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

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

EPA Contract No. 68-02-4346
Work Assignment 5

September 25, 1989

Determination of the Performance Level of a Single Packed-Bed Scrubber

Candidate Plant
Fusion, Inc.
Houston, Texas

Prepared for

U.S. Environmental Protection Agency
Emissions Measurement Branch
Research Triangle Park, North Carolina 27711

Prepared by

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SECTION 1.0
INTRODUCTION

During the week of May 17-24, 1989, an emission measurement program was conducted at the Fusion, Inc. plant in Houston, Texas. The purpose of this program was to collect data to determine the efficiency of the single packed bed scrubber, operating with an overhead washdown system running under three separate conditions. The conditions tested were: without the washdown; the washdown system operating periodically; and with the washdown system operating constantly.

The primary reason for selecting Fusion, Inc. was that the plant was willing to allow EPA to modify the scrubber by adding an overhead weir system to determine if the flooding action provided by the weir improves scrubber performance. The capture and control system on the plating tank consists of a double-sided draft hood ducted to the scrubber. In order to assess the control efficiency of the system, hexavalent chromium (Cr^{+6}) and total chromium emissions were measured at two locations along the duct. These locations are identified in Figure 1-1 as: (1) inlet to the single packed-bed scrubber and (2) outlet from the single packed-bed scrubber.

The emission samples were collected using the Modified Method 13B (MM13B) sample train. This method will be discussed in Section 4.0. The samples were analyzed for Cr^{+6} concentration using the diphenylcarbazide colorimetric method. This method will also be discussed in Section 4.0.

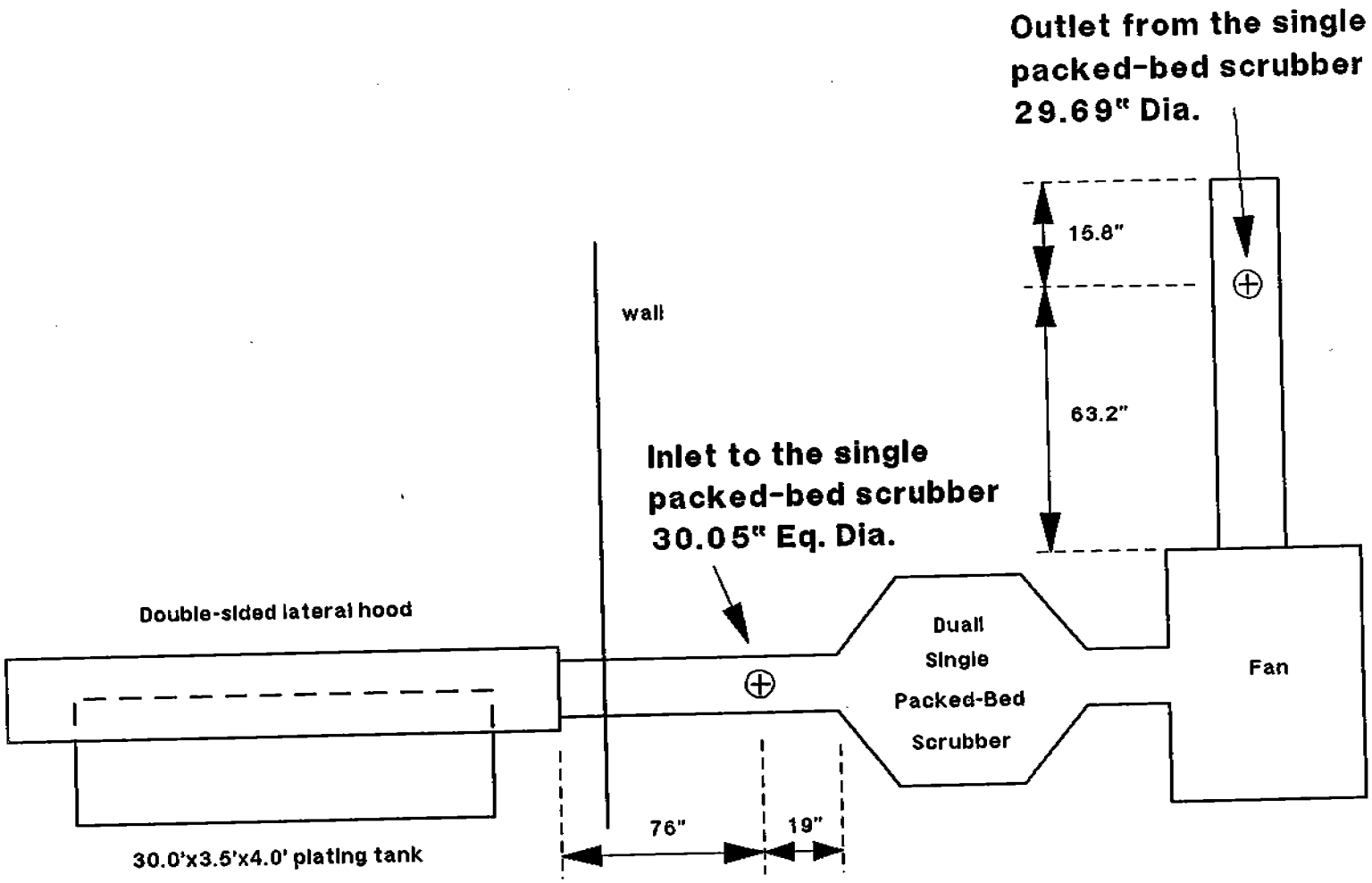

Figure 1-1. Location of Sample Points

PEER Consultants, P.C., located in Dayton, Ohio, was responsible for developing the test protocol, conducting the field test, on-site analysis of samples and the preparation of draft and final reports. PEER was supported by its subcontractor, Pacific Environmental Services, Inc. located in Cincinnati, Ohio. Midwest Research Institute, located in Raleigh, North Carolina, was responsible for monitoring the process operation, and EPA personnel conducted Screening Method testing and monitored the implementation of the test protocol.

SECTION 2.0
PROCESS OPERATION

2.1 PROCESS OPERATION

Fusion, Inc. in Houston, Texas, is a job shop that specializes in hard chromium electroplating of crankshafts. The plating shop consists of five hard chromium plating tanks that are operated 24 hours per day, 7 days per week, and 52 weeks per year.

The plating tank (No. 1) tested during this source test program is 9.1 m (30 ft) long, 1.1 m (3.5 ft) wide, and 1.2 m (4.0 ft) deep, and holds approximately 10,410 liters (ℓ) (2,750 gallons [gal]) of plating solution. The plating tank is equipped with a single rectifier rated at 15 volts (V) and 8000 amperes (A). The tank contains a conventional hard chromium plating solution consisting of 240 grams per liter (g/ℓ) (32 ounces per gallon [oz/gal]) of chromic acid and 2.4 g/ℓ (0.32 oz/gal) of sulfuric acid. The plating solution is maintained at 54°C (130°F).

The only portions of the crankshafts that are plated are the cams. The crankshafts contained from 5 to 15 cams. Semicircular-shaped anodes are positioned over each cam on the crankshaft. The crankshaft is them lowered by hoist into the plating tank. The anodes are connected to the electrical circuit, and the current and voltage are applied stepwise until the current density reaches 3100 A per square meter (2 A per square inch). During plating, each crankshaft is rotated continuously in the tank to ensure that an even plate thickness is applied over the entire surface area of each cam. Typically, two to three crankshafts are plated simultaneously over a 24-hr period at a current loading of 3000 to 4000 amperes.

2.2 AIR POLLUTION CONTROL

The capture and control system on the plating tank consists of a double-sided draft hood that is vented to a horizontal-flow single packed-bed scrubber. Figure 2-1 presents a schematic of the capture and control system on the plating tank.

The scrubber was manufactured by Duall, Industries, Inc., (Model No. F-101) and installed in 1988. Figure 2-2 presents a detailed schematic of the scrubber. The design gas flow rate to the scrubber is 450 cubic meters per minute (m^3/min) (16,000 cubic feet per minute [ft^3/min]). The scrubbing water flow rate is approximately 180 liters per minute (48 gallons per minute). The design pressure drop across the scrubber is 0.5 kilopascal (kPa) (2.0 inches of water column [in.w.c.]).

Within the scrubber system, the velocity of the gas stream is reduced to approximately 143 meters per minute (440 feet per minute), and the gas stream is humidified by a spray of water. Water is sprayed countercurrent to the flow of the gas stream through 10 spray nozzles. The saturated gas stream then passes through a packed bed of polypropylene, spherical-type mass packing. The packed bed is approximately 2.0 m (6.4 ft) high, 1.9 m (6.2 ft) wide, and 0.30 m (1.0 ft) deep. Entrained mist and water droplets impinge on the packing and drain into a sump. Behind the packed bed is a two-stage mist elimination section that removes entrained water droplets. The first stage allows large droplets to settle by gravity to the bottom of the scrubber. The second stage contains a series of vertically-mounted chevron blades that change the direction of the gas flow four times at 30° angles, which causes any entrained droplets to impinge on the blades. The mist eliminator is not washed down.

The scrubber water drains into a sump in the bottom of the scrubber and is recirculated by a pump. A level indicator (sight gauge) is used to monitor the water level in the sump, which holds approximately 450 ℓ

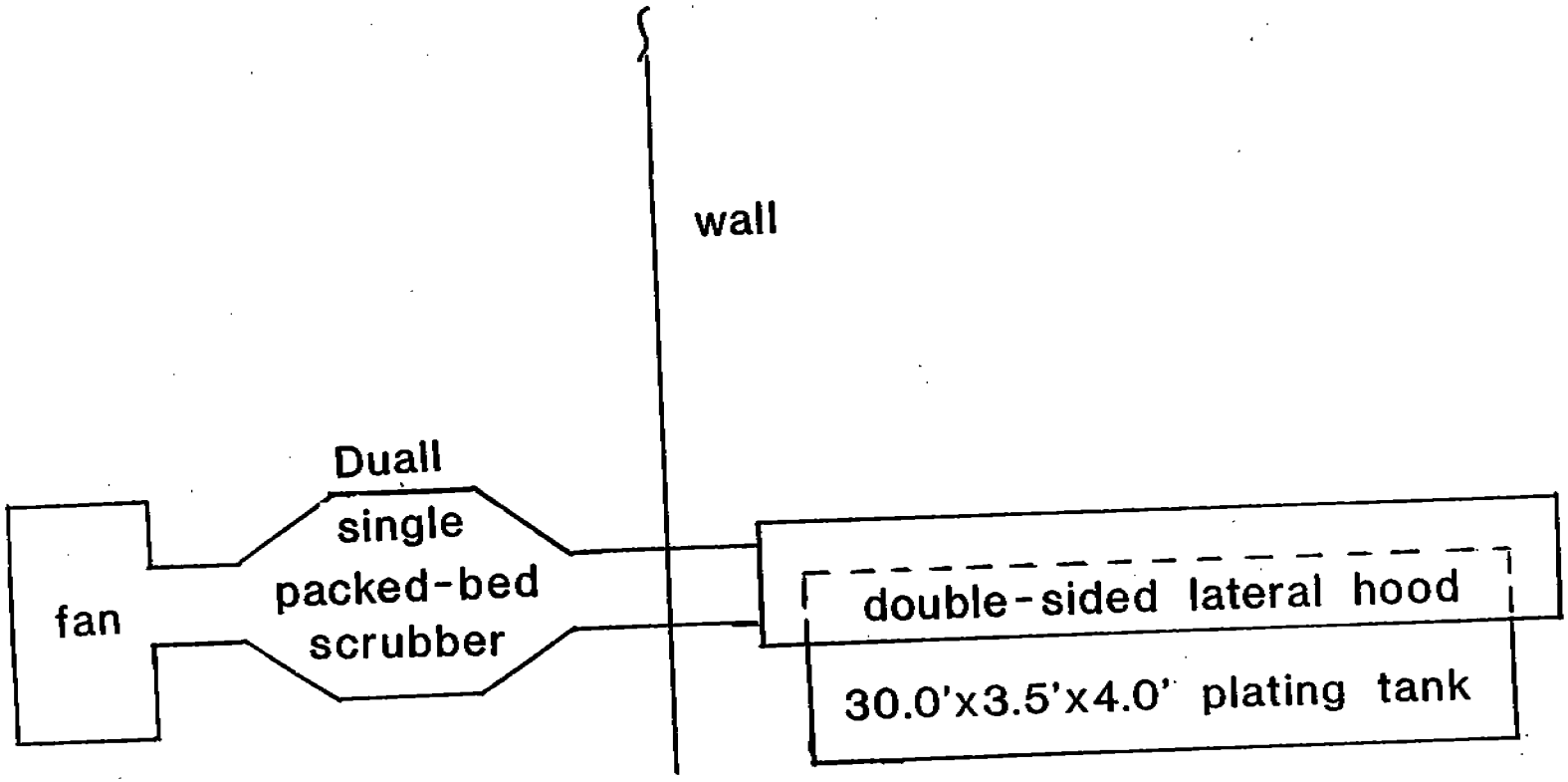

Figure 2-1. Side view of capture and control system at Fusion, Inc., Houston, Texas.

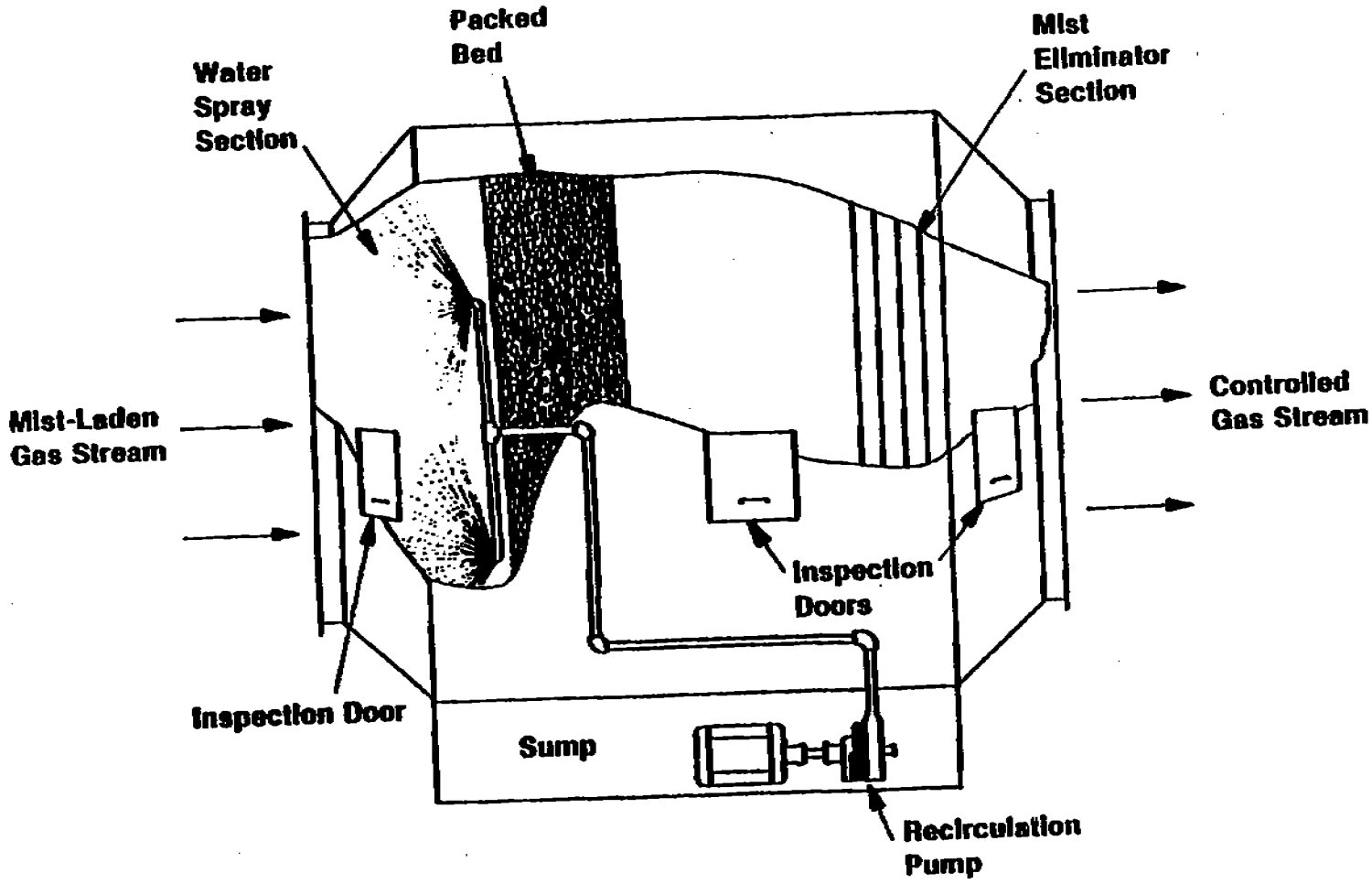

Figure 2-2. Detailed schematic of a Duall horizontal-flow, single packed-bed scrubber.

(120 gal) of water. Once a week, the water in the sump is drained into a 5680 ℓ (1500 gal) holding tank and the sump is recharged with fresh water. During testing, the chromic acid concentration of the water samples taken from the sump averaged 0.08 g/ℓ (0.01 oz/gal) through test run No. 3 After the scrubber was thoroughly cleaned by draining the sump and washing down the inside walls, packing media, and mist elimination section, the chromic acid concentration of the sump water averaged 4.9 g/ℓ (0.65 oz/gal) for the next three runs. Although the plating tank is operated 24 hours per day, the recirculation system on the scrubber is turned off from 11:30 p.m. to 7:30 a.m. During this time, there are no plant employees on site. The company is concerned that if the pump or water line broke there would be no one on site to detect the break and prevent a significant spill.

Prior to emissions testing, the scrubber was retrofitted with an overhead weir so that the scrubber could be operated with and without periodic washdown of the scrubber packing with fresh water. The scrubber was also moved back approximately 1.5 m (5.0 ft) and a section of duct was inserted between the plating tank exhaust plenum and the inlet of the scrubber to accommodate inlet testing. A stack was also added to the fan to accommodate outlet testing. Figure 2-3 presents a schematic of the capture and control system on the plating tank after modifications. Duall Industries, Inc., the manufacturer of the scrubber, performed the modifications on the ventilation system and scrubber in addition to inspecting the scrubber to ensure proper operation.

