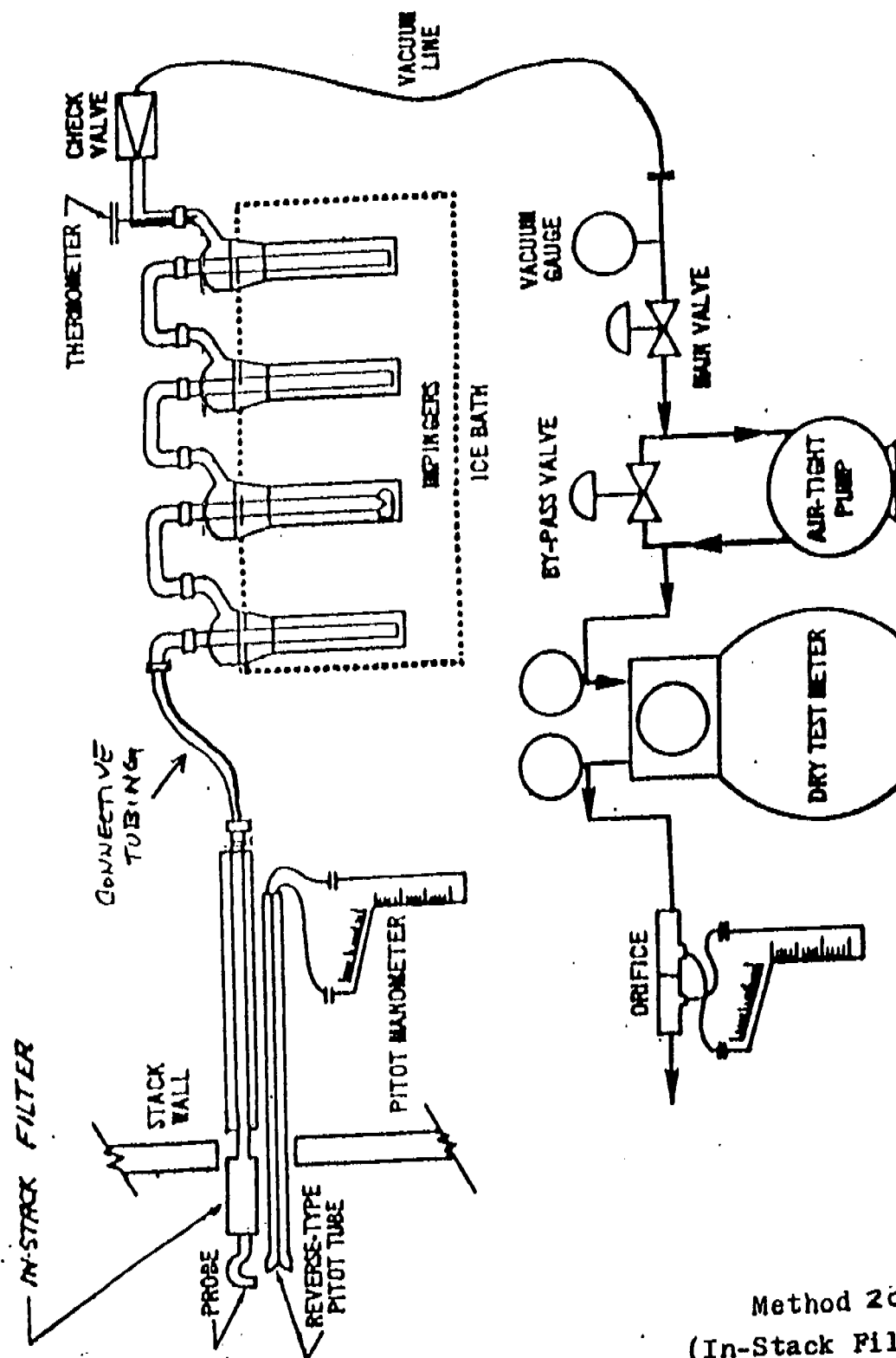
The sampling train consisted of a probe tip, a cascade impactor head with a series of seven plates and corresponding filters. A series of four impingers followed in an ice bath. The first was a modified Greenburg-Smith impinger with 100 ml of nitric acid/hydrogen peroxide solution; the second was a Greenburg-Smith impinger with 100 ml of the same solution; the third was a modified Greenburg Smith impinger dry; and 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 velocity traverse at the three baghouse inlet ducts 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 calculate the total system airflow. The velocities in the test compartments were then calculated from the airflow and the compartment areas. A probe tip was selected to optimize a sampling rate for a cut size of 10 microns through the impactor.

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.

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 impinger contents were then analyzed for condensible particulate in accordance with Method 202 procedures. The probe tip washings and impactor filters were weighed for the determination of front half particulate matter. This weight was combined with the condensible weight gain to determine the total particulate. The PM10 weight gain was determined to be the sum of the filter weight fraction greater than 10 microns plus the condensible weight gain.



Method 202
(In-Stack Filter)

Particulate sampling train.

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

3.2 Carbon Monoxide

Sampling for carbon monoxide was performed in accordance with the procedures outlined in EPA Method 10 -- "Determination of Carbon Monoxide Emissions from Stationary Sources" - as published in the Federal Register. Time integrated bag samples were extracted from the exhaust gas stream and analyzed for carbon monoxide concentration using a Horiba nondispersive infrared analyzer (NDIR). The analyzer was calibrated with span gas and zero gas prior to and following each hour of testing. The calibration gas was introduced into a tedlar bag through the sampling apparatus, similar to the exhaust gas sampled.