2.3 PROCESS CONDITIONS DURING TESTING

The primary purpose of this source test was to determine if the periodic flooding action provided by the scrubber overhead weir system could significantly improve the scrubber performance. Therefore, eight mass emissions tests runs were conducted at the inlet and outlet of the scrubber at each of the following three conditions: (1) the scrubber recirculation system was in operation and any required makeup water was

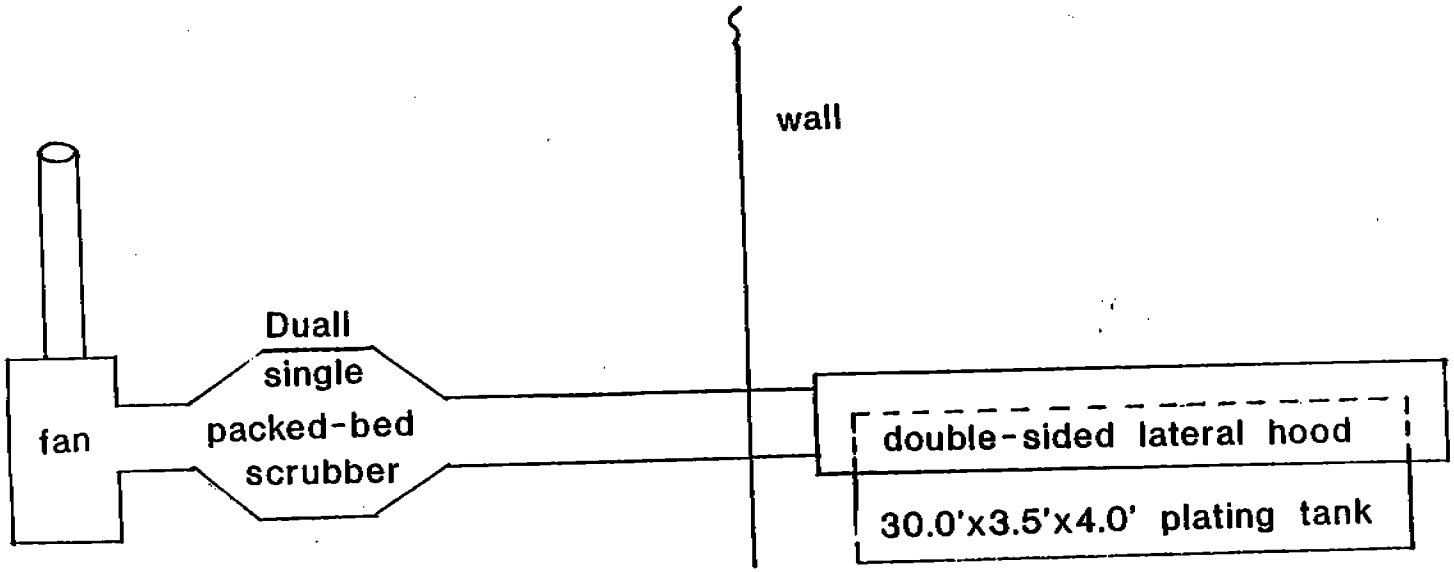

Figure 2-3. Side view of capture and control system at Fusion, Inc., Houston, Texas.

supplied by a hose through one of the scrubber's inspection doors; and (2) the scrubber recirculation system was in operation and all required makeup water was supplied through a pipe that extended out about 10 to 13 centimeters (4 to 5 inches) over the top of the packed bed. Two subsequent test runs were conducted at the inlet and outlet of the scrubber with the scrubber recirculation system in operation and a continuous flow of fresh water supplied through the overhead weir at a rate of 7.6 ℓ/min (2.0 gal/min).

Prior to test runs No. 1 and 3, the sump in the bottom of the scrubber was drained to the holding tank and the sump was recharged with fresh water supplied by a hose through one of the scrubber's inspection doors. During test runs 1 through 3, makeup water required by the scrubber to replace evaporation losses was added through the inspection doors with a water hose. Prior to test run No. 4, the scrubber was inspected and found to contain a heavy buildup of chromic acid resulting from the overnight shutdown of the recirculation system. Therefore, the scrubber was thoroughly cleaned by draining the sump and washing down the inside walls, packing media, and mist elimination section with a pressurized water hose. During test runs 4 through 6., makeup water required by the scrubber to replace evaporation losses was supplied through the pipe located over the top of the packed-bed. Prior to test run No. 7, the scrubber was cleaned again. During test run Nos. 7 and 8, makeup water was added continuously over the top of the packed bed through the overhead weir at a flow rate of 7.6 ℓ/min (2.0 gal/min).

The scrubber parameters monitored during testing were the pressure drop across the scrubber, the frequency and, if possible, the amount of makeup water added, the chromic acid concentration of the scrubber water, and when applicable, the overhead water flow rate. The actual inlet gas flow rate to the scrubber during testing averaged 575 m^3/min (20,350 ft^3/min), and the monitored pressure drop was close to the design pressure drop of 0.5 kPa (2.0 in. w.c.). The average scrubber parameters monitored during each test run are presented in Table 2-1.

TABLE 2-1. AVERAGE SCRUBBER OPERATING PARAMETERS MONITORED DURING EACH MASS EMISSION TEST RUN

Test run No.	Frequency of water replacement, No. of times per run	Amount of makeup water added, ℓ (gal)	Pressure drop, kPa (in. w.c.)
No washdown			
1	6	a	0.45 (1.8)
2	4	a	0.45 (1.8)
3	4	a	0.45 (1.8)
Periodic washdown			
4	4	260 (70)[b]	0.55 (2.2)
5	5	380 (100)[b]	0.55 (2.2)
6	4	260 (70)[b]	0.55 (2.2)
Continuous washdown			
7	c	1,590 (420)[d]	0.55 (2.2)
8	c	980 (260)[d]	0.55 (2.2)

[a]Makeup water was supplied by a garden hose and, therefore, the amount of water added was not measured.
[b]Makeup water was added through a flow meter. The quantities of water provided are based on the amount of time required to fill the sump and the flow rate measured through the flow meter.
[c]Fresh water was added continuously at a rate of 2 gallons per minute.
[d]Based on the total amount of time to collect a complete emission sample and a continuous fresh water flow rate of 2.0 gallons per minute.

Grab samples of the scrubber water were taken from the sump at the end of each test run. The chromic acid concentration of the scrubber water samples is reported in Section 3 of this report.

The process was operating normally during the test. Process operating parameters such as voltage, current, and plating solution temperature were monitored and recorded during each test run. Also recorded were the number and approximate size of the crankshafts in the plating tank during each test run. Averages for the operating parameters recorded are presented in Table 2-2. The total amount of current supplied to the plating tank during each test run was calculated in terms of ampere-hours based on the duration of sampling at the inlet and outlet test locations. Information on the total ampere-hours supplied to the plating tank during each test run is presented in Table 2-3. Data sheets documenting the process parameters that were recorded during each test run and the ampere-hour calculations are presented in Appendix A.

Grab samples of the plating solution were taken at the beginning, middle, and end of each test run to determine the chromic acid concentration of the solution during testing. The chromic acid concentration of the composite samples is reported in Section 3.0 of this report.

Test Runs 1 through 6 and test run 8 were each 2 hours in duration. Test run No. 7 was 3.2 hours in duration. Each test run was interrupted for 10 to 25 minutes to change test ports. Test run No. 1 was interrupted for approximately 3 hours because of an electrical problem in the plating line, which resulted from a current overload. Test run No. 2 was interrupted for 8 minutes because of a problem with maintaining the isokinetic sampling rate at the outlet test location.

TABLE 2-3. TOTAL AMPERE-HOURS SUPPLIED TO PLATING TANK DURING EACH MASS EMISSIONS TEST RUN

Test Run No.	Test time, hours	Total current, ampere-hours[a]	
		Inlet	Outlet
1	2	5,500	5,400
2	2	6,000	6,000
3	2	4,600	4,600
4	2	7,200	7,100
5	2	7,200	7,200
6	2	7,400	7,400
7	3.2	10,000	10,000
8	2	5,600	5,600

[a]Numbers were rounded to the nearest 100.

TABLE 2-2. AVERAGES OF OPERATING PARAMETERS MONITORED DURING EACH MASS EMISSION TEST RUN

Run No.	Operating voltage, volts	Operating current, amperes[a]	Operating bath temp., °F
1	5.5	2,600	127
2	5.8	3,000	127
3	6.0	2,300	127
4	5.6	3,600	127
5	5.6	3,600	127
6	5.6	3,700	128
7	6.6	3,100	126
8	6.2	2,800	127

[a]Rounded to nearest 100.

SECTION 3.0
SUMMARY OF RESULTS

INTRODUCTION

Eight Modified Method 13B (MM13B) samples were collected at each sample location. All of the emission samples were analyzed on site for Cr^{+6} concentrations using the procedures outlined in the method entitled "Draft Method - Determination of Hexavalent Chromium in Dry Particulate Emissions from Stationary Sources." Upon completion of the test program, two emission samples from each location were analyzed for total chromium concentrations using the procedure outlined in EPA Method 218.1. These analytical methods are presented in Appendix D.

Testing was carried out under three separate conditions. Under the first condition (Condition 1), three tests were run when the scrubber's overhead washdown system was not in operation. For the second condition (Condition 2), the scrubber was cleaned and the overhead washdown system was in operation periodically; this condition was also tested for three runs. Under the final condition (Condition 3), the overhead washdown system was operating continuously; testing under this condition was only carried out for two runs.

In addition to the emission samples, grab samples of the plating bath were composited during each MM13B run and analyzed using the same colorimetric procedures used for the emission samples. Table 3-1 presents a schedule of the activities during the test program. The results from the sampling program are presented in the remainder of this section.

TABLE 3-1. SCHEDULE OF ACTIVITIES

Date (1989)	Sample Type	Run No.	Test Time (Minutes)	Parameter Measured
5/19/89	MM13B	I-1, 0-1	120	Cr^{+6}
5/19/89	SM	1-I, 1-0		Cr^{+6}
5/19/89	Plating Sol.	1		Cr^{+6}
5/19/89	Scrubber Rinse	1		Cr^{+6}
5/19/89	MM13B	I-2, 0-2	120	Cr^{+6}, Total Cr
5/19/89	SM	2-I, 2-0		Cr^{+6}, Total Cr
5/19/89	Plating Sol.	2		Cr^{+6}
5/19/89	Scrubber Rinse	2		Cr^{+6}
5/20/89	MM13B	I-3, 0-3	120	Cr^{+6}
5/20/89	SM	3-I, 3-0		Cr^{+6}
5/20/89	Plating Sol.	3		Cr^{+6}
5/20/89	Scrubber Rinse	3		Cr^{+6}
5/21/89	MM13B	I-4, 0-4	120	Cr^{+6}
5/21/89	SM	4-I, 4-0		Cr^{+6}
5/21/89	Plating Sol.	4		Cr^{+6}
5/21/89	Scrubber Rinse	4		Cr^{+6}
5/21/89	MM13B	I-5, 0-5	120	Cr^{+6}, Total Cr
5/21/89	SM	5-I, 5-0		Cr^{+6}, Total Cr
5/21/89	Plating Sol.	5		Cr^{+6}
5/21/89	Scrubber Rinse	5		Cr^{+6}
5/21/89	MM13B	I-6, 0-6	120	Cr^{+6}
5/21/89	SM	6-I, 6-0		Cr^{+6}
5/21/89	Plating Sol.	6		Cr^{+6}
5/21/89	Scrubber Rinse	6		Cr^{+6}
5/23/89	MM13B	I-7, 0-7	192	Cr^{+6}
5/23/89	SM	7-I, 7-0		Cr^{+6}
5/23/89	Plating Sol.	7		Cr^{+6}
5/23/89	Scrubber Rinse	7		Cr^{+6}
5/23/89	MM13B	I-8, 0-8	120	Cr^{+6}
5/23/89	SM	8-I, 8-0		Cr^{+6}
5/23/89	Plating Sol.	8		Cr^{+6}
5/23/89	Scrubber Rinse	8		Cr^{+6}

CHROMIUM EMISSION RESULTS

Emission samples were collected isokinetically using a Method 13B sample train that had been modified by removing the glass fiber filter and placing 100 mℓ of 0.1N NaOH in each of the first two impingers. The impinger solutions were recovered into tared polyethylene sample bottles and the total volume of the recovered samples was determined gravimetrically. Following recovery of the samples, an aliquot of the solution was analyzed for Cr^{+6}. The following subsections present the flue gas data and analytical results for each sample location.

Scrubber Inlet

Modified Method 13B--

A summary of the flue gas conditions at this location are presented in Table 3-2. The volumetric flowrates were consistent and averaged 541 dry standard cubic meters per minute (dscmm) [19,100 dry standard cubic feet per minute, (dscfm)]. The flue gas temperature averaged 31°C (88°F) and the moisture content averaged 2.41 percent. The flue gas was essentially ambient air and was assigned a dry molecular weight of 28.95 lb/lb mole. The isokinetic sampling rates were within the allowable limitations for these sample runs.

Prior to sampling, it was decided that the MM13B runs should be run at 5 minutes per point for a total sample time of 120 minutes. This sample time was chosen to ensure the collection of a detectable concentration of Cr^{+6}. To ensure collection of a detectable sample during Run 7, testing was carried out at 8 minutes per point for a total sample time of 192 minutes. Following the analyses of the sample, it was determined that the subsequent sample time per point could be reduced to 5 minutes. The uncontrolled emissions as measured in each MM13B run were consistent and averaged 0.697 mg/dscm (0.00030 gr/dscf). It should be noted that results for I-1 came out significantly lower than the other

TABLE 3-2. SUMMARY OF FLUE GAS CONDITIONS

Run No.	Date	Volumetric Flowrate dscm/min	Volumetric Flowrate dscf/min	Temperature °C	Temperature °F	% Moisture	% Isokinetic
Condition 1 - No Washdown							
I-1	5/19/89	542	19,140	29	85	2.44	108.4
0-1	5/19/89	500	17,670	28	83	2.68	104.0
I-2	5/19/89	537	18,940	28	83	2.39	108.2
0-2	5/19/89	507	17,880	28	82	3.01	102.0
I-3	5/20/89	537	18,960	31	88	2.67	107.0
0-3	5/20/89	504	17,800	29	84	2.88	101.8
Condition 2 - Periodic Washdown							
I-4	5/21/89	546	19,290	31	87	2.31	104.9
0-4	5/21/89	510	18,000	27	81	2.52	101.8
I-5	5/21/89	543	19,160	34	93	2.31	104.4
0-5	5/21/89	499	17,610	29	84	2.86	101.6
I-6	5/21/89	536	18,910	31	88	2.52	104.7
0-6	5/21/89	503	17,730	28	82	3.06	102.1
Condition 3 - Continuous Washdown							
I-7	5/23/89	548	19,330	31	88	2.33	105.0
0-7	5/23/89	504	17,780	28	82	2.87	98.00
I-8	5/23/89	540	19,080	33	91	2.30	105.1
0-8	5/23/89	508	17,930	28	82	2.86	97.4

ROUTING AND TRANSMITTAL SLIP

Date 6/9/80

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REMARKS

Attached are the preliminary results from Andy W. for Fusion Test. Frank needs to check these and his screening method.

DO NOT use this form as a RECORD of approvals, concurrences, disposals, clearances, and similar actions

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6/9/89
R. Bolen

PRELIMINARY DATA SUMMARY
FUSION, INC., HOUSTON, TEXAS

Run No.	Vm_{std} dscf	Q_{std} dscfm	Cr^{+6} mass mg	Concentration gr/dscf	Concentration mg/m^3	Emission Rate lb/hr	Emission Rate kg/hr
I-1	162.741	19,137	1.3794	0.00013	0.2993	0.0216	0.00973
0-1	141.229	17,655	0.1496	0.00002	0.0375	.00249 0.0025	0.00112
I-2	160.691	18,944	2.9411	0.00028	0.6464	.0459 0.046	0.0208
0-2	140.140	17,877	0.1550	0.00002	0.0391	0.00261	.00114 0.0012
I-3	159.143	18,964	3.5306	0.00034	0.7834	.0557 0.056	0.0252
0-3	139.366	17,803	0.1624	0.00002	0.0412	0.00274	0.00124
I-4	158.593	19,283	3.8189	0.00037	0.8504	0.0614	0.0279
0-4	140.892	17,998	0.1025	0.00001	0.0257	0.00173	.000784 0.0008
I-5	156.730	19,152	2.5549	0.00025	0.5757	0.0413	0.0187
0-5	137.602	17,518	0.0841	0.00001	0.0216	0.00142	0.000642
I-6	155.214	18,945	2.5477	0.00025	0.5796	0.0411	0.0187
0-6	139.263	17,734	0.0858	0.00001	0.0217	.00145 0.0015	.000654 0.0007
I-7	255.460	19,321	5.4262	0.00033	0.7501	0.0543	0.0246
0-7	214.324	17,790	0.1380	0.00001	0.0227	0.00151	.000687 0.0007
I-8	157.047	19,066	3.0854	0.00030	0.6938	0.0496	0.0225
0-8	134.313	17,928	0.0766	0.00001	0.02013	.00135 0.0014	0.000613

0222S

seven runs. Noticeable discoloration of the sample could be seen and may have been caused by accidental contact with the duct wall. Due to this probable contamination the results of Run I-1 were not used in any calculations. A summary of the MM13B sample volumes, analytical results and emission rates by test condition for this location are presented in Table 3-3.

Scrubber Outlet

Modified Method 13B--

A summary of the flue gas conditions at this location are presented in Table 3-2. The volumetric flowrates were consistent and averaged 504 dry standard cubic meters per minute (dscmm) [(17,800 dry standard cubic feet per minute, (dscfm)]. The flue gas temperature averaged 28°C (83°F) and the moisture content averaged 2.84 percent. The flue gas was essentially ambient air and was assigned a dry molecular weight of 28.95 lb/lb mole. The isokinetic sampling rates were within the allowable limitations for these sample runs.

Prior to sampling, it was decided that testing should be run at 5 minutes per point for a total sample time of 120 minutes. This sample time ensured the collection of a detectable concentration of Cr^{+6}. As with the inlet samples, testing during run 7 was done at 8 minutes per point to assure a detectable sample. Following the analysis of the sample, it was determined that the sample time per point could be reduced to 5 minutes as was done for the inlet samples. When the scrubber was operating without the overhead washdown system in use (Condition 1) the emissions were consistent and averaged 0.0392 mg/dscm (0.000017 gr/dscf); furthermore, emissions were consistent and averaged 0.0230 mg/dscm (0.000010 gr/dscf) when the overhead washdown system was used periodically (Condition 2), and 0.0214 mg/dscm (0.000010 gr/dscf) with the overhead washdown in constant use (Condition 3). Outlet emissions over the course of all eight test runs averaged 0.0287 mg/dscm (0.000012 gr/dscf). A summary of the MM13B sample volumes, analytical results and emission rates broken down by condition for this location is presented in Table 3-4.