4.0 CALIBRATIONS

4.1 Particulate & PM10

The probe tip, pitot tube, dry gas meter, and orifice were calibrated prior to the test according to standard procedures as to procedures published by the EPA. The values obtained were:

DATE	PARAMETER	VALUE
April 8, 2005	Probe Tip Diameters	1.00" & 1.025"
	Pitot Coefficient	0.84
	Dry Gas Meter	1.003
	Orifice Factor	1.802

APPENDIX A

Field and Laboratory Data

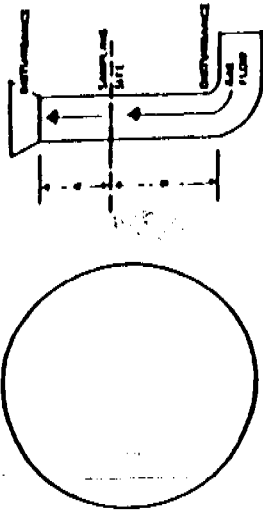
CHARTER STEEL
EAF BAGHOUSE
April 12-14, 2005

	TEST 1 4/12/05	TEST 2 4/13/05	TEST 3 4/13/05	AVERAGE	DNR PERMIT LIMIT & PERCENT OF LIMIT	
C O						
ppm	118.00	62.00	62.00	80.67		
mg/m3	137.67	72.33	72.33	94.11		
lb/hr	269.04	147.32	170.65	195.67		
lb/ton	3.023	1.593	1.917	2.178	3.50 62.22	lb/ton %
PART						
lb/hr	1.86	1.93	2.05	1.95	6.05 32.18	lb/hr %
PM10						
lb/hr	1.70	1.77	1.87	1.78	5.56 32.01	lb/hr %
AIR FLOW						
dscfm	521693	543678	629805	565059		
m3/hr	886461	923818	1070165	960148		
MELT RATE						
ton/hr	89.00	92.50	89.00	90.17		

%

PARTICULATE FIELD DATA

PLANT CHARTER AMBIENT TEMPERATURE _____
 DATE 6-12-05 BAROMETRIC PRESSURE _____
 LOCATION SAN JUAN ASSUMED MOISTURE % _____
 OPERATOR WJD PROBE LENGTH, in. _____
 STACK NO. 3A E (S) NOZZLE DIAMETER, in. _____
 RUN NO. _____ STACK DIAMETER, in. _____
 SAMPLE BOX NO. 2A PROBE HEATER SETTING _____
 METER BOX NO. _____ HEATER BOX SETTING _____



CROSS SECTION

TRAVERSE POINT NUMBER	SAMPLING TIME (Hr.)	STATIC PRESSURE (in. H ₂ O)	STACK TEMPERATURE (T _{st}), °F	VELOCITY HEAD (VP) (1/VP) ³	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in. H ₂ O) ACTUAL DESIRED	GAS SAMPLE VOLUME (V _g), 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/min
1	006	12	106/157/112		2.00	908.0	INLET (T _{in}), °F	OUTLET (T _{out}), °F		35	3	
2	26	120	153/125/131		2.00	24.0	63					
3	46	17	153/125/125	172	2.00	37.8	82					
4	04	132	153/125/131	142	2.00	58.6	100			38	5	
5	26	112	133/125/106	112	2.00	70.6	108					
6	06	157	124/126/157	182	2.00	85.0	112					
7	06	153	122/126/138	116	2.00	100.6	120					
8	26	138	131/125/127	105	2.00	15.2	126					
9	46	127	125/127/150	12	2.00	30.0	130			45		
10	06	179	177/100/205	133	2.00	46.4	136					
11	26	122	133/125/118	131	2.00	60.4	138				5	
12	46	124	157/181/146	136	2.00	75.6	140			50		
1404					2.00	1090.25	142					
						(18.7)						

Set I

ORSAT RESULTS
 CO₂ _____
 CO _____
 N₂ _____

PROCESS WEIGHT RATE _____

C FACTOR _____

ARBIENT TEMPERATURE _____

BAROMETRIC PRESSURE _____

ASSUMED MOISTURE % _____

PROBE LENGTH, in. _____

NOZZLE DIAMETER, in. _____

STACK DIAMETER, in. _____

PROBE HEATER SETTING _____

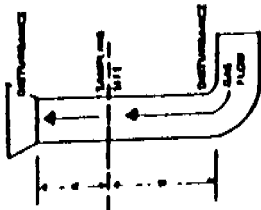
HEATER BOX SETTING _____

LEAK CHECK

Pre _____
 Pitot _____
 on Post _____
 on Pitot _____

PARTICULATE FIELD DATA

PLANT SARIN
 DATE 4-13-01
 LOCATION SACKVILLE
 OPERATOR WJD
 STACK NO. CAF BAKTON
 RUN NO. 2
 SAMPLE BOX NO. 2
 METER BOX NO. 1



CROSS SECTION

AMBIENT TEMPERATURE 29.60
 BAROMETRIC PRESSURE 29.60
 ASSUMED MOISTURE %
 PROBE LENGTH, in.
 NOZZLE DIAMETER, in.
 STACK DIAMETER, in.
 PROBE HEATER SETTING
 HEATER BOX SETTING