TABLE 3-3. SUMMARY OF SAMPLE VOLUMES, ANALYTICAL RESULTS AND EMISSION RATES FOR THE SCRUBBER INLET

Run No.	Stack dscfm	Volume Metered dscf	Total Mass Cr+6, mg	Concentration mg/dscm	Concentration gr/dscf	Emission Rates kg/hr	Emission Rates lb/hr
Condition 1							
I-1	19,140	162.729	1.3794	0.299	0.00013	0.00097	0.0215
I-2	18,940	160.691	2.9411	0.646	0.00028	0.0208	0.0458
I-3	18,960	159.143	3.5306	0.783	0.00034	0.0252	0.0557
Condition 2							
I-4	19,290	158.581	3.8189	0.850	0.00037	0.0279	0.0614
I-5	19,150	156.719	2.5549	0.576	0.00025	0.0187	0.0413
I-6	18,910	155.491	2.5477	0.580	0.00025	0.0186	0.0410
Condition 3							
I-7	19,330	254.682	5.4262	0.752	0.00033	0.0247	0.0545
I-8	19,080	157.312	3.0854	0.693	0.00030	0.0225	0.0495

TABLE 3-4. SUMMARY OF SAMPLE VOLUMES, ANALYTICAL RESULTS AND EMISSION RATES FOR THE SCRUBBER OUTLET

Run No.	Stack dscfm	Volume Metered dscf	Total Mass Cr+6, mg	Concentration mg/dscm	Concentration gr/dscf	Emission Rates kg/hr	Emission Rates lb/hr
Condition 1							
0-1	17,670	141.229	0.14996	0.0375	0.000016	0.00113	0.00248
0-2	17,880	140.140	0.15495	0.0390	0.000017	0.00119	0.00261
0-3	17,800	139.366	0.16240	0.0412	0.000018	0.00124	0.00274
Condition 2							
0-4	18,000	140.892	0.10248	0.0257	0.000011	0.00078	0.00173
0-5	17,610	137.619	0.08409	0.0216	0.000009	0.00065	0.00142
0-6	17,730	139.263	0.08582	0.0218	0.000010	0.00066	0.00145
Condition 3							
0-7	17,780	214.324	0.13798	0.0227	0.000010	0.00069	0.00151
0-8	17,930	134.313	0.07656	0.0201	0.000009	0.00061	0.00135

The Cr^{+6} removal efficiencies for the scrubber without washdown averaged 94.7% (based on emission rates) and 94.4% (based on concentration). When periodic washdown was in use, efficiency averaged 96.8% (emission rates) and 96.5% (concentration). Constant washdown produced efficiencies averaging 97.3% (emission rates) and 97.1% (concentration). A summary of removal efficiencies for the system is presented in Table 3-5.

TOTAL CHROMIUM ANALYSIS

Upon returning from Houston the samples from Run 2 and Run 5 were submitted for total chromium analysis. Based on the concentration determined from these analyses, the total Cr removal efficiencies for these runs were: 91.3% for Run 2 and 92.6% for Run 5. The results from the total chrome analysis are presented in Table 3-6. The analyses were performed by Datachem Inc. in Cincinnati, Ohio. Their quality control plan is presented in Appendix G.

PLATING TANK SOLUTIONS

During each MM13B run, grab samples of the plating bath solution were collected and composited. The samples were analyzed for Cr^{+6} concentration. The results from these analyses and the chromic acid concentrations are presented in Table 3-7.

SCRUBBER RINSE

Prior to the start of the sampling program, and between conditions, the scrubber was cleaned with fresh water. After every test run, a sample of the scrubber rinseate was collected and analyzed for Cr^{+6} concentrations. The results of these analyses are presented in Table 3-7.

TABLE 3-5. SUMMARY OF Cr^{+6} REMOVAL EFFICIENCIES

Run No.	Emission Rate lb/hr Cr^{+6}	Cr^{+6} Removal Efficiency %	Concentration mg/m^3 Cr^{+6}	Cr^{+6} Removal Efficiency %
Condition 1				
*I-1	0.0215		0.2996	
O-1	0.00248	88.4	0.0375	87.5
I-2	0.0458		0.646	
O-2	0.00261	94.3	0.0390	94.0
I-3	0.0557		0.783	
O-3	0.00274	95.1	0.0412	94.7
Average Condition 1		94.7		94.4
Condition 2				
I-4	0.0614		0.850	
O-4	0.00173	97.2	0.0257	97.0
I-5	0.0413		0.576	
O-5	0.00142	96.6	0.0216	96.3
I-6	0.0410		0.580	
O-6	0.00145	96.5	0.0217	96.3
Average Condition 2		96.8		96.5
Condition 3				
I-7	0.0545		0.752	
O-7	0.00151	97.2	0.0227	97.0
I-8	0.0495		0.693	
O-8	0.00135	97.3	0.0201	97.1
Average Condition 3		97.3		97.1

* - This run is not included in the average due to possible contamination of sample I-1

TABLE 3-6. TOTAL CHROMIUM DATA FUSION, INC. HOUSTON, TEXAS

Run No.	Vm_{std} dscf	Q_{std} dscfm	Total Cr mass mg	Concentration mg/m^3	Concentration gr/dscf	Emission Rate kg/hr	Emission Rate lb/hr
I-2	160.691	18,940	3.59	0.789	0.00034	0.0254	0.0560
O-2	140.140	17,880	0.27	0.0680	0.000029	0.00207	0.00456
I-5	156.719	19,160	3.25	0.732	0.00032	0.0238	0.0525
O-5	137.619	17,610	0.21	0.0539	0.000024	0.00161	0.00355

TABLE 3-7. SUMMARY OF PLATING SOLUTION & RINSEATE ANALYTICAL RESULTS

Run No.	Cr^{+6} Concentration, mg/ℓ	CrO_3 Concentration (oz/gal)
Plating Solution		
Run 1	115,039	33.0
Run 2	115,981	33.3
Run 3	117,569	33.7
Run 4	115,981	33.3
Run 5	116,297	33.3
Run 6	115,353	33.1
Run 7	114,416	32.8
Run 8	114,105	32.7
Scrubber Rinse		
Run 1	14.7	0.00422
Run 2	14.1	0.00404
Run 3	91.91	0.0264
Run 4	1995	0.572
Run 5	2709	0.777
Run 6	29.07	0.00834
Run 7	119.5	0.0343
Run 8	64.7	0.0186

SECTION 4.0
SAMPLING LOCATIONS AND TEST METHODS

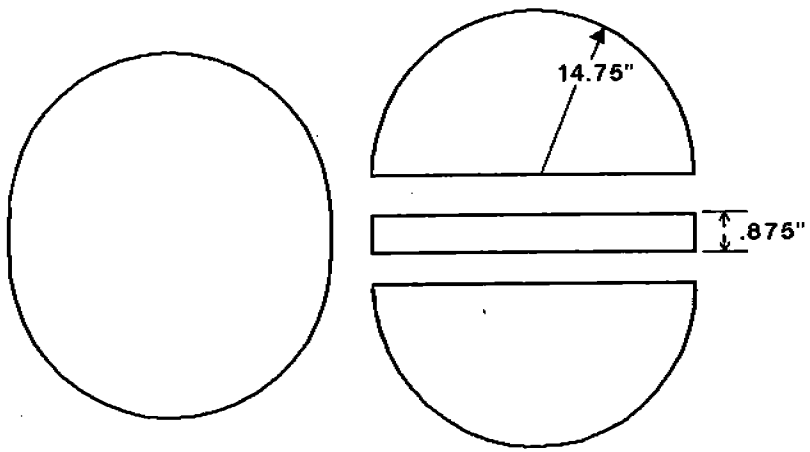
EMISSION SAMPLES

Location of Measurement Sites

EPA Reference Method 1 "Sample and Velocity Traverses for Stationary Sources" was used to select representative measurement sites. The inlet measurement site was located in a horizontal duct that was slightly out-of-round (30.375 in. vertical diameter and 29.5 in. horizontal diameter). The diameter of 30.05 inches was determined by procedures shown in Figure 4-1. The site was located 76 inches (2.5 duct diameters) downstream from the nearest downstream flow disturbance (plating tank) and 19 inches (0.6 duct diameters) from the nearest upstream flow disturbance (scrubber). According to EPA Method 1 criteria, this location required 24 sample traverse points, 12 along each of two perpendicular diameters (30.375 and 29.5 inches). Table 4-1 shows the traverse point locations.

The outlet measurement site was located in a 29.69 in. ID circular vertical stack, 63.2 inches (2.1 stack diameters) downstream of the nearest flow disturbance (ID fan) and approximately 15.8 inches (0.53 stack diameters) upstream of the nearest flow disturbance (atmosphere). According to EPA Method 1 criteria, this location required 24 sample traverse points, 12 along each of two perpendicular diameters. Table 4-1 also shows these traverse point locations.

Prior to sampling, the absence of cyclonic flow at each sample traverse point was verified based on procedures described in EPA Reference Method 1. In this method, the face openings of the Type-S



$$A = \pi R^2 + LW$$

$$A = 3.14(14.75)^2 + (29.5)(0.875)$$

$$A = 708.96 in^2$$

$$R = \sqrt{\frac{708.96}{3.14}}$$

$$R = 15.026"$$

$$D = 30.05"$$

Figure 4-1. Duct Area Calculation

TABLE 4-1. SAMPLE TRAVERSE POINT LOCATIONS FOR THE PACKED-BED SCRUBBER INLET AND OUTLET

Traverse Point No.	Location (inches) Scrubber Inlet Horizontal	Scrubber Inlet Vertical	Scrubber Outlet
1	1.0	1.0	1.0
2	2.0	2.0	2.0
3	3.5	3.6	3.5
4	5.2	5.4	5.3
5	7.4	7.6	7.4
6	10.5	10.8	10.6
7	19.0	19.6	19.1
8	22.1	22.8	22.3
9	24.3	25.0	24.4
10	26.0	26.8	26.2
11	27.5	28.3	27.7
12	28.5	29.375	28.7

pitot tube are aligned perpendicular to the duct cross-sectional plane, designated "0-degree reference." Null (zero) pitot readings obtained at 0-degree reference indicate an acceptable flow condition at a given point. If the point reading was not zero at 0-degree reference, the pitot was rotated until a null reading was obtained. The value of the rotation angle (yaw) was recorded for each point and averaged across the duct. Method 1 criteria stipulate that average angular rotations greater than 20 degrees indicate cyclonic (nonaxial) flow conditions in the duct. However, both of these sites indicated acceptable flow patterns so that extraction of representative samples from these sites was performed using appropriate sampling procedures.

Test Methods

Velocity and static pressures, moisture content, and temperature were measured prior to sampling in order to define sampling rates and nozzle sizes as described in the EPA Reference Methods 1, 2 and 4.

An EPA MM13B sample train was used to collect the Cr^{+6} samples. The sample train consisted of a 316 stainless steel button-hook nozzle, an unheated Pyrex glass-lined probe, and a series of four impingers. The first, third and fourth impingers were Greenburg-Smith design, modified by replacing the tip with a 1/2-in. inside diameter glass tube extending to 1/2-in. from the bottom of the flask. The second impinger was a Greenburg-Smith impinger with the standard tip. The first and second impingers contained 100 mℓ of 0.1N NaOH. The third impinger was empty and the fourth impinger contained approximately 200 grams of silica gel. The balance of the sampling system consisted of a vacuum pump, dry gas meter, calibrated orifice and related temperature and pressure indicating apparatus to determine dry gas sample volume, stack gas temperature, volumetric flow rate and isokinetic sampling rates. During sampling, stack gas temperature and the gas temperature exiting the last impinger were monitored with calibrated thermocouples.

The sampling time was initially set at 5 minutes per point (120 minute total sample time) and increased to 8 minutes per point (192 minute total sample time) to assure the concentration of Cr^{+6} was such that good analytical results could be obtained.

The impingers were weighed before and after each test to determine the moisture content of the flue gas stream. All connecting glassware, the nozzle and probe were rinsed with 0.1N NaOH and combined with the impinger solution into a tared polyethylene sample bottle. The total volume of the sample was determined gravimetrically. The liquid level was marked on each sample bottle and each bottle was marked indicating the run number and bottle contents.

Following the recovery of the samples, all samples, including blanks, were analyzed for Cr^{+6} concentration using the analytical methodology developed by the EPA.

EMISSION SAMPLE ANALYSIS

The MM13B samples and the plating solution were analyzed for Cr^{+6} concentration. The analyses were conducted on site in the EPA Mobile Laboratory. Immediately following the sample recovery, the samples were submitted to the analyst and the analyses and calculations were performed the same day. The reported results were calculated on the Hewlett Packard 41CV computer. The calculations were also performed by the EPA Task Manager.

The analytical method entitled "Draft Method - Determination of Hexavalent Chromium in Dry Particulate Emissions from Stationary Sources" was used as a "guideline" in conducting the Cr^{+6}analyses. This method is currently under development by the EPA and is presented in Appendix C.

There were several variations between the draft method and the analytical method that was performed in the field. They are described as follows:

1. The collected samples were not digested in an alkaline solution. Aliquots of the recovered samples were pipeted directly from the sample bottle and prepared as in paragraph 5.7.1 of the Draft Method.

2. The pH of the sample aliquot was monitored with a pH meter while adjusting the pH of the aliquot to 2 ± 0.5.

3. The spectrophotometer was calibrated with standards containing 2 mℓ, 5 mℓ, 7 mℓ, 10 mℓ, 15 mℓ and 20 mℓ of the 5 μg/mℓ working standard. The spectrophotometer calibration factor, K_C, was calculated as follows:

$$K_C = 10 \frac{A_1 + 2.5A_2 + 3.5A_3 + 5A_4 + 7.5A_5 + 10A_6}{A_1^2 + A_2^2 + A_3^2 + A_4^2 + A_5^2 + A_6^2}$$

4. The value of this calibration factor was calculated using a computer program that was developed by the EPA Task Manager for the HP41 calculator.

The total chromium analyses were performed by Datachem Laboratories in Cincinnati, Ohio. The method used was EPA Method 218. This method is presented in Appendix C, and the results are given in Appendix G.

SECTION 5.0
QUALITY ASSURANCE

INTRODUCTION

The goal of the quality assurance activities for this project is to ensure, to the highest degree possible, the accuracy of data collected. The procedures contained in the "Quality Assurance Handbook for Air Pollution Measurement Systems," Volume III, "Stationary Source Specific Methods," EPA-600/4-77-027B served as the basis for performance of all testing and related work activities that were undertaken in this testing program. In addition to the quality assurance measure guidelines presented above, specific quality assurance activities were conducted for several of the individual testing activities. These are presented in the paragraphs that follow.

FIELD QUALITY ASSURANCE PROCEDURES

To assure a high level of quality control while sampling in order to allow the comparison of data from these two methods, a field quality assurance program was followed during the test program. Methods used to obtain the required level of quality assurance are itemized below.

Sample Blanks

Reagent Blanks--

The 0.1N NaOH absorbing solution was transported to the field in its "as-purchased" container. When in the field, the 0.1N NaOH was transferred to a polyethylene wash bottle. From the wash bottle, the NaOH solution was used for sample train preparation and recovery.

A blank sample was collected from the solution in the wash bottle. This sample was given to the on-site laboratory personnel with the emission samples, and analyzed in the same manner. Results of the blank analyses are presented in Table 5-1.

H_2O Blanks--

A distilled water blank was obtained from the wash bottles and analyzed in the same manner as the emission samples.

Duplicate Samples

One sample for every 10 samples analyzed was a duplicate, e.g., if 24 samples were analyzed, 3 duplicate samples would be analyzed. The analytical results for the duplicated samples are presented in Table 5-1.

Standards

Daily, throughout the analysis of the samples, standards were set up as a spot check of the spectrophotometer calibration. The results of these checks are presented in Table 5-1.

Chain of Custody

In an effort to maintain the integrity of all samples taken at the test facility, a chain of custody procedure was followed. Once the samples were placed in custody of the analytical group, that group provided for safe storage and maintenance of records sufficient to maintain sample integrity. The "Chain of Custody" record sheets are presented in Appendix D.

Sample Transfer

All MM13B samples collected during testing remained in the custody of PEER personnel and were secured in the mobile laboratory while in the field.

TABLE 5-1. SUMMARY OF ANALYTICAL RESULTS FOR QA/QC SAMPLES AND BLANKS

Sample No.	Date (1989)	Type of Sample: Duplicate	Type of Sample: Standard	Total µg Cr^{+6}	
75 g/100 mℓ	5/21		X	74.6	
0-2	5/21	X		161.99	*154.95
50 µg/mℓ	5/21		X	49.7	
75 µg/100 mℓ	5/21		X	73.6	
50 µg/100 mℓ	5/22		X	50.2	
75 µg/100 mℓ	5/22		X	74.1	
Blanks					
0.1N NaOH	5/21			0.00	

* Original values against which data are to be compared.

SAMPLING TRAIN COMPONENTS

The equipment used in this test program, including nozzles, pitot tubes, dry gas meters, orifices, and thermocouples were uniquely identified and were calibrated in accordance with calibration procedures specified in the applicable EPA Reference Method prior to, and at the completion of, the testing program. The calibration sheets are presented in Appendix F.

VERIFICATION OF CALCULATIONS

Emission Calculations

Dry gas volumes, percent moisture of the stack gas, gas flow rates, and Cr^{+6} emission rates were calculated using a Hewlett Packard 41CV programmable calculator. The programs used can be found in the document: "Source Test Calculation and Check Programs for Hewlett Packard 41 Calculators" (EPA-340/1-85-018). The results were checked and verified by the PEER Task Manager.

Chromium Concentration Calculations

All absorbance data for blanks, standards, samples and QA/QC samples were documented in a notebook. The Cr^{+6} content and total mass of Cr^{+6} collected were calculated using a program developed by the EPA Task Manager for the HP41CV programmable calculator.

APPENDIX A

PROCESS DATA SHEETS AND AMPERE-HOUR CALCULATIONS

AMPERE-HOUR CALCULATIONS
TEST RUN NO. 1
TANK NO. 1

Date: May 19, 1989

Inlet
Start time: 11:19
Stop time: 16:49

Outlet
Start time: 11:20
Stop time: 16:50

Time, 24-hour clock		Time interval, min		Current, amperes	Ampere-hours	
Inlet	Outlet	Inlet	Outlet		Inlet	Outlet
11:19	11:20					
11:30	11:30	11	10	2,600	477	433
11:40	11:40	10	10	2,600	433	433
11:50	11:50	10	10	2,600	433	433
12:00	12:00	10	10	2,600	433	433
12:10	12:10	10	10	2,600	433	433
12:12	12:12	2	2	2,600	87	87
Subtotal		53	52		2,296	2,252
15:05	15:05					
15:10	15:10	5	5	2,000	167	167
15:12	15:13	2	3	2,000	67	100
Subtotal		7	8		234	267
15:49	15:50					
16:00	16:00	11	10	2,900	532	483
16:10	16:10	10	10	3,000	500	500
16:20	16:20	10	10	2,900	483	483
16:30	16:30	10	10	2,900	483	483
16:40	16:40	10	10	2,900	483	483
16:49	16:50	9	10	2,900	435	483
Subtotal		60	60		2,916	2,915
Total[a]		120	120		5,450	5,430

[a]Ampere-hours were rounded to nearest 10.