WEIER A.H. SAGTEST-1
 C FACTOR
 PROCESS WEIGHT RATE
 SEAT RESULTS
 CO2
 CO
 N2
 LEAK CHECK
 Pre
 Pitot
 on Post
 on Pitot

SET 'M'

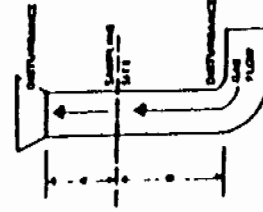
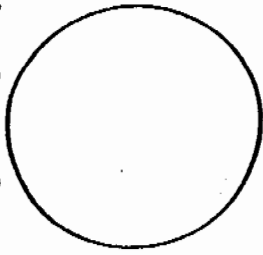
TRAVERSE POINT NUMBER	SAMPLING TIME (M), min	STATIC PRESSURE (in. H ₂ O)	STACK TEMPERATURE (T ₁), °F	VELOCITY HEAD (V.P.), (in. H ₂ O)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in. H ₂ O)	GAS SAMPLE VOLUME (V _m), ft ³	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET (T _{m1}), °F	OUTLET (T _{m2}), °F	SAMPLE BOX TEMPERATURE °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER °F	PUMP VACUUM (in. Hg gauge)	VELOCITY fps
1	0910	137	138/135/137/143	2.00	2.00	092.0	100	102	31	31	5	
2	0915	137	152/122/124/135	2.00	2.00	107.2	102	110				
3	0920	138	127/142/170/172	2.00	2.00	122.2	110	112				
4	0925	147	146/132/131/105	2.00	2.00	37.3	112	113				
5	0930	147	128/175/170/163	2.00	2.00	52.5	112	113				
6	0935	147	140/135/136/138	2.00	2.00	67.3	113	110				
7	0940	147	128/192/148/133	2.00	2.00	83.0	110	102				
8	0945	151	142/142/123/132	2.00	2.00	93.4	102	99				
9	0950	146	138/146/144/154	2.00	2.00	213.7	100	100				
10	0955	162	184/187/146/136	2.00	2.00	28.9	92	92				
11	1000	152	142/162/155/150	2.00	2.00	244.1	92	92				
12	1005	160	159/162/193/156	2.00	2.00	59.9	92	92				
13	1010	160	159/162/193/156	2.00	2.00	274.3	92	92				
14	1015	160	159/162/193/156	2.00	2.00	274.3	92	92				
15	1020	160	159/162/193/156	2.00	2.00	274.3	92	92				
16	1025	160	159/162/193/156	2.00	2.00	274.3	92	92				
17	1030	160	159/162/193/156	2.00	2.00	274.3	92	92				
18	1035	160	159/162/193/156	2.00	2.00	274.3	92	92				
19	1040	160	159/162/193/156	2.00	2.00	274.3	92	92				
20	1045	160	159/162/193/156	2.00	2.00	274.3	92	92				
21	1050	160	159/162/193/156	2.00	2.00	274.3	92	92				
22	1055	160	159/162/193/156	2.00	2.00	274.3	92	92				
23	1100	160	159/162/193/156	2.00	2.00	274.3	92	92				
24	1105	160	159/162/193/156	2.00	2.00	274.3	92	92				
25	1110	160	159/162/193/156	2.00	2.00	274.3	92	92				
26	1115	160	159/162/193/156	2.00	2.00	274.3	92	92				
27	1120	160	159/162/193/156	2.00	2.00	274.3	92	92				
28	1125	160	159/162/193/156	2.00	2.00	274.3	92	92				
29	1130	160	159/162/193/156	2.00	2.00	274.3	92	92				
30	1135	160	159/162/193/156	2.00	2.00	274.3	92	92				

PARTICULATE FIELD DATA

See Test-1

City of

Technology & Engineering Corp.



CROSS SECTION

C FACTOR _____

PROCESS WEIGHT RATE _____

ORSAT RESULTS

Base

CO2 _____

O2 _____

CO _____

N2 _____

SET

LEAK CHECK

Pre *OK*

Pitot *OK*

Expost *OK*

OK Pitot *OK*

DATE 5-14-68 BAROMETRIC PRESSURE _____
LOCATION SAUKVILLE ASSUMED MOISTURE % _____
OPERATOR WJD PROBE LENGTH, in. _____
STACK NO. EAF-1 NOZZLE DIAMETER, in. _____
RUN NO. 3 STACK DIAMETER, in. _____
SAMPLE BOX NO. 2 PROBE HEATER SETTING _____
METER BOX NO. 1 HEATER BOX SETTING _____