AMPERE-HOUR CALCULATIONS
TEST RUN NO. 2
TANK NO. 1

Date: May 19, 1989

Inlet
Start time: 17:48
Stop time: 20:35

Outlet
Start time: 17:48
Stop time: 20:35

Time, 24-hour clock		Time interval, min		Current, amperes	Ampere-hours	
Inlet	Outlet	Inlet	Outlet		Inlet	Outlet
17:48	17:48					
17:50	17:50	2	2	3,000	100	100
17:58	17:58	8	8	3,000	400	400
Subtotal		10	10		500	500
18:16	18:16					
18:20	18:20	4	4	3,000	200	200
18:30	18:30	10	10	3,000	500	500
18:40	18:40	10	10	3,000	500	500
18:50	18:50	10	10	3,000	500	500
19:00	19:00	10	10	3,000	500	500
19:06	19:06	6	6	3,000	300	300
Subtotal		50	50		2,500	2,500
19:35	19:35					
19:40	19:40	5	5	3,000	250	250
19:50	19:50	10	10	3,000	500	500
20:00	20:00	10	10	3,000	500	500
20:10	20:10	10	10	3,000	500	500
20:20	20:20	10	10	3,000	500	500
20:30	20:30	10	10	3,000	500	500
20:35	20:35	5	5	3,000	250	250
Subtotal		60	60		3,000	3,000
Total[a]		120	120		6,000	6,000

[a]Ampere-hours were rounded to nearest 10.

AMPERE-HOUR CALCULATIONS
TEST RUN NO. 3
TANK NO. 1

Date: May 20, 1989

Inlet
Start time: 13:12
Stop time: 15:24

Outlet
Start time: 13:12
Stop time: 15:24

Time, 24-hour clock		Time interval, min		Current, amperes	Ampere-hours	
Inlet	Outlet	Inlet	Outlet		Inlet	Outlet
13:12	13:12					
13:15	13:15	3	3	2,200	110	110
13:25	13:25	10	10	2,200	367	367
13:35	13:35	10	10	2,200	367	367
13:45	13:45	10	10	2,200	367	367
13:55	13:55	10	10	2,200	367	367
14:05	14:05	10	10	2,200	367	367
14:12	14:12	7	7	2,200	257	257
Subtotal		60	60		2,202	2,202
14:24	14:24					
14:30	14:30	6	6	2,400	240	240
14:40	14:40	10	10	2,400	400	400
14:50	14:50	10	10	2,400	400	400
15:00	15:00	10	10	2,400	400	400
15:10	15:10	10	10	2,400	400	400
15:20	15:20	10	10	2,400	400	400
15:24	15:24	4	4	2,400	160	160
Subtotal		60	60		2,400	2,400
Total[a]		120	120		4,600	4,600

[a]Ampere-hours were rounded to nearest 10.

AMPERE-HOUR CALCULATIONS
TEST RUN NO. 4
TANK NO. 1

Date: May 21, 1989

Inlet
Start time: 10:39
Stop time: 12:51

Outlet
Start time: 10:39
Stop time: 12:51

Time, 24-hour clock		Time interval, min		Current, amperes	Ampere-hours	
Inlet	Outlet	Inlet	Outlet		Inlet	Outlet
10:39	10:39					
10:40	10:40	1	1	3,400	57	57
10:50	10:50	10	10	3,400	567	567
11:00	11:00	10	10	3,400	567	567
11:10	11:10	10	10	3,600	600	600
11:20	11:20	10	10	3,600	600	600
11:30	11:30	10	10	3,600	600	600
11:40	11:39	10	9	3,600	600	540
Subtotal		61	60		3,591	3,531
11:51	11:51					
11:55	11:55	4	4	3,600	240	240
12:05	12:05	10	10	3,600	600	600
12:15	12:15	10	10	3,600	600	600
12:25	12:25	10	10	3,600	600	600
12:35	12:35	10	10	3,600	600	600
12:45	12:45	10	10	3,600	600	600
12:51	12:51	6	6	3,600	360	360
Subtotal		60	60		3,600	3,600
Total[a]		121	120		7,190	7,130

[a]Ampere-hours were rounded to nearest 10.

AMPERE-HOUR CALCULATIONS
TEST RUN NO. 5
TANK NO. 1

Date: May 21, 1989

Inlet
Start time: 13:49
Stop time: 16:02

Outlet
Start time: 13:49
Stop time: 16:02

Time, 24-hour clock		Time interval, min		Current, amperes	Ampere-hours	
Inlet	Outlet	Inlet	Outlet		Inlet	Outlet
13:49	13:49					
13:55	13:55	6	6	3,600	360	360
14:05	14:05	10	10	3,600	600	600
14:15	14:15	10	10	3,600	600	600
14:25	14:25	10	10	3,600	600	600
14:35	14:35	10	10	3,600	600	600
14:45	14:45	10	10	3,600	600	600
14:49	14:49	4	4	3,600	240	240
Subtotal		60	60		3,600	3,600
15:02	15:02					
15:05	15:05	3	3	3,600	180	180
15:15	15:15	10	10	3,600	600	600
15:25	15:25	10	10	3,600	600	600
15:35	15:35	10	10	3,600	600	600
15:45	15:45	10	10	3,600	600	600
15:55	15:55	10	10	3,600	600	600
16:02	16:02	7	7	3,600	420	420
Subtotal		60	60		3,600	3,600
Total[a]		120	120		7,200	7,200

[a]Ampere-hours were rounded to nearest 10.

AMPERE-HOUR CALCULATIONS
TEST RUN NO. 6
TANK NO. 1

Date: May 21, 1989

Inlet
Start time: 17:37
Stop time: 19:49

Outlet
Start time: 17:37
Stop time: 19:49

Time, 24-hour clock		Time interval, min		Current, amperes	Ampere-hours	
Inlet	Outlet	Inlet	Outlet		Inlet	Outlet
17:37	17:37					
17:40	17:40	3	3	3,600	180	180
17:50	17:50	10	10	3,600	600	600
18:00	18:00	10	10	3,600	600	600
18:10	18:10	10	10	3,600	600	600
18:20	18:20	10	10	3,600	600	600
18:30	18:30	10	10	3,600	600	600
18:37	18:37	7	7	3,800	443	443
Subtotal		60	60		3,623	3,623
18:49	18:49					
18:50	18:50	1	1	3,800	63	63
19:00	19:00	10	10	3,800	633	633
19:10	19:10	10	10	3,800	633	633
19:20	19:20	10	10	3,800	633	633
19:30	19:30	10	10	3,800	633	633
19:40	19:40	10	10	3,800	633	633
19:49	19:49	9	9	3,800	570	570
Subtotal		60	60		3,798	3,798
Total[a]		120	120		7,420	7,420

[a]Ampere-hours were rounded to nearest 10.

AMPERE-HOUR CALCULATIONS
TEST RUN NO. 7
TANK NO. 1

Date: May 23, 1989

Inlet
Start time: 09:38
Stop time: 13:04

Outlet
Start time: 09:38
Stop time: 13:04

Time, 24-hour clock		Time interval, min		Current, amperes	Ampere-hours	
Inlet	Outlet	Inlet	Outlet		Inlet	Outlet
09:38	09:38					
09:40	09:40	2	2	3,000	100	100
09:50	09:50	10	10	2,800	467	467
10:00	10:00	10	10	3,000	500	500
10:10	10:10	10	10	3,000	500	500
10:20	10:20	10	10	3,000	500	500
10:30	10:30	10	10	3,200	533	533
10:40	10:40	10	10	3,100	517	517
10:50	10:50	10	10	3,100	517	517
11:00	11:00	10	10	3,100	517	517
11:10	11:10	10	10	3,100	517	517
11:14	11:14	4	4	3,200	213	213
Subtotal		96	96		4,881	4,881
11:28	11:28					
11:30	11:30	2	2	3,200	107	107
11:40	11:40	10	10	3,200	533	533
11:50	11:50	10	10	3,200	533	533
12:00	12:00	10	10	3,200	533	533
12:10	12:10	10	10	3,200	533	533
12:20	12:20	10	10	3,200	533	533
12:30	12:30	10	10	3,200	533	533
12:40	12:40	10	10	3,200	533	533
12:50	12:50	10	10	3,200	533	533
13:00	13:00	10	10	3,200	533	533
13:04	13:04	4	4	3,200	213	213
Subtotal		96	96		5,117	5,117
Total[a]		192	192		10,000	10,000

[a]Ampere-hours were rounded to nearest 10.

AMPERE-HOUR CALCULATIONS
TEST RUN NO. 8
TANK NO. 1

Date: May 23, 1989

Inlet
Start time: 14:41
Stop time: 16:52

Outlet
Start time: 14:41
Stop time: 16:52

Time, 24-hour clock		Time interval, min		Current, amperes	Ampere-hours	
Inlet	Outlet	Inlet	Outlet		Inlet	Outlet
14:41	14:41					
14:45	14:45	4	4	2,800	187	187
14:55	14:55	10	10	2,800	467	467
15:05	15:05	10	10	2,800	467	467
15:15	15:15	10	10	2,800	467	467
15:25	15:25	10	10	2,800	467	467
15:35	15:35	10	10	2,800	467	467
15:41	15:41	6	6	2,800	280	280
Subtotal		60	60		2,802	2,802
15:52	15:52					
15:55	15:55	3	3	2,800	140	140
16:05	16:05	10	10	2,800	467	467
16:15	16:15	10	10	2,800	467	467
16:25	16:25	10	10	2,800	467	467
16:35	16:35	10	10	2,800	467	467
16:45	16:45	10	10	2,800	467	467
16:52	16:52	7	7	2,800	327	327
Subtotal		60	60		2,802	2,802
Total[a]		120	120		5,600	5,600

[a]Ampere-hours were rounded to nearest 10.

SOURCE SAMPLING PROGRAM PROCESS DATA SHEET

Place: Fusion, Inc.
Date: May 19, 1989

Test Run No. 1
Tank No. 1

Inlet
Start time: 11:19
Stop time: 16:49

Outlet
Start time: 11:20
Stop time: 16:50

Time, 24-h clock	Current, amperes	Voltage, volts	Temp., °F	Notes
11:20	2,800	5.4	126	Started testing at 11:19
11:30	2,600	5.4	128	
11:40	2,600	5.4	126	
11:50	2,600	5.4	126	
12:00	2,600	5.4	126	
12:10	2,600	5.4	126	Stopped testing at 12:12
				Electrical circuit overload
15:05	2,000	5.0	128	Started testing at 15:05
15:10	2,000	5.0	126	
15:15	2,000	5.0	126	Stopped testing at 15:13 port change
15:50	2,900	5.8	128	Started testing at 15:49
16:00	2,900	5.8	126	
16:10	3,000	5.8	127	
16:20	2,900	5.8	127	
16:30	2,900	5.8	127	
16:40	2,900	5.8	126	
16:50	2,900	5.8	126	Stopped testing at 16:50

SOURCE SAMPLING PROGRAM PROCESS DATA SHEET

Place: Fusion, Inc.
Date: May 19, 1989

Test Run No. 2
Tank No. 1

Inlet
Start time: 17:48
Stop time: 20:35

Outlet
Start time: 17:48
Stop time: 20:35

Time, 24-h clock	Current, amperes	Voltage, volts	Temp., °F	Notes
17:50	3,000	5.8	126	Started testing at 17:48
18:00	3,000	5.8	127	Stopped testing at 17:58 Problem in maintaining isokinetics at outlet
18:20	3,000	5.8	127	Started testing at 18:16
18:30	3,000	5.8	127	
18:40	3,000	5.8	127	
18:50	3,000	5.8	127	
19:00	3,000	5.8	126	
19:10	3,000	5.8	126	Stopped testing at 19:06 port change
19:40	3,000	5.8	127	Started testing at 19:35
19:50	3,000	5.8	127	
20:00	3,000	5.8	127	
20:10	3,000	5.8	127	
20:20	3,000	5.8	127	
20:30	3,000	5.8	127	
20:40	3,000	5.8	127	Stopped testing at 20:35

SOURCE SAMPLING PROGRAM PROCESS DATA SHEET

Place: Fusion, Inc.
Date: May 20, 1989

Test Run No. 3
Tank No. 1

Inlet
Start time: 13:12
Stop time: 15:24

Outlet
Start time: 13:12
Stop time: 15:24

Time, 24-h clock	Current, amperes	Voltage, volts	Temp., °F	Notes
13:15	2,200	6.0	128	Started testing at 13:12
13:25	2,200	6.0	128	
13:35	2,200	6.0	126	
13:45	2,200	6.0	127	
13:55	2,200	6.0	128	
14:05	2,200	6.0	128	
14:15	2,200	6.0	128	Stopped testing at 14:12 port change
14:30	2,400	6.0	127	Started testing at 14:24
14:40	2,400	6.0	127	
14:50	2,400	6.0	127	
15:00	2,400	6.0	126	
15:10	2,400	6.0	128	
15:20	2,400	6.0	128	
15:30	2,400	6.0	128	Stopped testing at 15:24

SOURCE SAMPLING PROGRAM PROCESS DATA SHEET

Place: Fusion, Inc.
Date: May 21, 1989

Test Run No. 5
Tank No. 1

Inlet
Start time: 13:49
Stop time: 16:02

Outlet
Start time: 13:49
Stop time: 16:02

Time, 24-h clock	Current, amperes	Voltage, volts	Temp., °F	Notes
13:55	3,600	5.6	128	Started testing at 13:49
14:05	3,600	5.6	128	
14:15	3,600	5.6	128	
14:25	3,600	5.6	128	
14:35	3,600	5.6	128	
14:45	3,600	5.6	128	
14:50	3,600	5.6	128	Stopped testing at 14:49 port change
15:05	3,600	5.6	128	Started testing at 15:02
15:15	3,600	5.6	127	
15:25	3,600	5.6	128	
15:35	3,600	5.6	127	
15:45	3,600	5.6	128	
15:55	3,600	5.6	127	
16:05	3,600	5.6	126	Stopped testing at 16:02

SOURCE SAMPLING PROGRAM PROCESS DATA SHEET

Place: Fusion, Inc.
Date: May 21, 1989

Test Run No. 6
Tank No. 1

Inlet
Start time: 17:37
Stop time: 19:49

Outlet
Start time: 17:37
Stop time: 19:49

Time, 24-h clock	Current, amperes	Voltage, volts	Temp., °F	Notes
17:40	3,600	5.6	128	Started testing at 17:37
17:50	3,600	5.6	128	
18:00	3,600	5.6	128	
18:10	3,600	5.6	126	
18:20	3,600	5.6	127	
18:30	3,600	5.6	128	
18:40	3,800	5.6	128	Stopped testing at 18:37 port change
18:50	3,800	5.6	128	Started testing at 18:49
19:00	3,800	5.6	127	
19:10	3,800	5.6	127	
19:20	3,800	5.6	128	
19:30	3,800	5.6	126	
19:40	3,800	5.6	128	
19:50	3,800	5.6	128	Stopped testing at 19:49

SOURCE SAMPLING PROGRAM PROCESS DATA SHEET

Place: Fusion, Inc.
Date: May 23, 1989

Test Run No. 7
Tank No. 1

Inlet
Start time: 09:38
Stop time: 13:04

Outlet
Start time: 09:38
Stop time: 13:04

Time, 24-h clock	Current, amperes	Voltage, volts	Temp., °F	Notes
09:40	3,000	7.0	127	Started testing at 09:38
09:50	2,800	6.6	126	
10:00	3,000	6.6	126	
10:10	3,000	6.6	128	
10:20	3,000	6.6	126	
10:30	3,200	6.6	126	
10:40	3,100	6.6	126	
10:50	3,100	6.6	127	
11:00	3,100	6.6	126	
11:10	3,100	6.6	126	
11:20	3,200	6.6	126	Stopped testing at 11:14 port change
11:30	3,200	6.6	127	Started testing at 11:28
11:40	3,200	6.6	127	
11:50	3,200	6.6	127	
12:00	3,200	6.6	126	
12:10	3,200	6.6	127	
12:20	3,200	6.6	126	
12:30	3,200	6.6	126	
12:40	3,200	6.6	126	
12:50	3,200	6.6	126	
13:00	3,200	6.6	126	
13:05	3,200	6.6	126	Stopped testing at 13:04

SOURCE SAMPLING PROGRAM PROCESS DATA SHEET

Place: Fusion, Inc.
Date: May 23, 1989

Test Run No. 8
Tank No. 1

Inlet
Start time: 14:41
Stop time: 16:52

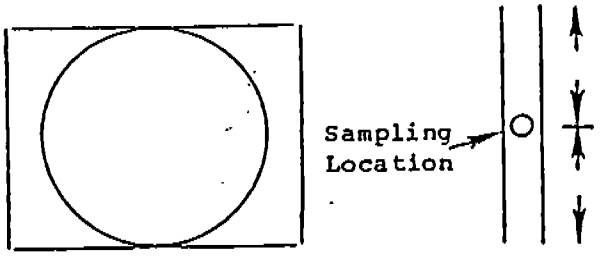
Outlet
Start time: 14:41
Stop time: 16:52

Time, 24-h clock	Current, amperes	Voltage, volts	Temp., °F	Notes
14:45	2,800	6.2	126	Started testing at 14:41
14:55	2,800	6.2	126	
15:05	2,800	6.2	126	
15:15	2,800	6.2	126	
15:25	2,800	6.2	126	
15:35	2,800	6.2	126	
15:45	2,800	6.2	128	Stopped testing at 15:36 port change
15:55	2,800	6.2	127	
16:05	2,800	6.2	128	Started testing at 15:56
16:15	2,800	6.2	128	
16:25	2,800	6.2	128	
16:35	2,800	6.2	127	
16:45	2,800	6.2	127	
16:50	2,800	6.2	127	Stopped testing at 16:52

APPENDIX B
FIELD DATA SHEETS

PRELIMINARY VELOCITY TRAVERSE

Plant: Fusion Inc. Job No.
Date: 5-14-89
Location: Scrubber Outlet
Stack I.D.: 29"68/5"
Barometric Pressure, in. Hg:
Stack Gauge Pressure, in. H_2O: +.66
Operators: Gerber Simas
Pitot Tube I.D. Number:
Temperature Readout I.D.: Omega
Pitot Tube Leak Check:
Run Number _____ Time 0900



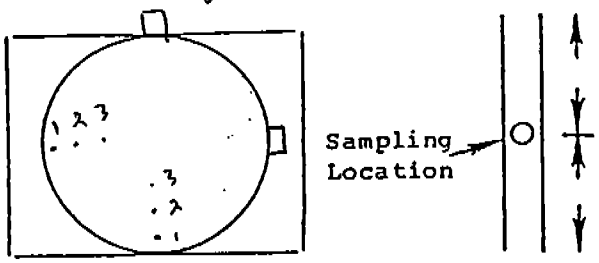
Schematic of Traverse Point Layout

Traverse Point Number	Velocity Head (Δp_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
1	1.9	79	+5
2	1.95	80	+4
3	1.9	79	+3
4	1.9	79	+4
5	1.8	79	+6
6	1.5	79	+5
7	1.1	79	-2
8	1.0	79	-4
9	1.0	79	-8
10	1.1	79	-12
11	1.1	79	-17
12	1.0	79	-15
	Right Port 1A		
Average			

Traverse Point Number	Velocity Head (Δp_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
1	1.8	79	+5
2	1.75	79	+10
3	1.6	79	+7
4	1.5	79	+5
5	1.4	79	+2
6	1.3	79	0
7	0.86	79	-4
8	0.83	79	-10
9	0.81	79	-10
10	0.77	79	-15
11	0.74	79	-4
12	0.68	79	-6
	Left Port B		
Average			

PRELIMINARY VELOCITY TRAVERSE

Plant: Fusion Inc. Job No.
Date: 5-18-89
Location: Scrubber Inlet
Stack I.D.: 20.375 / 29.5
Barometric Pressure, in. Hg: 29.98
Stack Gauge Pressure, in. H_2O: -3.6
Operators: Gerber, Hollins
Pitot Tube I.D. Number:
Temperature Readout I.D.: 1-2
Pitot Tube Leak Check: O.K.
Run Number P-1 Time 12:00



Schematic of Traverse Point Layout

Vertical

Traverse Point Number	Velocity Head (Δp_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
1	1.3	77	+20
2	1.3	76	+15
3	1.2	76	+12
4	1.1	75	0
5	1.1	75	+5
6	1.2	75	0
7	1.3	75	-20
8	1.4	75	-7
9	1.5	75	-15
10	1.6	75	0/-5
11	1.6	75	0
12	1.6	75	0
	Nozzle		
	.243 / .240 / .245 = .243 Ave		
Average			

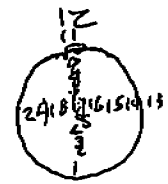
Horizontal

Traverse Point Number	Velocity Head (Δp_s) in. H_2O	Stack Temp. (T_s), °F	Cyclonic Flow Check ° from Null
1	1.5	74	~~0~~ +10
2	1.6	74	~~0~~ +8
3	1.5	75	~~0~~ +10
4	1.4	74	~~0~~ +10
5	1.4	75	+10
6	1.4	74	+5
7	1.3	74	-2
8	1.4	74	-3
9	1.5	74	0
10	1.6	74	0
11	1.6	74	-10
12	1.6	74	-10
Average			

FIELD DATA

Plant: Fusion, inc.
Date: 5/19/89 Job No.
Sampling Location: Scrubber Inlet
Sample Type: Modified 13B
Run Number: I-1
Operator: Simon
Ambient Temperature: 80°F
Barometric Pressure: 30.05" Hg
Static Pressure (P_s): -3.6
Filter Number(s): N.A.
Pretest Leak Rate = [redacted] cfm @ 15.0 in. Hg
Pretest Pitot Leak Check: O.K.
Pretest Orsat Leak Check: N.A.
Read and Record all Data Every 5 Minutes

Page 1 of 2 [redacted]



(Flow is out of paper)

Schematic of Traverse Point Layout
SIDE VIEW

Probe Length and Type: 5' glass-lined, SS nozzle
Pitot Tube I.D. No.: S-4A Cp: 0.84
Nozzle I.D.: a.243 | 0.2490.245 | Avg. 0.243
Assumed Moisture, %: 2.5
Temp. Readout S/N: T-2
Meter Box Number: MB 3
Meter $\Delta H_@$: 1.987
C Factor: 1.15
Meter Gamma: 0.985
Heater Box Setting: N.A.
Reference Δp: 0.44
Post Test Leak Rate = 0.00 cfm @ 16.0 in. Hg
Post Test Pitot Leak Check: O.K.
Post Test Orsat [redacted]eak Check: N.A.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
Temp. Sensor ID No.							2	Top	Top		N.A	1	N.A
	0	11:19	921.089										
1	5	11:24	926.2	1.30	5.60	5.60	84	93.4	84.0	3.5	—	70	—
2	10	11:29	932.7	1.30	5.60	5.60	94	108.8	84	3.5	—	74	—
3	15	11:34	939.2	1.20	5.40	5.40	94	111.3	86	3.50	—	79	—
4	20	11:39	945.2	1.10	4.70	4.70	84	112.1	88	3.0	—	77	—
5	25	11:44	951.6	1.20	5.40	5.40	85	112.5	89	3.50	—	75	—
6	30	1149	958.4	1.30	5.60	5.60	85	113.6	90	3.[illegible]	—	76	—
7	35	1154	965.2	1.40	6.00	6.00	85	115.5	90	4.5	—	[illegible]	—
8	40	1159	972.3	1.40	6.00	6.00	86	117.4	90	4.5	—	[illegible]	—
9	45	1204	980.2	1.50	6.50	6.50	87	118.6	92	5.0	—	71	—
10	50	1209	987.6	1.60	6.80	6.80	87	120.1	94	5.5	—	69	—
11		1212	991.967	1.65	7.20	7.20	87	121.2	95	6.0	—	69	—
		1212	→ STOP TEST, RESUMED AT			1505				6.0	—	71	—
		1507	991.967	1.65	7.20	7.2	86	95.6	88	6.0	—	71	—
11	55	1512	996.8	1.50	6.2	6.2	87	103.7	88	5.5	—	63	—
12	60		003.556	STOP - SWITCH PORTS									
				See next sheet for Continuation of Test									
			~~[illegible]~~	Leak Check 0.003 at 15"									
			~~[illegible]~~	Leak check after probe removed & assembled - 0.005 at 15"									

Pressure Drop across scrubber = 1.75 in.

1.75

1.75

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Fusion, Inc

Test Date: 5-19-89

Run Number: I-1

Operator: Simon

Page 2 of 2

Traverse Point Number	Sampling Time, (min)	/ Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
	60	/ 1549	003.920										
13	65	/ 1554	010.6	1.50	6.50	6.5	85	94.5	89	5.0	—	65	—
14	70	/ 1559	019.4	1.70	7.4	7.4	85	112.5	90	6.0	—	63	—
15	75	/ 1604	029.40	1.60	6.8	6.8	86	117.8	92	5.0	—	63	—
16	80	/ 1609	034.1	1.50	6.5	6.5	85	119.4	94	5.0	—	62	—
17	85	/ 1614	042.1	1.40	6.0	6.0	85	120.3	95	4.5	—	62	—
18	90	/ 1619	049.0	1.45	6.2	6.2	85	120.7	96	5.0	—	63	—
19	95	/ 1624	055.9	1.40	6.0	6.0	85	121.4	96	4.5	—	64	—
20	100	/ 1629	063.9	1.40	6.0	6.0	84	121.4	97	4.5	—	64	—
21	105	/ 1634	071.0	1.50	6.5	6.5	84	122.0	97	5.5	—	62	—
22	110	/ 1639	078.6	1.6	6.9	6.9	85	123.7	98	6.0	—	62	—
23	115	/ 1644	086.4	1.6	6.9	6.9	83	124.6	98	6.0	—	61	—
24	120	/ 1649	094.536	STOP-END OF TEST				124.9	99		—	61	—
		/		1.55	6.9	6.9				5.5			
		/											
		/	90.616		~~AVE. 6.25~~								
		/			AVE ΔH = 6.225								
		/		~~AVE ΔP = 1.495~~				AVE. T_m = 101.6					
		/		AVE ΔP = 1.200									
		/	V_m = 173.447			NE T_s = 85.1							
		/	173.083										

Pressure Drop Across Scrubber = 1.75

~~1.75~~ 1.80

PACIFIC ENVIRONMENTAL SERVICES, INC.

SAMPLE RECOVERY DATA

Plant: Fusion, Inc Run No.: I-1

Date: 5/19/89 Sample Box No.: RAC 1 Job No.: _____

Sample Location: Scrubber inlet

Sample Type: MM13B Filter No.: N/A

Sample Recovery Person: _____

Comments: _____

FRONT HALF

Acetone Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: _____ _____ _____ Sealed: _____

Description of Filter: _____

Samples stored and locked: _____

BACK HALF/MOISTURE

Container No: _____ _____ _____

Liquid Level Marked: _____ Sealed: _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1	0.1 N NaOH	100 ml	594.5	625.7	31.2
2	0.1 N NaOH	100 ml	586.9	601.8	14.9
3	MT	—	467.3	472.8	5.3
4	Silica Gel	~200 g	658.2	693.0	35.8
5					
6					
TOTAL					87.2

Description of Impinger Catch: _____

F1

```
                XROM "PRESS"
NO. OF POINTS ?
          24.0000      RUN
DELTA P ?
           1.3000      RUN
STACK TEMP ?
          84.0000      RUN
DELTA P ?
           1.3000      RUN
STACK TEMP ?
          84.0000      RUN
DELTA P ?
           1.2000      RUN
STACK TEMP ?
          84.0000      RUN
DELTA P ?
           1.1000      RUN
STACK TEMP ?
          84.0000      RUN
DELTA P ?
           1.2000      RUN
STACK TEMP ?
          85.0000      RUN
DELTA P ?
           1.3000      RUN
STACK TEMP ?
          85.0000      RUN
DELTA P ?
           1.4000      RUN
STACK TEMP ?
          85.0000      RUN
DELTA P ?
           1.4000      RUN
STACK TEMP ?
          86.0000      RUN
DELTA P ?
           1.5000      RUN
STACK TEMP ?
          87.0000      RUN
DELTA P ?
           1.6000      RUN
STACK TEMP ?
          87.0000      RUN
DELTA P ?
           1.6500      RUN
STACK TEMP ?
          87.0000      RUN
DELTA P ?
           1.5000      RUN
STACK TEMP ?
          87.0000      RUN
DELTA P ?
           1.5000      RUN
STACK TEMP ?
          85.0000      RUN
DELTA P ?
           1.7000      RUN
STACK TEMP ?
          85.0000      RUN
DELTA P ?
           1.6000      RUN
STACK TEMP ?
          86.0000      RUN
DELTA P ?
           1.5000      RUN
STACK TEMP ?
          85.0000      RUN
DELTA P ?
           1.4000      RUN
STACK TEMP ?
          85.0000      RUN
DELTA P ?
           1.4500      RUN
STACK TEMP ?
          85.0000      RUN
DELTA P ?
           1.4000      RUN
STACK TEMP ?
          85.0000      RUN
DELTA P ?
           1.4000      RUN
STACK TEMP ?
          84.0000      RUN
```

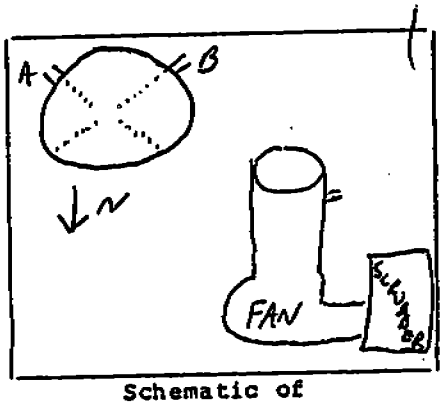
```
DELTA P ?
           1.5000      RUN
STACK TEMP ?
          84.0000      RUN
DELTA P ?
           1.6000      RUN
STACK TEMP ?
          85.0000      RUN
DELTA P ?
           1.6000      RUN
STACK TEMP ?
          83.0000      RUN
DELTA P ?
           1.5500      RUN
STACK TEMP ?
          85.0000      RUN

SQRT PSTS = 28.0143
AVE STK TEMP = 85.0833
```

```
                XROM "MASSFLO"
RUN NUMBER
I-1
                       RUN

VOL MTR STD ?
         162.729       RUN
STACK DSCFM ?
       19,137.00       RUN
FRONT 1/2 MG ?
         1.37941       RUN
BACK 1/2 MG ?
                     FIX 5
                       RUN


F  GR/DSCF = 0.00013
F  MG/MMM = 0.29935
F  LB/HR = 0.02146
F  KG/HR = 0.00973
```

```
                XROM "METH 5"
RUN NUMBER
I-1
                       RUN
METER BOX Y?
            .9850      RUN
DELTA H?
           6.2000      RUN
BAR PRESS ?
          30.0500      RUN
METER VOL ?
         173.0830      RUN
MTR TEMP F?
         104.0000      RUN
STATIC HOH IN ?
          -3.6000      RUN
STACK TEMP.
          85.0000      RUN
ML. WATER ?
           6.0000      CLX
          86.4000      RUN

SAT % = 4.1

IMP. % HOH = 2.4

% HOH=2.4

% CO2?
            .7000      RUN
% OXYGEN?
          21.0000      RUN
% CO ?
                       RUN

MWd =28.95
MW WET=28.68

SQRT PSTS ?
          28.0143      RUN
COS SQRT PSTS ?
                       RUN
TIME MIN ?
         120.0000      RUN
NOZZLE DIA ?
            .2430      RUN
STK DIA INCH ?
          30.0500      RUN

* VOL MTR STD = 162.729
  STK PRES ABS = 29.79
  VOL HOH GAS = 4.07
  % MOISTURE = 2.44
  MOL DRY GAS = 0.976
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.68
  VELOCITY FPS = 68.83
  STACK AREA = 4.93
  STACK ACFM = 20,338.
* STACK DSCFM = 19,137.
  % ISOKINETIC =  108.43

END OF FIELD DATA
```

FIELD DATA

Plant: Fusion Inc.
Date: 5-19-89 Job No.: 2958
Sampling Location: Scrubber Outlet
Sample Type: Chrome
Run Number: 0-1
Operator: Gerber, Hollins
Ambient Temperature: 87
Barometric Pressure: 30.03
Static Pressure (P_s): -.67
Filter Number(s): N/A
Pretest Leak Rate = 0.000 cfm @ 15 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check: N/A
Read and Record all Data Every 5 Minutes



Schematic of Traverse Point Layout

Probe Length and Type: 3' Glass
Pitot Tube I.D. No.: 5-6 Cp: .84
Nozzle I.D.: .2391, .2361, .2381 Avg. .2372
Assumed Moisture, %: 2.5
Temp. Readout S/N: Omega
Meter Box Number: MB-4
Meter $\Delta H_@$: 1.441
C Factor: 0.90
Meter Gamma: ~~1.441~~ 1.009
Heater Box Setting: N/A
Reference Δp: 0.63
Post Test Leak Rate = 0.018 cfm @ 11 in. Hg
Post Test Pitot Leak Check: O.K.
Post Test Orsat Leak Check: N/A

Page 1 of 2

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
1	0	11:20	254.903	2.0	5.8	5.8	82	88	85	10		67	
2	5	11:25	262.360	2.0	5.8	5.8	83	98	86	10		73	
3	10	11:30	269.900	1.9	5.6	5.6	82	110	88	10		80	
4	15	11:35	277.375	1.9	5.6	5.6	82	118	90	10		76	
5	20	11:40	284.888	1.7	5.0	5.0	82	122	93	9		73	
6	25	11:45	292.055	1.4	4.1	4.1	82	123	95	7		72	
7	30	11:50	298.765	1.2	3.6	3.6	82	122	96	5		71	
8	35	11:55	304.867	1.0	3.0	3.0	82	122	97	4		69	
9	40	12:00	310.500	1.05	3.1	3.1	82	122	98	4		67	
10	45	12:05	316.144	1.05	3.1	3.1	82	123	98	4		66	
11	50	12:10	321.790	0.93	2.7	2.7	82	122	100	4		68	
12	55	15:08	327.079	0.88	2.6	2.6	85	94	92	4		54	
13	60	15:50	332.236	1.80	5.3	5.3	83	93	92	8		65	
14	65	15:55	339.300	1.80	5.3	5.3	83	104	93	8		58	
15	70	16:00	346.491	1.60	4.7	4.7	83	115	94	7		61	
16	75	16:05	353.295	1.50	4.3	4.3	83	121	96	7		59	
17	80	16:10	359.932	1.40	4.1	4.1	83	125	98	6		58	
18	85	16:15	366.442	1.40	4.1	4.1	82	127	100	6		57	
19	90	16:20	372.934	0.92	2.7	2.7	83	126	102	4		59	
20	95	16:25	378.348	0.92	2.7	2.7	83	126	102	4		59	

* OFF 12:12 (52.7)

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Fusion Inc.

Test Date: 5-19-89

Run Number: O-1

Operator: Gerber, Hollins.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F
21	100	16:30	383.900	0.90	2.6	2.6	82	126	103	4		59
22	105	16:35	388.891	0.85	2.5	2.5	82	126	104	3		59
23	110	16:40	393.451	0.77	2.3	2.3	82	127	104	3		59
24	115	16:45	398.838	0.65	1.9	1.9	83	129	104	3		59
OFF	120	16:50	403.262									
					3.85			AVE. = 107				
			145.359									

PACIFIC ENVIRONMENTAL SERVICES INC.