TRAVERSE POINT NUMBER	SAMPLING TIME (H), MIN.	STATIC PRESSURE (in. H ₂ O)	STACK TEMPERATURE (T _s), °F	VELOCITY HEAD (V _p) (1/12 P)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔP) (in. H ₂ O)	ACTUAL DESIRED	GAS SAMPLE VOLUME (Vol.), 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 gauge)	VELOCITY (ft/s)
1	0400	20.1	176/195/205/233	2.00	2.00	277.0	108	35	5				
2	20	14.9	152/136/141/160	2.00	2.00	92.2	110	35	5				
3	40	16.1	170/162/157/151	2.00	2.00	307.4	116	35	5				
4	1000	16.2	135/116/106/100	2.00	2.00	22.5	120	35	5				
5	20	14.5	150/153/148/142	2.00	2.00	37.8	124	35	5				
6	40	15.2	140/144/135/147	2.00	2.00	53.0	128	35	5				
7	1100	15.7	150/142/140/135	2.00	2.00	68.0	130	35	5				
8	20	16.0	149/140/141/132	2.00	2.00	82.5	134	35	5				
9	40	12.5	133/124/116/132	2.00	2.00	97.4	135	35	5				
10	1200	15.1	140/172/138/154	2.00	2.00	413.1	137	35	5				
11	20	16.0	169/152/134/147	2.00	2.00	27.8	139	35	5				
12	40	16.2	157/184/140/150	2.00	2.00	42.3	140	35	5				
13	1500					457.01							
						100.01							

LABORATORY DATA SHEET
PARTICULATE WITH METHOD 202 BACKHALF ANALYSIS

JOB NAME CHARTER DATE OF TEST 4-12-05
 JOB NO. _____ TEST ENGINEER WTD
 RUN NO. 1 STACK PAVHOUSE
 SAMPLE BOX 2 FILTER NUMBER _____
 BEAKERS: FH Acetone _____ BH MetCl 1 BH Water A

WATER COLLECTED

Impinger No.	Final Wt (g)	Initial Wt (g)	Water Collected (g)
<u>1</u>	<u>87</u>	<u>100</u>	<u>-13</u>
<u>2</u>	<u>100</u>	<u>100</u>	<u>0</u>
<u>3</u>	<u>100</u>	<u>100</u>	<u>0</u>
Sil Gel	<u>706</u>	<u>677</u>	<u>29</u>
WATER TOTAL -			<u>16</u>

PARTICULATE COLLECTED

	Blank	Final Wt (g)	Tare Wt (g)	Net Wt Gain (g)
Filter				
FH Wash				
FRONT HALF TOTAL -				
Extract	<u>.0005</u>	<u>68.5766</u>	<u>68.5761</u>	<u>.0000</u>
Water	<u>.0003</u>	<u>115.5621</u>	<u>115.5597</u>	<u>.0021</u>
BACK HALF TOTAL -				<u>.0021</u>
TOTAL PARTICULATE -				

Comments:

TOTAL PM .0047
 PM10 .0043

LABORATORY DATA SHEET
PARTICULATE WITH METHOD 202 BACKHALF ANALYSIS

JOB NAME CHARTER DATE OF TEST 4-13-05
 JOB NO. _____ TEST ENGINEER WTD
 RUN NO. 2 STACK BAL HOUSE
 SAMPLE BOX 2 FILTER NUMBER _____
 BEAKERS: FH Acetone _____ BH MetCl 2 BH Water B

WATER COLLECTED

Impinger No.	Final Wt (g)	Initial Wt (g)	Water Collected (g)
<u>1</u>	<u>90</u>	<u>100</u>	<u>-10</u>
<u>2</u>	<u>102</u>	<u>100</u>	<u>2</u>
<u>3</u>	<u>101</u>	<u>100</u>	<u>1</u>
Sil Gel	<u>694</u>	<u>671</u>	<u>23</u>
WATER TOTAL -			<u>15</u>

PARTICULATE COLLECTED

	Blank	Final Wt (g)	Tare Wt (g)	Net Wt Gain (g)
Filter				
FH Wash				
FRONT HALF TOTAL -				
Extract	<u>.0005</u>	<u>89.1534</u>	<u>89.1524</u>	<u>.0005</u>
Water	<u>.0003</u>	<u>113.5301</u>	<u>113.5279</u>	<u>.0019</u>
BACK HALF TOTAL -				<u>.0024</u>
TOTAL PARTICULATE -				

Comments:

TOTAL PM .0048
 PM10 .0044

**LABORATORY DATA SHEET
PARTICULATE WITH METHOD 202 BACKHALF ANALYSIS**

JOB NAME CHARTER DATE OF TEST 4-14-05
 JOB NO. _____ TEST ENGINEER WJD
 RUN NO. 3 STACK Baghouse
 SAMPLE BOX 2 FILTER NUMBER _____
 BEAKERS: FH Acetone _____ BH MetCl 3 BH Water C

WATER COLLECTED

Impinger No.	Final Wt (g)	Initial Wt (g)	Water Collected (g)
<u>1</u>	<u>85</u>	<u>100</u>	<u>-15</u>
<u>2</u>	<u>90</u>	<u>100</u>	<u>-10</u>
<u>3</u>	<u>106</u>	<u>100</u>	<u>6</u>
Sil Gel	<u>714</u>	<u>686</u>	<u>28</u>
WATER TOTAL -			<u>9</u>

PARTICULATE COLLECTED

	Blank	Final Wt (g)	Tare Wt (g)	Net Wt Gain (g)
Filter				
FH Wash				
FRONT HALF TOTAL -				
Extract	<u>.0005</u>	<u>68.6518</u>	<u>68.6513</u>	<u>.0000</u>
Water	<u>.0003</u>	<u>110.2406</u>	<u>110.2382</u>	<u>.0021</u>
BACK HALF TOTAL -				<u>.0021</u>
TOTAL PARTICULATE -				

Comments:

Total PM .0046
PM10 .0042

FLOW DATA SHEET

CLIENT	Charter Steel
PROCESS	EAF Baghouse Inlet Ducts
DATE	4-12-05
BAROMETRIC PRESSURE	29.21
PITOT COEFF.	0.84
DIAMETER	90 " each

7000 - 0.5

DUCT	SOUTH		CENTER		NORTH	
PORT	1	2	1	2	1	2
POINT	DEL P	DEL P	DEL P	DEL P	DEL P	DEL P
1	1.75	1.35	1.85	.75	2.05	2.50
2	1.65	1.40	1.60	.75	2.00	2.90
3	1.50	1.40	1.60	.80	1.75	3.20
4	1.40	1.40	1.55	.75	1.65	2.35
5	1.40	1.25	1.55	.75	1.55	2.05
6	1.35	1.25	1.50	.90	1.45	1.95
7	1.45	1.55	1.35	1.50	1.50	1.75
8	1.60	1.60	1.55	1.55	1.60	1.75
9	1.80	1.75	1.50	1.55	1.55	1.90
10	1.95	1.75	1.50	1.70	1.55	1.95
11	1.95	1.75	1.65	1.70	1.55	1.95
12	1.90	1.90	1.25	1.70	1.20	1.55
TEMP	250		242		240	
STATIC	-5.0		-5.2		-5.0	

cor. o.f.
0.2

FLOW DATA SHEET

CLIENT	Charter Steel
PROCESS	EAF Baghouse Inlet Ducts
DATE	4-13-05
BAROMETRIC PRESSURE	29.60
PITOT COEFF	0.84
DIAMETER	90 " each

DUCT	SOUTH		CENTER		NORTH	
PORT	1	2	1	2	1	2
POINT	DEL P	DEL P	DEL P	DEL P	DEL P	DEL P
1	1.75	2.75	2.25	1.25	2.15	2.15
2	1.80	2.80	2.20	1.25	2.10	1.95
3	1.75	2.80	2.15	1.40	2.10	1.95
4	1.65	2.70	2.25	1.55	1.95	1.85
5	1.65	1.65	2.00	1.75	1.80	1.85
6	1.75	1.70	1.95	1.90	1.90	1.75
7	1.80	2.05	1.80	2.25	1.55	1.40
8	1.95	2.10	1.25	2.40	1.60	1.60
9	2.00	2.20	1.00	2.40	1.75	1.90
10	2.20	2.25	1.00	2.35	1.70	1.85
11	2.25	2.35	.95	2.25	1.60	1.75
12	2.30	2.25	.90	2.10	1.45	1.50
TEMP	17.8		17.5		16.0	
STATIC	-5.4		-5.5		-5.5	

CO₂ 0.1 F

FLOW DATA SHEET

CLIENT	Charter Steel
PROCESS	EAF Baghouse Inlet Ducts
DATE	6-14-00
BAROMETRIC PRESSURE	29.55
PITOT COEFF.	0.84
DIAMETER	90 " each

DUCT	SOUTH		CENTER		NORTH	
PORT	1	2	1	2	1	2
POINT	DEL P	DEL P	DEL P	DEL P	DEL P	DEL P
1	1.75	2.00	2.55	1.25	2.95	3.50
2	1.80	2.00	2.50	1.25	2.90	3.50
3	1.80	2.05	2.40	1.95	2.85	3.25
4	1.85	2.00	2.20	1.65	2.85	3.35
5	1.85	1.95	2.25	1.95	2.65	2.65
6	1.80	1.95	2.25	2.05	2.50	2.75
7	2.20	2.20	1.85	2.20	1.95	2.05
8	2.25	2.35	1.65	2.10	1.95	2.30
9	2.35	2.80	1.55	2.05	2.40	2.30
10	2.55	3.05	1.30	2.05	2.40	2.40
11	3.00	3.10	1.00	2.00	1.65	2.05
12	2.50	3.00	1.25	2.00	1.65	1.75
TEMP	145		135		125	
STATIC	-5.3		-5.5		-5.5	

CO₂ 0.5

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.

CHARTER BAGHOUSE
SOUTH INLET DUCT
1 4/12/05

DIAMETER 90
STACK AREA 44.18
STACK TEMPERATURE 250
PITOT COEFFICIENT 0.84
PERCENT WATER 1

BAR PRESSURE IN HG 29.25
STATIC PRESSURE IN H2O -5
STACK PRESSURE IN HG 28.88

ORSAT CONSTITUENTS

O2 20.7
CO2 0
CO 0
N2 79.3

MOLECULAR WEIGHT DRY 28.99
MOLECULAR WEIGHT WET 28.88
NUMBER OF POINTS 24

POINT	DELTA P	VELOCITY
1	2.25	99.39
2	2.15	97.15
3	2.00	93.70
4	1.90	91.33
5	1.90	91.33
6	1.85	90.12
7	1.95	92.52
8	2.10	96.02
9	2.30	100.48
10	2.45	103.71
11	2.45	103.71
12	2.40	102.65
13	1.85	90.12
14	1.90	91.33
15	1.90	91.33
16	1.90	91.33
17	1.75	87.65
18	1.75	87.65
19	2.05	94.87
20	2.10	96.02
21	2.25	99.39
22	2.25	99.39
23	2.25	99.39
24	2.40	102.65

AVERAGE VELOCITY, AFPS 95.55

FLOW RATE

ACFM 253276
DSCFM 180001
M3/HR 305858

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.