SAMPLE RECOVERY DATA

Plant: Fusion Inc Run No.: 0-1

Date: 5/19/89 Sample Box No.: Blue Cooler Job No.: _____

Sample Location: Scrubber Outlet

Sample Type: MM13B Filter No.: _____

Sample Recovery Person: _____

Comments: _____

FRONT HALF

Acetone Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: _____ _____ _____ Sealed: _____

Description of Filter: _____

Samples stored and locked: _____

BACK HALF/MOISTURE

Container No: _____ _____ _____

Liquid Level Marked: _____ Sealed: _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1	0.1 N NaOH	100	588.3	634.3	46
2	0.1 N NaOH	100	612.3	619.0	6.7
3	MT	—	503.6	508.7	5.1
4	Silica Gel	-200 gr	713.7	738.4	24.7
5					
6					
TOTAL					82.5

Description of Impinger Catch: _____

F1

```
NO. DELTA P ?  XROM "PRESS"
               24.        RUN
STACK TEMP ?   2.0        RUN
DELTA P ?      82.        RUN
STACK TEMP ?   8.0        RUN
DELTA P ?      82.        RUN
                          FIX 4
STACK TEMP ?   1.4000     RUN
DELTA P ?      82.0000    RUN
STACK TEMP ?   1.7000     RUN
DELTA P ?      82.0000    RUN
STACK TEMP ?   1.7000     RUN
DELTA P ?      82.0000    RUN
STACK TEMP ?   1.4200     RUN
DELTA P ?      82.0000    RUN
STACK TEMP ?   1.2000     RUN
DELTA P ?      82.0000    RUN
STACK TEMP ?   1.0200     RUN
DELTA P ?      82.0000    RUN
STACK TEMP ?   1.2500     RUN
DELTA P ?      82.0000    RUN
STACK TEMP ?   1.0500     RUN
DELTA P ?      82.0000    RUN
STACK TEMP ?   .9000      RUN
DELTA P ?      82.0000    RUN
STACK TEMP ?   .8500      RUN
DELTA P ?      85.0000    RUN
STACK TEMP ?   1.0000     RUN
DELTA P ?      83.0000    RUN
STACK TEMP ?   1.0000     RUN
DELTA P ?      82.0000    RUN
STACK TEMP ?   1.6000     RUN
DELTA P ?      83.0000    RUN
STACK TEMP ?   1.5000     RUN
DELTA P ?      83.0000    RUN
STACK TEMP ?   1.4000     RUN
DELTA P ?      83.0000    RUN
STACK TEMP ?   1.4000     RUN
DELTA P ?      82.0000    RUN
STACK TEMP ?   .9200      RUN
DELTA P ?      83.0000    RUN
STACK TEMP ?   .9200      RUN
               83.0000    RUN
```

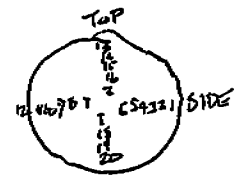
```
DELTA P ?
STACK TEMP ?   .9000      RUN
               82.0000    RUN
DELTA P ?
STACK TEMP ?   .8500      RUN
               82.0000    RUN
DELTA P ?
STACK TEMP ?   .7700      RUN
               82.0000    RUN
DELTA P ?
STACK TEMP ?   .6500      RUN
               83.0000    RUN
SQRT PSTS = 26.3306
AVE STK TEMP = 82.5000
```

```
                XROM "MASSFLO"
RUN NUMBER
0-1
                          RUN
VOL MTR STD ?
               141.229    RUN
STACK DSCFM ?
               17,671.00  RUN
FRONT 1/2 MG ?
               .14996     RUN
BACK 1/2 MG ?
                          FIX 7
                          RUN

F  GR/DSCF = 0.0000164
F  MG/MMM = 0.0374972
F  LB/HR = 0.0024819
F  KG/HR = 0.0011258
```

```
RUN NUMBER     XROM "METH 5"
0-1
METER BOX Y?               RUN
               1.0090      RUN
DELTA H?
               3.8500      RUN
BAR PRESS ?
               30.0300     RUN
METER VOL ?
               148.3590    RUN
MTR TEMP F?
               107.0000    RUN
STATIC HOH IN ?
               .6600       RUN
STACK TEMP
               83.0000     RUN
ML. WATER ?
               82.5000     RUN

SAT % = 3.8

IMP. % HOH = 2.7
% HOH=2.7

% CO2?
               .7000       RUN
% OXYGEN?
               21.0000     RUN
% CO ?
                           RUN

MWd =28.95
MW WET=28.66

SQRT PSTS ?
               26.3306     RUN
COS SQRT PSTS ?
                           RUN
TIME MIN ?
               120.0000    RUN
NOZZLE DIA ?
               .2377       RUN
STK DIA INCH ?
               29.6875     RUN

* VOL MTR STD = 141.229
  STK PRES ABS = 30.08
  VOL HOH GAS = 3.88
  % MOISTURE = 2.68
  MOL DRY GAS = 0.973
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.66
  VELOCITY FPS = 64.40
  STACK AREA = 4.81
  STACK ACFM = 18,575.
* STACK DSCFM = 17,671.
  % ISOKINETIC = 103.95

END OF FIELD DATA
```

FIELD DATA

Plant: Fusion, Inc.
Date: 5-19-89 Job No. 2958
Sampling Location: Scrubber Inlet
Sample Type: Modified Method 5 (chrome)
Run Number: I-2
Operator: Simon
Ambient Temperature: 85°F
Barometric Pressure: 30.05" Hg
Static Pressure (P_s): -3.4" H_2O
Filter Number(s): N.A.
Pretest Leak Rate = 0.003 cfm @ 15 in. Hg
Pretest Pitot Leak Check: O.K.
Pretest Orsat Leak Check: N.A.
Read and Record all Data Every 5 Minutes



(Flow is out of paper)
SIDE VIEW - INLET

Schematic of Traverse Point Layout

Probe Length and Type: 54" glass-lined SS nozzle
Pitot Tube I.D. No.: S-4A Cp 0.84
Nozzle I.D.: 0.243 | 0.240 | 0.245 | Avg. 0.243
Assumed Moisture, %: 2.5
Temp. Readout S/N: T-2
Meter Box Number: MB-3
Meter $\Delta H_@$: 1.987
C Factor: 1.15
Meter Gamma: 0.985
Heater Box Setting: Not Used
Reference Δp: 0.44
Post Test Leak Rate = 0.003 cfm @ 16 in. Hg After Side Port
Post Test Pitot Leak Check: After Side Port
Post Test Orsat Leak Check: N.A.

Page 1 of 2

Traverse Point Number	Sampling Time, (min)	(ending) Clock (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
							Temp. Sensor ID No. 2	Top of Box	Top of Box		N.A.	1	N.A.
	0	1748	095.098										
1	5	1753	102.0	1.60	6.80	6.80	85	97.1	89	6.0	—	67	—
2	10	1758	110.136	1.60	6.80	6.80	86	109.5	89	6.0	—	66	—
—	—	—	—	STOPPED AT END OF POINT 2 BECAUSE OF PROBLEM W/ OTHER METER BOX									
—	—	—	110.136	RESTARTED AT 18:16			—	—	—	—	—		
3	15	1821	117.3	1.50	6.40	6.40	87	99	89	6.0	—	65	—
4	20	1826	124.3	1.50	6.40	6.40	85	109.7	90	6.0	—	58	—
5	25	1831	131.6	1.45	6.20	6.20	86	115.6	92	5.5	—	60	—
6	30	1836	138.8	1.40	6.00	6.00	85	117.9	92	5.0	—	60	—
7	35	1841	146.1	1.40	6.00	6.00	85	119.0	93	5.0	—	60	—
8	40	1846	152.6	1.30	5.60	5.60	84	119.4	94	4.5	—	60	—
9	45	1851	160.0	1.35	5.85	5.85	84	119.2	95	5.0	—	60	—
10	50	1856	167.6	1.50	6.40	6.40	83	119.9	95	6.0	—	61	—
11	55	1901	174.7	1.60	6.90	6.90	84	122.0	95	6.5	—	62	—
12	60	1906	182.730	1.50	6.40	6.40	83	123.2	96	6.0	—	62	—
				END OF FIRST HALF OF TEST - SEE PAGE TWO FOR SECOND HALF									

Pressure Drop Across Scrubber = 1.75" H_2O

1.75

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Fusion, Inc. Test Date: 5-19-89

Run Number: I-2 Operator: Simon

Page 2 of 2 Pitot Initial Leak Check O.K. Final O.K. Initial Leak Rate 0.001 CFM at 15.0 Final 0.002 at 15"

Traverse Point Number	Sampling Time, (min) / Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
	60 / 1935	182.954										
13	65 / 1940	189.6	1.35	5.85	5.85	84	94.8	89	5.5	—	60	—
14	70 / 1945	196.9	1.25	5.5	5.50	84	109.5	90	4.5	—	56	—
15	75 / 1950	202.4	1.10	4.70	4.70	83	111.3	90	3.5	—	60	—
16	80 / 1955	208.2	1.10	4.70	4.70	83	111.7	90	3.5	—	60	—
17	85 / 2000	214.6	1.15	5.00	5.00	84	112.3	91	4.0	—	61	—
18	90 / 2005	220.9	1.25	5.50	5.50	83	114.3	92	4.0	—	61	—
19	95 / 2010	228.3	1.40	5.90	5.90	82	116.0	93	5.0	—	61	—
20	100 / 2015	235.2	1.45	6.30	6.30	78	118.0	93	5.5	—	61	—
21	105 / 2020	242.9	1.55	6.80	6.80	78	119.5	94	6.5	—	63	—
22	110 / 2025	250.8	1.55	6.80	6.80	78	120.8	99	6.5	—	64	—
23	115 / 2030	258.2	1.50	6.60	6.60	78	121.7	95	6.5	—	64	—
24	120 / 2035	265.967	1.45	6.30	6.30	79	121.0	95	5.5	—	65	—
				STOP	— END	OF	TEST —					
		V_m = 170.889 ✓	Avg. $\sqrt{\Delta P}$ = 1.185 ✓		Avg. ΔH = 6.07 ✓			AVG T_m = 103.4°F or 563.3°R ✓				
		170.665				AVG T_s = 83°F or 543°R ✓		103°F	MAX = 6.5 ✓		MAX = 67 ✓	

1.75"

B-13

PACIFIC ENVIRONMENTAL SERVICES, INC.

SAMPLE RECOVERY DATA

Plant: Fusion, Inc. Run No.: ~~I-1~~ I-2

Date: 5/19/89 Sample Box No.: RAG-1 Job No.: _____

Sample Location: Scrubber Inlet

Sample Type: MM13B Filter No.: _____

Sample Recovery Person: _____

Comments: _____

FRONT HALF

Acetone Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: _____ _____ _____ Sealed: _____

Description of Filter: _____

Samples stored and locked: _____

BACK HALF/MOISTURE

Container No: _____ _____ _____

Liquid Level Marked: _____ Sealed: _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1	.1N NaOH	100	579.8	618.7	38.9
2	.1N NaOH	100	610.2	618.4	8.2
3	—	-	472.8	477.0	4.2
4	Silica Gel	~200g	758.0	790.4	32.4
5					
6					
TOTAL					83.7

Description of Impinger Catch: _____

F1

```
                    XROM "PRESS"
NO. OF POINTS ?
              24.00      RUN
DELTA P ?
               1.60      RUN
STACK TEMP ?
              85.00      RUN
DELTA P ?
               1.60      RUN
STACK TEMP ?
               6.00      CLX
              86.00      RUN
DELTA P ?
               1.50      RUN
STACK TEMP ?
              87.00      RUN
DELTA P ?
               1.50      RUN
STACK TEMP ?
              85.00      RUN
DELTA P ?
                         FIX 4
               1.4500    RUN
STACK TEMP ?
              86.0000    RUN
DELTA P ?
               1.4000    RUN
STACK TEMP ?
              85.0000    RUN
DELTA P ?
               1.4000    RUN
STACK TEMP ?
              85.0000    RUN
DELTA P ?
               1.3000    RUN
STACK TEMP ?
              84.0000    RUN
DELTA P ?
               1.3500    RUN
STACK TEMP ?
              84.0000    RUN
DELTA P ?
               1.5000    RUN
STACK TEMP ?
              83.0000    RUN
DELTA P ?
               1.5000    RUN
STACK TEMP ?
              84.0000    RUN
DELTA P ?
               1.5000    RUN
STACK TEMP ?
              83.0000    RUN
DELTA P ?
               1.3500    RUN
STACK TEMP ?
              84.0000    RUN
DELTA P ?
               1.2500    RUN
STACK TEMP ?
              84.0000    RUN
DELTA P ?
               1.1000    RUN
STACK TEMP ?
              83.0000    RUN
DELTA P ?
               1.1000    RUN
STACK TEMP ?
              83.0000    RUN
DELTA P ?
               1.1500    RUN
STACK TEMP ?
              84.0000    RUN
DELTA P ?
               1.2500    RUN
STACK TEMP ?
              83.0000    RUN
DELTA P ?
               1.4000    RUN
STACK TEMP ?
              82.0000    RUN
DELTA P ?
               1.4500    RUN
STACK TEMP ?
              78.0000    RUN
```

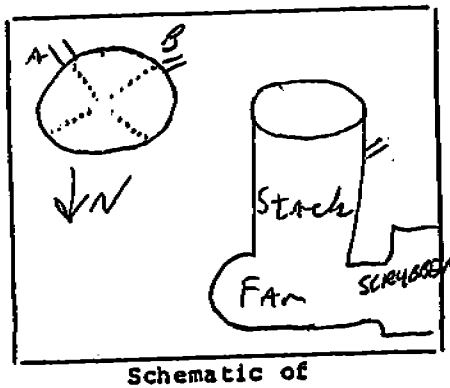
```
DELTA P ?
               1.5500    RUN
STACK TEMP ?
              78.0000    RUN
DELTA P ?
               1.5500    RUN
STACK TEMP ?
              78.0000    RUN
DELTA P ?
               1.5000    RUN
STACK TEMP ?
              78.0000    RUN
DELTA P ?
               1.4500    RUN
STACK TEMP ?
              79.0000    RUN

SQRT PSTS = 27.6123
AVE STK TEMP = 82.9583
```

```
                    XROM "MASSFLO"
RUN NUMBER
1-2                      RUN

VOL MTR STD ?
            160.69100    RUN
STACK DSCFM ?
          18,944.00000   RUN
FRONT 1/2 MG ?
              2.00000    CLX
              2.94111    RUN
BACK 1/2 MG ?            RUN

F  GR/DSCF = 0.00028
F  MG/NMM = 0.64635
F  LB/HR = 0.04586
F  KG/HR = 0.02289
```

```
                    XROM "METH 5"
RUN NUMBER
1-2                      RUN
METER BOX Y?
               0.9850    RUN
DELTA H?
               6.0790    RUN
BAR PRESS ?
              30.0500    RUN
METER VOL ?
             179.6650    RUN
MTR TEMP F?
             103.0000    RUN
STATIC HOV IN ?
              -3.4000    RUN
STACK TEMP.
              83.0000    RUN
ML. WATER ?
              33.7000    RUN

SAT % = 3.8

IMP. % HOH = 2.4

% HOH=2.4

% CO2?
                .7000    RUN
% OXYGEN?
             21.0000     RUN
% CO ?                   RUN

MWd =29.95
MW WET=28.69

SQRT PSTS ?
              27.6123    RUN
COS SQRT PSTS ?          RUN
TIME MIN ?
             120.0000    RUN
NOZZLE DIA ?
                .2430    RUN
STK DIA INCH ?
              30.0500    RUN

* VOL MTR STD = 160.691
  STK PRES ABS = 29.80
  VOL HOH GAS = 3.94
  % MOISTURE = 2.39
  MOL DRY GAS = 0.976
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.69
  VELOCITY FPS = 67.81
  STACK AREA = 4.93
  STACK ACFM = 20,040.
* STACK DSCFM = 18,944.
  % ISOKINETIC =  108.16

END OF FIELD DATA
```

FIELD DATA

Plant: Fusion Inc.
Date: 5-19-89 Job No.: 2958
Sampling Location: Scrubber Outlet
Sample Type: Chrome
Run Number: 0-2
Operator: Gerber, Hollins
Ambient Temperature: 94
Barometric Pressure: 30.00
Static Pressure (P_s): -.66
Filter Number(s): N/A
Pretest Leak Rate = 0.013 cfm @ 15 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check: N/A
Read and Record all Data Every 5 Minutes



Schematic of Traverse Point Layout

Probe Length and Type: 3' Glass
Pitot Tube I.D. No.: 5-6 Cp: .84
Nozzle I.D.: .239 | .236 | .238 | Avg. .2327
Assumed Moisture, %: 2.5
Temp. Readout S/N: Omega
Meter Box Number: MB-4
Meter $\Delta H_@$: 1.441
C Factor: 0.90
Meter Gamma: 1.009
Heater Box Setting: N/A
Reference Δp: 0.63
Post Test Leak Rate = 0.010 cfm @ 18 in. Hg
Post Test Pitot Leak Check: O.K.
Post Test Orsat Leak Check: N/A

Page 1 of 2

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
B 1	0	17:48	404.204	1.9	5.6	5.6	84	97	96	17		68	
2	5	17:53	410.492	1.8	5.3	4.0	83	104	95	17		60	
3	10	18:16	416.808	1.7	4.9	4.9	83	101	95	7		68	
4	15	18:21	424.228	1.6	4.6	4.6	82	112	96	7		63	
5	20	18:26	430.119	1.5	4.3	4.3	82	121	98	7		65	
6	25	18:31	437.738	1.4	4.1	4.1	82	125	99	6		65	
7	30	18:36	444.248	0.92	2.7	2.7	82	126	100	4		64	
8	35	18:41	449.081	0.92	2.7	2.7	82	126	102	4		64	
9	40	18:46	454.970	0.90	2.6	2.6	82	126	102	4		64	
10	45	18:51	460.279	0.86	2.5	2.5	82	126	103	4		64	
11	50	18:56	465.469	0.76	2.3	2.3	82	125	103	3		64	
12	55	19:01	470.292	0.70	2.1	2.1	82	124	104	3		63	
A 13	60	19:35	474.988	2.10	6.3	6.3	82	98	96	10		67	
14	65	19:40	482.703	2.0	5.8	5.8	82	106	96	10		64	
15	70	19:45	490.330	2.0	5.8	5.8	82	114	96	10		64	
16	75	19:50	497.924	1.9	5.6	5.6	82	120	98	9		64	
17	80	19:55	505.393	1.7	4.9	4.9	82	124	100	8		65	
18	85	20:00	512.387	1.4	4.1	4.1	82	127	100	6		64	
19	90	20:05	518.900	1.1	3.25	3.25	82	128	102	5		64	
20	95	20:10	524.736	1.1	3.25	3.25	81	128	103	5		63	

Pre- & Post-Leak Checks

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Fusion Inc.

Test Date: 5-19-89

Run Number: 0-2

Operator: Gerber, Hollins

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F
21	100	120:15	530.389	1.1	3.25	3.25	82	127	102	5		62
22	105	120:20	536.147	1.1	3.25	3.25	83	124	103	5		63
23	110	120:25	541.827	0.99	2.95	2.95	84	124	102	4		63
24	115	120:30	547.300	0.92	2.7	2.7	84	124	102	4		63
OFF	120	120:35	552.564									
						3.83		AVE = 109				
			147.888									

PACIFIC ENVIRONMENTAL SERVICES, INC.