CHARTER BAGHOUSE
CENTER INLET DUCT

1

4/12/05

DIAMETER
STACK AREA
STACK TEMPERATURE
PITOT COEFFICIENT
PERCENT WATER

90
44.18
242
0.84
1

BAR PRESSURE IN HG
STATIC PRESSURE IN H2O
STACK PRESSURE IN HG

29.25
-5.2
28.87

ORSAT CONSTITUENTS

O2	20.7
CO2	0
CO	0
N2	79.3

MOLECULAR WEIGHT DRY
MOLECULAR WEIGHT WET
NUMBER OF POINTS

28.99
28.88
24

POINT

DELTA P

VELOCITY

1	2.35	101.02
2	2.10	95.50
3	2.10	95.50
4	2.05	94.35
5	2.05	94.35
6	2.00	93.20
7	1.85	89.63
8	2.05	94.35
9	2.00	93.20
10	2.00	93.20
11	1.95	92.02
12	1.75	87.18
13	1.25	73.68
14	1.25	73.68
15	1.30	75.14
16	1.25	73.68
17	1.25	73.68
18	1.40	77.97
19	2.00	93.20
20	2.05	94.35
21	2.05	94.35
22	2.20	97.75
23	2.20	97.75
24	2.20	97.75

AVERAGE VELOCITY, AFPS

89.44

FLOW RATE

ACFM
DSCFM
M3/HR

237070
170317
289403

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.

CHARTER BAGHOUSE
NORTH INLET DUCT

1

4/12/05

DIAMETER
STACK AREA
STACK TEMPERATURE
PITOT COEFFICIENT
PERCENT WATER

90
44.18
240
0.84
1

BAR PRESSURE IN HG
STATIC PRESSURE IN H2O
STACK PRESSURE IN HG

29.25
-5
28.88

ORSAT CONSTITUENTS

O2	20.7
CO2	0
CO	0
N2	79.3

MOLECULAR WEIGHT DRY
MOLECULAR WEIGHT WET
NUMBER OF POINTS

28.99
28.88
24

POINT

DELTA P

VELOCITY

1	2.05	94.20
2	2.00	93.04
3	1.75	87.03
4	1.65	84.51
5	1.55	81.91
6	1.45	79.22
7	1.50	80.57
8	1.60	83.22
9	1.55	81.91
10	1.55	81.91
11	1.55	81.91
12	1.20	72.07
13	2.50	104.02
14	2.90	112.03
15	3.20	117.69
16	2.35	100.85
17	2.05	94.20
18	1.95	91.87
19	1.75	87.03
20	1.75	87.03
21	1.90	90.68
22	1.95	91.87
23	1.95	91.87
24	1.55	81.91

AVERAGE VELOCITY, AFPS

89.69

FLOW RATE

ACFM
DSCFM
M3/HR

237740
171374
291198

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.CHARTER BAGHOUSE
SOUTH INLET DUCT

2

4/14/05

DIAMETER
STACK AREA
STACK TEMPERATURE
PITOT COEFFICIENT
PERCENT WATER90
44.18
178
0.84
1BAR PRESSURE IN HG
STATIC PRESSURE IN H2O
STACK PRESSURE IN HG29.4
-5.4
29.00

ORSAT CONSTITUENTS

O2 20.7
CO2 0
CO 0
N2 79.3MOLECULAR WEIGHT DRY
MOLECULAR WEIGHT WET
NUMBER OF POINTS28.99
28.88
24

POINT

DELTA P

VELOCITY

1	1.75	82.91
2	1.80	84.09
3	1.75	82.91
4	1.65	80.51
5	1.65	80.51
6	1.75	82.91
7	1.80	84.09
8	1.95	87.52
9	2.00	88.64
10	2.20	92.97
11	2.25	94.02
12	2.30	95.05
13	2.75	103.94
14	2.80	104.88
15	2.80	104.88
16	2.70	102.99
17	1.65	80.51
18	1.70	81.72
19	2.05	89.74
20	2.10	90.83
21	2.20	92.97
22	2.25	94.02
23	2.35	96.08
24	2.25	94.02

AVERAGE VELOCITY, AFPS

90.53

FLOW RATE

ACFM
DSCFM
M3/HR239968
190582
323838

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.

CHARTER BAGHOUSE
CENTER INLET DUCT
2 4/14/05

DIAMETER 90
STACK AREA 44.18
STACK TEMPERATURE 175
PITOT COEFFICIENT 0.84
PERCENT WATER 1

BAR PRESSURE IN HG 29.4
STATIC PRESSURE IN H2O -5.5
STACK PRESSURE IN HG 29.00

ORSAT CONSTITUENTS

O2 20.7
CO2 0
CO 0
N2 79.3

MOLECULAR WEIGHT DRY 28.99
MOLECULAR WEIGHT WET 28.88
NUMBER OF POINTS 24

POINT	DELTA P	VELOCITY
1	2.25	93.81
2	2.20	92.76
3	2.10	90.63
4	2.25	93.81
5	2.00	88.44
6	1.95	87.33
7	1.80	83.90
8	1.25	69.92
9	1.00	62.54
10	1.00	62.54
11	0.95	60.95
12	0.90	59.33
13	1.25	69.92
14	1.25	69.92
15	1.40	74.00
16	1.55	77.86
17	1.75	82.73
18	1.90	86.20
19	2.25	93.81
20	2.40	96.88
21	2.40	96.88
22	2.35	95.87
23	2.25	93.81
24	2.10	90.63

AVERAGE VELOCITY, AFPS 82.27

FLOW RATE

ACFM 218071
DSCFM 173965
M3/HR 295602

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.

CHARTER BAGHOUSE
NORTH INLET DUCT

2

4/14/05

DIAMETER
STACK AREA
STACK TEMPERATURE
PITOT COEFFICIENT
PERCENT WATER

90
44.18
160
0.84
1

BAR PRESSURE IN HG
STATIC PRESSURE IN H2O
STACK PRESSURE IN HG

29.4
-5.5
29.00

ORSAT CONSTITUENTS

O2	20.7
CO2	0
CO	0
N2	79.3

MOLECULAR WEIGHT DRY
MOLECULAR WEIGHT WET
NUMBER OF POINTS

28.99
28.88
24

POINT

DELTA P

VELOCITY

1	2.15	90.61
2	2.10	89.55
3	2.10	89.55
4	1.95	86.29
5	1.80	82.91
6	1.90	85.18
7	1.55	76.93
8	1.60	78.16
9	1.75	81.75
10	1.70	80.57
11	1.60	78.16
12	1.45	74.41
13	2.15	90.61
14	1.95	86.29
15	1.95	86.29
16	1.85	84.05
17	1.85	84.05
18	1.75	81.75
19	1.40	73.12
20	1.60	78.16
21	1.90	85.18
22	1.85	84.05
23	1.75	81.75
24	1.50	75.68

AVERAGE VELOCITY, AFPS

82.71

FLOW RATE

ACFM
DSCFM
M3/HR

219242
179131
304380

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.

CHARTER BAGHOUSE
SOUTH INLET DUCT
3 4/14/05

DIAMETER
STACK AREA
STACK TEMPERATURE
PITOT COEFFICIENT
PERCENT WATER

90
44.18
145
0.84
1

BAR PRESSURE IN HG
STATIC PRESSURE IN H2O
STACK PRESSURE IN HG

29.55
-5.3
29.16

ORSAT CONSTITUENTS

O2	20.7
CO2	0
CO	0
N2	79.3

MOLECULAR WEIGHT DRY
MOLECULAR WEIGHT WET
NUMBER OF POINTS

28.99
28.88
24

POINT

DELTA P

VELOCITY

1	1.75	80.52
2	1.80	81.67
3	1.80	81.67
4	1.85	82.79
5	1.85	82.79
6	1.80	81.67
7	2.20	90.28
8	2.25	91.30
9	2.35	93.31
10	2.85	102.76
11	3.00	105.43
12	2.50	96.24
13	2.00	86.08
14	2.05	87.15
15	2.05	87.15
16	2.00	86.08
17	1.95	85.00
18	1.95	85.00
19	2.20	90.28
20	2.35	93.31
21	2.80	101.85
22	3.05	106.30
23	3.10	107.17
24	3.00	105.43

AVERAGE VELOCITY, AFPS

91.30

FLOW RATE

ACFM
DSCFM
M3/HR

242018
203794
346287

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.

CHARTER BAGHOUSE
CENTER INLET DUCT
3 4/14/05

DIAMETER 90
STACK AREA 44.18
STACK TEMPERATURE 135
PITOT COEFFICIENT 0.84
PERCENT WATER 1

BAR PRESSURE IN HG 29.55
STATIC PRESSURE IN H2O -5.5
STACK PRESSURE IN HG 29.15

ORSAT CONSTITUENTS

O2 20.7
CO2 0
CO 0
N2 79.3

MOLECULAR WEIGHT DRY 28.99
MOLECULAR WEIGHT WET 28.88
NUMBER OF POINTS 24

POINT

DELTA P

VELOCITY

1	2.55	96.42
2	2.50	95.47
3	2.40	93.54
4	2.20	89.56
5	2.25	90.57
6	2.25	90.57
7	1.85	82.13
8	1.65	77.56
9	1.55	75.17
10	1.30	68.84
11	1.00	60.38
12	1.25	67.51
13	1.25	67.51
14	1.25	67.51
15	1.45	72.71
16	1.65	77.56
17	1.95	84.32
18	2.05	86.45
19	2.20	89.56
20	2.10	87.50
21	2.05	86.45
22	2.05	86.45
23	2.00	85.39
24	2.00	85.39

AVERAGE VELOCITY, AFPS

81.85

FLOW RATE

ACFM 216972
DSCFM 185681
M3/HR 315509

FLOW DATA

LOCATION
DESCRIPTION
TEST NO.