SAMPLE RECOVERY DATA

Plant: Fusion Inc. Run No.: 0-2

Date: 5/19/89 Sample Box No.: Blue Cooler Job No.: 2958

Sample Location: Scrubber Outlet

Sample Type: MM13B Filter No.: _____

Sample Recovery Person: HJO

Comments: _____

FRONT HALF

Acetone Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: _____ _____ _____ Sealed: _____

Description of Filter: _____

Samples stored and locked: _____

BACK HALF/MOISTURE

Container No: _____ _____ _____

Liquid Level Marked: _____ Sealed: _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1			608.5	656.2	47.7
2			605.3	617.3	12
3			456.1	456.6	.5
4			713.6	741.2 *739.3 +1.9	27.6
5					
6		Imp # 3 replace.	505.3	510.0	4.7
TOTAL					

Description of Impinger Catch: 68.2 − 66.3 = 1.9

* had to unplug # 4 imp. HJO

B-18

```
                    NORM
              XROM "PRESS"
NO. OF POINTS ?
              24.00      RUN
DELTA P ?
               1.90      RUN
STACK TEMP ?
              84.00      RUN
DELTA P ?
               1.80      RUN
STACK TEMP ?
              83.00      RUN
DELTA P ?
               1.70      RUN
STACK TEMP ?
              83.00      RUN
DELTA P ?
                       FIX 4
               1.6000    RUN
STACK TEMP ?
              82.0000    RUN
DELTA P ?
               1.5000    RUN
STACK TEMP ?
              82.0000    RUN
DELTA P ?
               1.4000    RUN
STACK TEMP ?
              82.0000    RUN
DELTA P ?
               .9200     RUN
STACK TEMP ?
              82.0000    RUN
DELTA P ?
               .9200     RUN
STACK TEMP ?
              82.0000    RUN
DELTA P ?
               .9000     RUN
STACK TEMP ?
              82.0000    RUN
DELTA P ?
               .8600     RUN
STACK TEMP ?
              82.0000    RUN
DELTA P ?
               .7600     RUN
STACK TEMP ?
              82.0000    RUN
DELTA P ?
               .7000     RUN
STACK TEMP ?
              82.0000    RUN
DELTA P ?
               2.1000    RUN
STACK TEMP ?
              82.0000    RUN
DELTA P ?
               2.0000    RUN
STACK TEMP ?
              82.0000    RUN
DELTA P ?
               2.0000    RUN
STACK TEMP ?
              82.0000    RUN
DELTA P ?
               1.9000    RUN
STACK TEMP ?
              82.0000    RUN
DELTA P ?
               1.7000    RUN
STACK TEMP ?
              82.0000    RUN
DELTA P ?
               1.4000    RUN
STACK TEMP ?
              82.0000    RUN
DELTA P ?
               1.1000    RUN
STACK TEMP ?
              82.0000    RUN
```

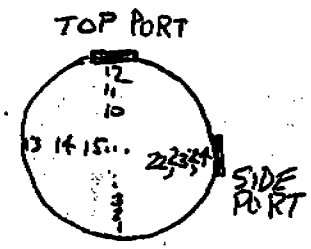
```
DELTA P ?
               1.1000    RUN
STACK TEMP ?
              81.0000    RUN
DELTA P ?
               1.1000    RUN
STACK TEMP ?
              82.0000    RUN
DELTA P ?
               1.1000    RUN
STACK TEMP ?
              83.0000    RUN
DELTA P ?
               .9900     RUN
STACK TEMP ?
              84.0000    RUN
DELTA P ?
               .9200     RUN
STACK TEMP ?
              84.0000    RUN

SQRT PSTS = 26.6766
AVE STK TEMP = 82.3333
```

```
                XROM "MASSFLO"
RUN NUMBER
0-2
                         FIX 7
                          RUN

VOL MTR STD ?
        140.1400000       RUN
STACK DSCFM ?
        17,877.00000      RUN
FRONT 1/2 MG ?
              .1549500    RUN
BACK 1/2 MG ?             RUN

F  GR/DSCF = 0.0000171
F  MG/NMM = 0.0390460
F  LB/HR = 0.0026146
F  KG/HR = 0.0011860
```

```
                    CLX
              XROM "METH 5"
RUN NUMBER
0-2                       RUN
METER BOX Y?
               1.0090     RUN
DELTA H?
               3.9300     RUN
BAR PRESS ?
              30.0000     RUN
METER VOL ?
             147.8880     RUN
MTR TEMP F?
             109.0000     RUN
STATIC HOH IN ?
                .6600     RUN
STACK TEMP.
              82.0000     RUN
ML. WATER ?
              92.5000     RUN

SAT % = 3.7

IMP. % HOH = 3.0
% HOH=3.0

% CO2?
                .7000     RUN
% OXYGEN?
             21.0000      RUN
% CO ?                    RUN

MWd =28.95
MW WET=28.62

SQRT PSTS ?
              26.6766     RUN
COS SQRT PSTS ?           RUN
TIME MIN ?
             120.0000     RUN
NOZZLE DIA ?
                .2377     RUN
STK DIA INCH ?
              29.6875     RUN

* VOL MTR STD = 140.140
  STK PRES ABS = 30.05
  VOL HOH GAS = 4.35
  % MOISTURE = 3.01
  MOL DRY GAS = 0.970
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.62
  VELOCITY FPS = 65.32
  STACK AREA = 4.81
  STACK ACFM = 18,840.
* STACK DSCFM = 17,877.
  % ISOKINETIC = 101.96

END OF FIELD DATA
```

FIELD DATA

Plant: Fusion, Inc.
Date: 5-20-89 Job No. 2958
Sampling Location: Scrubber Inlet
Sample Type: Modified Method 5 - Chrome
Run Number: I-3
Operator: Simon/Owens
Ambient Temperature: 85°F
Barometric Pressure: 30.15" Hg
Static Pressure (P_s): -3.6p
Filter Number(s): N.A.
Pretest Leak Rate = 0.005 cfm @ 15.0 in. Hg
Pretest Pitot Leak Check: O.K.
Pretest Orsat Leak Check: N.A.
Read and Record all Data Every 5 Minutes



SIDE VIEW - Flow is out of page

Schematic of Traverse Point Layout

Probe Length and Type: 5' glass-lined probe, SS nozzle
Pitot Tube I.D. No. S-4A Cp 0.84
Nozzle I.D. 0.243 | 0.240 | 0.245 | Avg. 0.243"
Assumed Moisture, % 2.4
Temp. Readout S/N T-2
Meter Box Number MB-3
Meter $\Delta H_@$ 1.987
C Factor 1.15
Meter Gamma 0.985
Heater Box Setting Not Used
Reference Δp 0.45
Post Test Leak Rate = 0.006 cfm @ 15.0 in. Hg
Post Test Pitot Leak Check: O.K.
Post Test Orsat Leak Check: N.A.

Page 1 of 2

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
	0	1312	266.214										
1	5	1319	273.7	00.35	6.60	6.60	87	94.1	85	4.0	—	55	—
2	10	1322	279.6	00.20	4.90	4.90	88	109.1	87	3.0	—	56	—
3	15	1327	285.3	01.10	4.50	4.50	89	109.7	89	3.0	—	59	—
4	20	1332	290.9	1.10	4.50	4.50	87	110.4	89	3.0	—	60	—
5	25	1337	296.8	1.05	4.40	4.40	89	111.7	90	3.0	—	57	—
6	30	1342	302.8	1.20	4.90	4.90	87	113.4	91	3.0	—	53	—
7	35	1347	309.1	1.30	5.40	5.40	89	114.8	92	3.0	—	54	—
8	40	1352	316.6	1.45	6.00	6.00	87	116.2	93	3.5	—	54	—
9	45	1357	323.5	1.58	6.40	6.40	89	120.5	94	3.5	—	56	—
10	50	1402	331.2	1.60	6.70	6.70	89	122.2	95.0	3.5	—	57	—
11	55	1407	338.8	1.45	6.00	6.00	90	122.4	96	3.5	—	58	—
12	60	1412	346.308	1.60	6.60	6.60	89	122.8	97	3.5	—	59	—
				END OF FIRST HALF - SEE PAGE 2 FOR SECOND HALF OF TEST									
			80.094										

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Fusion, Inc Test Date: 5-20-89

Run Number: I-3 Operator: Simon/Owens

Page 2 of 2 Pretest Leak Rate 0.008 at 16.0", Post Test 0.004 at 15.0". Pretest Pitot Check O.K., Post Test O.K.

Traverse Point Number	Sampling Time, (min) / Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
	60 / 1424	346.590										
13	65 / 1429	353.9	1.65	6.80	6.80	88	105.8	94	4.0	—	60	—
14	70 / 1434	361.7	1.60	6.60	6.60	87	117.3	94	4.0	—	57	—
15	75 / 1439	369.3	1.60	6.60	6.60	88	121.3	95	4.0	—	60	—
16	80 / 1444	376.8	1.50	6.20	6.20	87	121.7	96	3.5	—	61	—
17	85 / 1449	383.8	1.50	6.20	6.20	88	121.7	97	3.5	—	62	—
18	90 / 1454	391.2	1.45	6.00	6.00	88	121.8	97	3.5	—	61	—
19	95 / 1459	398.4	1.45	6.00	6.00	87	122.5	97	3.5	—	61	—
20	100 / 1504	405.8	1.40	5.80	5.80	87	121.8	98	3.0	—	58	—
21	105 / 1509	412.9	1.50	6.20	6.20	89	122.2	98	3.5	—	58	—
22	110 / 1514	420.0	1.50	6.20	6.20	87	123.7	98	3.5	—	59	—
23	115 / 1519	427.8	1.60	6.60	6.60	87	123.2	98	4.0	—	59	—
24	120 / 1524	435.916	1.60	6.60	6.60	87	123.7	99	4.0	—	59	—
	/		STOP — END OF TEST									
	/						AVE=106					
	/	89.326		AVE=4.94								
	/											
	/											
	/	169.420										
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											

PACIFIC ENVIRONMENTAL SERVICES, INC

SAMPLE RECOVERY DATA

Plant: Fusion Inc. Run No.: I-3

Date: 5/20/89 Sample Box No.: RAC#1 Job No.: 2958

Sample Location: Scrubber inlet

Sample Type: MM13B Filter No.: _____

Sample Recovery Person: HJO

Comments: _____

FRONT HALF

Acetone Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: _____ _____ _____ Sealed: _____

Description of Filter: _____

Samples stored and locked: _____

BACK HALF/MOISTURE

Container No: ✓ I-3 _____ _____

Liquid Level Marked: _____ Sealed: _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1			590.8	632.8	42
2			590.3	604.9	14.6
3			467.9	471.8	3.9
4			713.0	745.4	32.4
5					
6					
TOTAL					92.9

Description of Impinger Catch: _____

```
XROM "PRESS"
NO. OF POINTS ?
          24.00      RUN
DELTA P ?
           1.35      RUN
STACK TEMP ?
          87.00      RUN
DELTA P ?
           1.20      RUN
STACK TEMP ?
          88.00      RUN
DELTA P ?
           1.10      RUN
STACK TEMP ?
          89.00      RUN
DELTA P ?
           1.10      RUN
STACK TEMP ?
          87.00      RUN
DELTA P ?
           1.05      RUN
STACK TEMP ?
          87.00      RUN
DELTA P ?
           1.20      RUN
STACK TEMP ?
          87.00      RUN
DELTA P ?
           1.30      RUN
STACK TEMP ?
          89.00      RUN
DELTA P ?
           1.45      RUN
STACK TEMP ?
          87.00      RUN
DELTA P ?
           1.55      RUN
STACK TEMP ?
          89.00      RUN
DELTA P ?
           1.60      RUN
STACK TEMP ?
          89.00      RUN
DELTA P ?
                    FIX 4
           1.4500     RUN
STACK TEMP ?
          88.0000     RUN
DELTA P ?
           1.6000     RUN
STACK TEMP ?
          89.0000     RUN
DELTA P ?
           1.6500     RUN
STACK TEMP ?
          88.0000     RUN
DELTA P ?
           1.6000     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.6000     RUN
STACK TEMP ?
          88.0000     RUN
DELTA P ?
           1.5000     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.5000     RUN
STACK TEMP ?
          88.0000     RUN
DELTA P ?
           1.4500     RUN
STACK TEMP ?
          88.0000     RUN
DELTA P ?
           1.4500     RUN
STACK TEMP ?
          87.0000     RUN
```

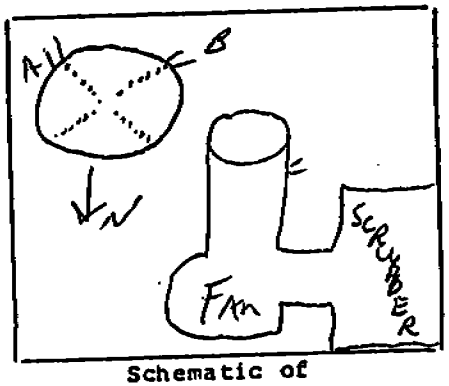
```
DELTA P ?
           1.4000     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.5000     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.5000     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.6000     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.6000     RUN
STACK TEMP ?
          87.0000     RUN

SQRT PSTS = 27.9222
AVE STK TEMP = 87.7500
```

```
                      RUN
RUN NUMBER
I-3                   RUN

VOL MTR STD ?
      159.1430000     RUN
STACK DSCFM ?
      18,964.00000    RUN
FRONT 1/2 MG ?
        3.5306000     RUN
BACK 1/2 MG ?         RUN

F  GR/DSCF = 0.0003424
F  MG/MMM = 0.7834439
F  LB/HR = 0.0556505
F  KG/HR = 0.0252431
```

```
XROM "METH 5"
RUN NUMBER
I-3                   RUN
METER BOX Y?
           .9850      RUN
DELTA H?
          5.9400      RUN
BAR PRESS ?
         30.1500      RUN
METER VOL ?
        169.4200      RUN
MTR TEMP F?
        106.0000      RUN
STATIC HOH IN ?
         -3.6000      RUN
STACK TEMP.
         88.0000      RUN
ML. WATER ?
         92.9000      RUN

SRT % = 4.5

IMP. % HOH = 2.7

% HOH=2.7

% CO2?
           .7000      RUN
% OXYGEN?
         21.0000      RUN
% CO ?                 RUN

MWd =28.95
MW WET=28.66

SQRT PSTS ?
         27.9222      RUN
COS SQRT PSTS ?       RUN
TIME MIN ?
        120.0000      RUN
NOZZLE DIA ?
           .2430      RUN
STK DIA INCH ?
         30.0500      RUN

* VOL MTR STD = 159.143
  STK PRES ABS = 29.89
  VOL HOH GAS = 4.37
  % MOISTURE = 2.67
  MOL DRY GAS = 4.973
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.66
  VELOCITY FPS = 68.51
  STACK AREA = 4.93
  STACK ACFM = 20,247.
* STACK DSCFM = 18,964.
  % ISOKINETIC = 107.01

END OF FIELD DATA
```

FIELD DATA

Plant: Fusion Inc
Date: 5-20-89 Job No. 2958
Sampling Location: Scrubber Outlet
Sample Type: Chrome
Run Number: 0-3
Operator: Gerber, Hollins
Ambient Temperature: 92
Barometric Pressure: 30.15
Static Pressure (P_s): +.66
Filter Number(s): N/A
Pretest Leak Rate = 0.018 cfm @ 16 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check: N/A
Read and Record all Data Every 5 Minutes



Schematic of Traverse Point Layout

Probe Length and Type: 3' Glass
Pitot Tube I.D. No. 5-6 Cp .84
Nozzle I.D. .239 | .236 | .238 | Avg. .2377
Assumed Moisture, % 2.5
Temp. Readout S/N: Omega
Meter Box Number: MB-4
Meter $\Delta H_@$: 1.471
C Factor: 0.90
Meter Gamma: 1.009
Heater Box Setting: N/A
Reference Δp: 0.63
Post Test Leak Rate = 0.019 cfm @ 12 in. Hg
Post Test Pitot Leak Check: OK
Post Test Orsat Leak Check: N/A

Page 1 of 2 Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
B 1	0	113:12	552.901	1.8	5.3	5.3	84	90	89	8		81	
2	5	113:17	559.947	1.7	5.0	5.0	84	101	89	8		73	
3	10	113:22	566.862	1.7	5.0	5.0	83	110	90	8		74	
4	15	113:27	573.776	1.6	4.7	4.7	83	116	93	8		75	
5	20	113:32	580.591	1.5	4.4	4.4	83	120	94	7		75	
6	25	113:37	587.272	1.45	4.25	4.25	83	122	96	7		75	
7	30	113:42	593.838	0.99	2.9	2.9	83	123	98	4		73	
8	35	113:47	599.292	0.98	2.85	2.85	83	122	99	4		73	
9	40	113:52	604.637	0.96	2.8	2.8	83	123	100	4		73	
10	45	113:57	609.926	0.89	2.6	2.6	83	124	100	4		74	
11	50	114:02	614.978	0.76	2.25	2.25	83	123	102	3		74	
12	55	114:07	619.724	0.71	2.1	2.1	83	122	102	3		73	
A 13	60	114:24	624.314	2.1	6.1	6.1	83	106	100	11		74	
14	65	114:29	631.919	2.1	6.1	6.1	84	116	100	10		65	
15	70	114:34	639.622	1.95	5.7	5.7	83	123	100	9		63	
16	75	114:39	647.034	1.8	5.3	5.3	83	127	102	8		63	
17	80	114:44	654.269	1.6	4.7	4.7	84	129	103	7		63	
18	85	114:49	660.040	1.3	3.85	3.85	83	129	104	6		63	
19	90	114:54	667.255	1.1	3.2	3.2	84	128	104	5		63	
20	95	114:59	672.872	1.1	3.2	3.2	84	127	104	5		62	

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Fusion Inc.

Run Number: 0-3

Test Date: 5-20-89

Operator: Gerber, Hollins

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F
21	100	17:04	678.475	1.05	3.0	3.0	85	128	105	4		63
22	105	17:09	683.913	1.05	3.0	3.0	85	127	105	4		64
23	110	17:14	689.333	0.95	2.8	2.8	84	126	105	4		64
24	115	17:19	694.558	0.85	2.5	2.5	85	124	105	3		64
OFF	120	17:24	699.480									
			14.579		AVE. = 3.9			AVE = 110				

PACIFIC ENVIRONMENTAL SERVICES, INC.