CHARTER BAGHOUSE
NORTH INLET DUCT
3 4/14/05

DIAMETER 90
STACK AREA 44.18
STACK TEMPERATURE 15
PITOT COEFFICIENT 0.84
PERCENT WATER 1

BAR PRESSURE IN HG 29.55
STATIC PRESSURE IN H2O -5.5
STACK PRESSURE IN HG 29.15

ORSAT CONSTITUENTS

O2 20.7
CO2 0
CO 0
N2 79.3

MOLECULAR WEIGHT DRY 28.99
MOLECULAR WEIGHT WET 28.88
NUMBER OF POINTS 24

POINT	DELTA P	VELOCITY
1	2.95	92.66
2	2.90	91.87
3	2.85	91.08
4	2.85	91.08
5	2.65	87.82
6	2.50	85.30
7	1.95	75.34
8	1.95	75.34
9	2.00	76.29
10	2.00	76.29
11	1.65	69.30
12	1.65	69.30
13	3.50	100.93
14	3.50	100.93
15	3.25	97.26
16	3.35	98.74
17	2.65	87.82
18	2.75	89.46
19	2.05	77.24
20	2.30	81.82
21	2.30	81.82
22	2.40	83.58
23	2.05	77.24
24	1.75	71.37

AVERAGE VELOCITY, AFPS 84.58

FLOW RATE

ACFM 224192
DSCFM 240330
M3/HR 408368

CHARTER STEEL
 2005 BAGHOUSE EAF STACK TESTS
 INLET FLOWS
 APRIL 12-14, 2005

TEST	SOUTH	CENTER	NORTH	TOTAL	
1	253276	237070	237740	728086	ACFM
	180001	170317	171374	521692	DSCFM
				886459	M3/HR
2	239968	218071	219242	677281	ACFM
	190582	173965	179131	543678	DSCFM
				923818	M3/HR
3	242018	216972	224192	683182	ACFM
	203794	185681	240330	629805	DSCFM
				1070165	M3/HR
			AVERAGE	696183	ACFM
				565058	DSCFM
				960147	M3/HR

267-268-2334

Mark HASE

TEST THER

4/12

1006 - 1406

89 TPH

4/13

0915 - 1335

92.5

4/14

0900 - 1300

89

APPENDIX B

Sample Calculations

PARTICULATE SAMPLE CALCULATION FORMULA

1. **DRY MOLECULAR WEIGHT (Md)** lb/lb-mole

$$Md = .44\% \text{ CO}_2 + .32\% \text{ O}_2 + .28\% \text{ N}_2 + .28\% \text{ CO}$$

2. **WATER VAPOR PERCENT (%H₂O)**

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

where: $Vw \text{ std}$ = standard cubic feet of water vapor

V_f = Final volume of impingers, ml

V_i = Initial volume of impingers, ml

$$\%H_2O = Vw \text{ std} * 100 / (Vm \text{ std} + Vw \text{ std})$$

where $Vm \text{ std}$ = standard cubic feet of gas sampled

3. **WET MOLECULAR WEIGHT (Ms)** lb/lb-mole

$$Ms = Md * (1 - \%H_2O/100) + 18 * \%H_2O/100$$

4. **STACK PRESSURE (Ps)** in. Hg.

$$Ps = Pb + Pg/13.6$$

where: Pb = barometric pressure (uncorrected), in. Hg

Pg = stack gauge pressure, in. H₂O

13.6 = specific gravity of mercury (Hg)

5. **AVERAGE STACK VELOCITY (vs)** feet per second

$$Vs = Kp * Cp * DELP * (Tsavg / (Ps * Ms))^{0.5}$$

where: Kp = 85.49 unit conversion

Cp = 0.84, pitot tube calibration factor

$DELP$ = average of square root of velocity head, in. H₂O

$Tsavg$ = average stack temperature, deg R (460+F)

Ps = stack pressure

Ms = wet molecular weight

6. **STACK GAS FLOW RATE (Qs)** std. cubic feet per minute

$$Qs = 60 \cdot (1 - \%H_2O/100) \cdot V_s \cdot A \cdot (528 \cdot P_s / T_{savg} / 29.92)$$

where: A = stack area, ft²

528 = std temperature, deg R

29.92 = std pressure, in. Hg

7. **DRY GAS VOLUME (Vmstd)** dry std. cubic feet

$$V_{m \text{ std}} = GAMAC \cdot (P_b + DELH / 13.6) / 29.92$$

where: GAMAC = dry gas meter calibration factor corrected for
meter temperature $(GAMA + (T_m - 70) \cdot .00012)$

Vm = volume of dry gas metered, cubic feet

Tm = average meter temperature, degrees F

DELH = average orifice pressure drop, in. H₂O

8. **PARTICULATE CONCENTRATION (cs)** grains per dry standard
cubic foot

$$Cs = Mn \cdot 15.43 / V_{m \text{ std}}$$

where: Mn = particulate captured, grams

15.43 = grains per gram

9. **EMISSION RATE (ER)** pounds per hour

$$PMRA = Mn \cdot A \cdot 60 / (t \cdot An \cdot 453.6) \quad \text{AREA METHOD lb/hr}$$

$$PMRC = Cs \cdot Qs \cdot 60 / (15.43 \cdot 453.6) \quad \text{CONC. METHOD lb/hr}$$

$$ER = (PMRA + PMRC) / 2$$

where: An = area of sampling nozzle, square feet

10. **EMISSION CONCENTRATION (EC)** lb/1000 lb exhaust gas

$$EC = ER \cdot 386700 \cdot (1 - \%H_2O/100) / (Qs \cdot 60 \cdot Ms)$$

where: 386700 = cubic feet per lb mole * 1000

11. **ISOKINETIC SAMPLING PERCENTAGE (I)**

$$I = PMRA / PMRC$$