SAMPLE RECOVERY DATA

Plant: Fusion, Inc. Run No.: 0-3

Date: 5/8/20/89 Sample Box No.: RAC 2 Job No.: 2958

Sample Location: Scrubber Outlet

Sample Type: MM13B Filter No.: _____

Sample Recovery Person: HJO

Comments: _____

FRONT HALF

Acetone Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: _____ _____ _____ Sealed: _____

Description of Filter: _____

Samples stored and locked: _____

BACK HALF/MOISTURE

Container No: 30-4 _____ _____

Liquid Level Marked: _____ Sealed: _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1			593.4	636.3	42.9
2			620.2	629.0	8.8
3			455.2	461.3	6.1
4			697.4	727.5	30.1
5					
6					
TOTAL					87.9

Description of Impinger Catch: _____

F1

```
NO. OF POINTS ?
          24.0000      RUN
DELTA P ?
          1.0000       RUN
STACK TEMP ?
          84.0000      RUN
DELTA P ?
          1.7000       RUN
STACK TEMP ?
          84.0000      RUN
DELTA P ?
          1.0000       RUN
STACK TEMP ?
          83.0000      RUN
DELTA P ?
          1.0000       RUN
STACK TEMP ?
          83.0000      RUN
DELTA P ?
          1.5000       RUN
STACK TEMP ?
          83.0000      RUN
DELTA P ?
          1.4500       RUN
STACK TEMP ?
          83.0000      RUN
DELTA P ?
          .9900        RUN
STACK TEMP ?
          83.0000      RUN
DELTA P ?
          .9800        RUN
STACK TEMP ?
          83.0000      RUN
DELTA P ?
          .9600        RUN
STACK TEMP ?
          83.0000      RUN
DELTA P ?
          .8900        RUN
STACK TEMP ?
          83.0000      RUN
DELTA P ?
          .7600        RUN
STACK TEMP ?
          83.0000      RUN
DELTA P ?
          .7100        RUN
STACK TEMP ?
          83.0000      RUN
DELTA P ?
          2.1000       RUN
STACK TEMP ?
          83.0000      RUN
DELTA P ?
          2.1000       RUN
STACK TEMP ?
          84.0000      RUN
DELTA P ?
          1.9500       RUN
STACK TEMP ?
          83.0000      RUN
DELTA P ?
          1.8000       RUN
STACK TEMP ?
          83.0000      RUN
DELTA P ?
          1.6000       RUN
STACK TEMP ?
          84.0000      RUN
DELTA P ?
          1.3000       RUN
STACK TEMP ?
          83.0000      RUN
DELTA P ?
          1.1000       RUN
STACK TEMP ?
          84.0000      RUN
```

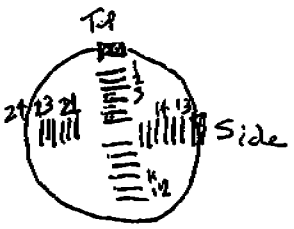
```
DELTA P ?
          1.1000       RUN
STACK TEMP ?
          84.0000      RUN
DELTA P ?
          1.0500       RUN
STACK TEMP ?
          85.0000      RUN
DELTA P ?
          1.0500       RUN
STACK TEMP ?
          85.0000      RUN
DELTA P ?
          .9500        RUN
STACK TEMP ?
          84.0000      RUN
DELTA P ?
          .9500        RUN
STACK TEMP ?
          85.0000      RUN

SQRT PSTS = 26.5685
AVE STK TEMP = 83.5417
```

```
                XROM "MASSFLO"
RUN NUMBER
0-3                    RUN

VOL MTR STD ?
          139.3660000  RUN
STACK DSCFM ?
          17,803.00000 RUN
FRONT 1/2 MG ?
          .1624000     RUN
BACK 1/2 MG ?          RUN

F  GR/DSCF = 0.0000180
F  MG/MMM = 0.0411506
F  LB/HR = 0.0027441
F  KG/HR = 0.0012447
```

```
                XROM "METH 5"
RUN NUMBER
0-3                    RUN

METER BOX Y?
          1.0090       RUN
DELTA H?
          3.9000       RUN
BAR PRESS ?
          30.1500      RUN
METER VOL ?
          146.5790     RUN
MTR TEMP ?
          19.0000      RUN
STATIC HOH IN ?
          .6600        RUN
STACK TEMP.
          84.0000      RUN
ML. WATER ?
          87.9000      RUN

SAT % = 3.9

IMP. % HOH = 2.9
% HOH=2.9

% CO2?
          .7000        RUN
% OXYGEN?
          21.0000      RUN
% CO ?                 RUN

MWd =29.95
MW WET=28.64

SQRT PSTS ?
          26.5685      RUN
CCS SQRT PSTS ?        RUN
TIME MIN ?
          120.0000     RUN
NOZZLE DIA ?
          .2377        RUN
STK DIA INCH ?
          29.6875      RUN

* VOL MTR STD = 139.366
  STK PRES ABS = 30.20
  VOL HOH GAS = 4.14
  % MOISTURE = 2.88
  MOL DRY GAS = 0.971
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.64
  VELOCITY FPS = 64.88
  STACK AREA = 4.81
  STACK ACFM = 18,713.
* STACK DSCFM = 17,803.
  % ISOKINETIC =  101.82

END OF FIELD DATA
```

FIELD DATA

Plant: Fusion, Inc
Date: 5-21-89 Job No. 2958
Sampling Location:
Sample Type: Modified Method 5
Run Number: I-4
Operator: SIMON
Ambient Temperature: 85°F
Barometric Pressure: 30.18
Static Pressure (P_g): -3.4" H_2O
Filter Number(s): N.A.
Pretest Leak Rate = 0.004 cfm @ 15.0 in. Hg
Pretest Pitot Leak Check: D.K.
Pretest Orsat Leak Check: N.A.
Read and Record all Data Every 5 Minutes



Schematic of Traverse Point Layout

Probe Length and Type: 5' glass-lined, SS nozzle
Pitot Tube I.D. No. 5-4A Cp 0.84
Nozzle I.D. | | | Avg. 0.243
Assumed Moisture, % 2.50
Temp. Readout S/N: N.A.
Meter Box Number: MB-3
Meter $\Delta H_@$: 1.987
C Factor: 1.15
Meter Gamma: 0.985
Heater Box Setting: Not used
Reference Δp: 0.48
Post Test Leak Rate = 0.002 cfm @ 15.0 in. Hg
Post Test Pitot Leak Check:
Post Test Orsat Leak Check: N.A

Page 1 of 2

Traverse Point Number	Sampling Time, (min) / Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
Temp. Sensor ID No.						2	Top of Box	Top of Box		—	1	—
	0 / 10:39	436.312										
1	5 / 1044	Not observed	1.40	5.60	5.50	87	95.3	82	3.0	—	58	—
2	10 / 1045	448.9	1.30	5.14	5.15	86	99	82	2.5	—	61	—
3	15 / 10:50	455.0	1.20	4.58	4.60	87	106.9	85	2.0	—	65	—
4	20 / 1055	460.8	1.20	4.79	4.80	87	107.5	86	2.0	—	65	—
5	25 / 1100	467.5	1.20	4.82	4.80	85	109.3	88	2.0	—	67	—
6	30 / 1105	473.2	1.25	5.03	5.00	86	111.3	89	2.0	—	65	—
7	35 / 1110	479.3	1.45	5.84	5.80	86	112.6	90	2.0	—	62	—
8	40 / 1115	487.1	1.50	6.07	6.10	86	116.5	91	3.0	—	63	—
9	45 / 1120	494.1	1.60	6.48	6.50	87	118.6	92	4.0	—	64	—
10	50 / 1125	501.5	1.55	6.27	6.30	88	119.0	93	3.5	—	64	—
11	55 / 1130	509.3	1.60	6.49	6.50	87	119.1	93	4.0	—	65	—
12	60 / 1135	515.829	1.30	5.23	5.22	87	119.3	84	2.0	—	66	—
	/									—		—
	/	74.517	STOP - END OF FIRST HALF									
	/											
	/											
	/											
	/											
	/											
	/											

NOTE: PROGRAMMABLE CALCULATOR WAS USED INSTEAD OF NOMOGRAPH

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Fusion, Inc.

Test Date: 5-21-89

Run Number: I-4

Operator: Simon

Page 2 of 2 Leak Pre-test/Pre: 0.008 at 15.0" Post: 0.003 at 15" Post-Test Pitot Check O.K.

Traverse Point Number	Sampling Time, (min) / Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
	60 / 1151	516.130										
13	65 / 1156	524.1	1.75	6.96	7.00	87	99.5	91	4.0	—	64	—
14	70 / 1201	531.1	1.65	6.64	6.65	87	111.8	92	4.0	—	62	—
15	75 / 1206	539.6	1.50	6.07	6.10	87	117.3	93	3.50	—	62	—
16	80 / 1211	545.6	1.5	6.10	6.10	86	119.6	93	3.50	—	61	—
17	85 / 1216	552.9	1.55	6.31	6.30	86	119.9	94	3.5	—	61	—
18	90 / 1221	560.3	1.50	6.12	6.10	86	120.4	95	3.5	—	62	—
19	95 / 1226	568.9	1.45	5.90	5.90	87	121.0	95	3.5	—	63	—
20	100 / 1231	574.0	1.45	5.90	5.90	87	121.0	95	3.5	—	64	—
21	105 / 1236	582.4	1.50	6.10	6.10	87	119.4	95	3.5	—	64	—
22	110 / 1241	588.8	1.60	6.51	6.50	87	120.4	96	4.0	—	64	—
23	115 / 1246	596.7	1.55	6.31	6.30	87	121.0	96	4.0	—	64	—
24	120 / 1251	604.512	STOP	END OF TEST		87	120.9	98	4.0	—	65	—
~~25~~	/			6.94	6.90							
	/						AVE. = 103					
	/			AVE. = 5.63								
	/											
	/	88.382										
	/											
	/											
	/	467.899										

SAMPLE RECOVERY DATA

Plant: Fusion Inc Run No.: I-4

Date: 5/21/89 Sample Box No.: RAC-1 Job No.: 2958

Sample Location: Scrubber Inlet

Sample Type: MM13B Filter No.: _____

Sample Recovery Person: HJO

Comments: _____

FRONT HALF

Acetone Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: _____ _____ _____ Sealed: _____

Description of Filter: _____

Samples stored and locked: _____

BACK HALF/MOISTURE

Container No: I-4 _____ _____

Liquid Level Marked: ✓ Sealed: ✓

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1			579.0	616.8	~~355~~ 378
2			607.4	615.7	8.3
3			505.2	510.6	5.4
4			745.4	773.5	28.1
5					
6					
TOTAL					79.6

Description of Impinger Catch: _____

F1

```
                XROM "PRESS"
NO. OF POINTS ?
          24.0000     RUN
DELTA P ?
           1.4000     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.3000     RUN
STACK TEMP ?
          86.0000     RUN
DELTA P ?
           1.2000     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.2000     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.2000     RUN
STACK TEMP ?
          85.0000     RUN
DELTA P ?
           1.2500     RUN
STACK TEMP ?
          86.0000     RUN
DELTA P ?
           1.4500     RUN
STACK TEMP ?
          86.0000     RUN
DELTA P ?
           1.5000     RUN
STACK TEMP ?
          86.0000     RUN
DELTA P ?
           1.6000     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.5500     RUN
STACK TEMP ?
          88.0000     RUN
DELTA P ?
           1.6000     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.3000     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.7500     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.6500     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.5000     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.5000     RUN
STACK TEMP ?
          86.0000     RUN
DELTA P ?
           1.5500     RUN
STACK TEMP ?
          86.0000     RUN
DELTA P ?
           1.5000     RUN
STACK TEMP ?
          86.0000     RUN
DELTA P ?
           1.4500     RUN
STACK TEMP ?
          87.0000     RUN
```

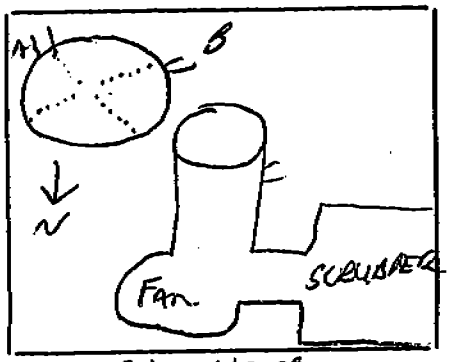
```
DELTA P ?
           1.4500     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.5000     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.6000     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.5500     RUN
STACK TEMP ?
          87.0000     RUN
DELTA P ?
           1.5500     RUN
STACK TEMP ?
          87.0000     RUN

SQRT PSTS = 28.2388
AVE STK TEMP = 86.6667
```

```
                XROM "MASSFLO"
RUN NUMBER                COS
I-4                       RUN

VOL MTR STD ?
         158.581          RUN
STACK DSCFM ?
       19,287.00          RUN
FRONT 1/2 MG ?
           3.8189         RUN
BACK 1/2 MG ?
                      FIX 7
                        RUN

F  GR/DSCF = 0.0003716
F  MG/MMM = 0.8504211
F  LB/HR = 0.0614370
F  KG/HR = 0.0278678
```

```
                XROM "METH 5"
RUN NUMBER
I-4                       RUN
METER BOX Y?
            .9850         RUN
DELTA H?
           5.6000         RUN
BAR PRESS ?
          30.1800         RUN
METER VOL ?
         167.8990         RUN
MTR TEMP F?
         103.0000         RUN
STATIC HOH IN ?
          -3.4000         RUN
STACK TEMP ?
          87.0000         RUN
ML. WATER ?
          79.6000         RUN

SAT % = 4.3

IMP. % HOH = 2.3
% HOH=2.3

% CO2?
            .7000         RUN
% OXYGEN?
          21.0000         RUN
% CO ?                    RUN

MWd =28.95
MW WET=28.70

SQRT PSTS ?
          28.2388         RUN
COS SQRT PSTS ?           RUN
TIME MIN ?
         120.0000         RUN
NOZZLE DIA ?
            .2430         RUN
STK DIA INCH ?
          30.0500         RUN

* VOL MTR STD = 158.581
  STK PRES ABS = 29.93
  VOL HOH GAS = 3.75
  % MOISTURE = 2.31
  MOL DRY GAS = 0.977
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.70
  VELOCITY FPS = 69.19
  STACK AREA = 4.93
  STACK ACFM = 20,447.
* STACK DSCFM = 19,287.
  % ISOKINETIC =  104.84

END OF FIELD DATA
```

FIELD DATA

Plant: Fusion Inc.
Date: 5-21-89 Job No. 2958
Sampling Location: Scrubber Outlet
Sample Type: Chrome
Run Number: 0-4
Operator: Gerber, Thomas
Ambient Temperature: 85
Barometric Pressure: 30.18
Static Pressure (P_s): +.67
Filter Number(s): N/A
Pretest Leak Rate = 0.017 cfm @ 16 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check: N/A
Read and Record all Data Every 5 Minutes



Schematic of Traverse Point Layout

Probe Length and Type: 3' Glass
Pitot Tube I.D. No. 5-6 Cp .84
Nozzle I.D. .239 | .236 | .238 | Avg. .2377
Assumed Moisture, % 2.5
Temp. Readout S/N: Omega
Meter Box Number: N/B-4
Meter $\Delta H_@$: 1.441
C Factor: 0.90
Meter Gamma: 1.009
Heater Box Setting: N/A
Reference Δp: 0.63
Post Test Leak Rate = 0.010 cfm @ 6 in. Hg
Post Test Pitot Leak Check:
Post Test Orsat Leak Check: N/A

Page 1 of 2

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
		110											
A 1	0	110:39	700.307	2.1	6.1	6.1	82	88	85	5		67	
2	5	110:44	707.868	2.1	6.1	6.1	82	99	86	5		67	
3	10	110:49	715.438	1.9	5.6	5.6	81	101	89	5		67	
4	15	110:54	722.722	1.85	5.4	5.4	81	118	92	5		69	
5	20	110:59	729.999	1.7	5.0	5.0	81	122	95	4		70	
6	25	111:04	737.009	1.4	4.2	4.2	80	125	97	4		67	
7	30	111:09	743.517	1.05	3.1	3.1	80	124	98	3		66	
8	35	111:14	749.123	0.99	2.85	2.85	81	122	100	2		64	
9	40	111:19	754.490	1.05	3.1	3.1	81	123	100	3		62	
10	45	111:24	760.027	1.0	2.9	2.9	81	123	101	3		60	
11	50	111:29	765.444	0.88	2.6	2.6	82	123	102	2		60	
12	55	111:34	770.538	0.88	2.6	2.6	82	123	102	2		59	
B 13	60	111:51	775.616	1.85	5.4	5.4	82	116	99	5		67	
14	65	111:56	782.872	1.9	5.6	5.6	82	114	99	5		57	
15	70	112:01	790.231	1.75	5.3	5.3	82	121	100	5		59	
16	75	112:06	797.397	1.6	4.7	4.7	81	124	100	4		59	
17	80	112:11	804.136	1.5	4.4	4.4	81	124	100	4		59	
18	85	112:16	810.731	1.45	4.3	4.3	81	122	101	4		60	
19	90	112:21	817.233	0.96	2.85	2.85	81	122	101	3		61	
20	95	112:26	822.177	0.95	2.8	2.8	82	122	102	3		62	

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Fusion Inc. Test Date: 5-21-89

Run Number: O-4 Operator: Gerber, Thomas

Page 2 of 2

Traverse Point Number	Sampling Time, (min)	/Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
21	100	12:31	827.878	0.95	2.8	2.8	81	120	101	2		63	
22	105	12:36	833.092	0.87	2.6	2.6	81	121	102	2		63	
23	110	12:41	838.165	0.78	2.3	2.3	82	122	102	2		63	
24	115	12:46	842.918	0.83	2.45	2.45	82	121	102	2		64	
OFF	120	12:51	847.804										
					AVE=3.96			AVE=108					
			47.497										

SAMPLE RECOVERY DATA

Plant: Rosion, Inc Run No.: O-4

Date: Sample Box No.: RAC-2 Job No.: 2958

Sample Location: Scrubber Outlet

Sample Type: MM13B Filter No.:

Sample Recovery Person: [illegible]

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples stored and locked:

BACK HALF/MOISTURE

Container No: O-4

Liquid Level Marked: ✓ Sealed: ✓

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1	0.1N NaOH	100	597.7	639.6	41.9
2	" "	100	593.3	594.7	1.4
3	—	MT	468.3	472.7	4.4
4	Silica Gel		745.8	775.4	29.6
5					
6					77.3
TOTAL					

Description of Impinger Catch:

```
NO. OF POIN ?
          24.0000      RUN
DELTA P ?
           2.1000      RUN
STACK TEMP ?
          82.0000      RUN
DELTA P ?
           2.1000      RUN
STACK TEMP ?
          82.0000      RUN
DELTA P ?
           1.9600      RUN
STACK TEMP ?
          81.0000      RUN
DELTA P ?
            .0000      CLX
           1.8500      RUN
STACK TEMP ?
          81.0000      RUN
DELTA P ?
           1.7000      RUN
STACK TEMP ?
          81.0000      RUN
DELTA P ?
           1.4000      RUN
STACK TEMP ?
          80.0000      RUN
DELTA P ?
           1.0500      RUN
STACK TEMP ?
          80.0000      RUN
DELTA P ?
            .9900      RUN
STACK TEMP ?
          81.0000      RUN
DELTA P ?
           1.0500      RUN
STACK TEMP ?
          81.0000      RUN
DELTA P ?
           1.0000      RUN
STACK TEMP ?
          81.0000      RUN
DELTA P ?
            .8800      RUN
STACK TEMP ?
          82.0000      RUN
DELTA P ?
            .8800      RUN
STACK TEMP ?
          82.0000      RUN
DELTA P ?
           1.8500      RUN
STACK TEMP ?
          82.0000      RUN
DELTA P ?
           1.9000      RUN
STACK TEMP ?
          82.0000      RUN
DELTA P ?
           1.7500      RUN
STACK TEMP ?
          82.0000      RUN
DELTA P ?
           1.6000      RUN
STACK TEMP ?
          81.0000      RUN
DELTA P ?
           1.5000      RUN
STACK TEMP ?
          81.0000      RUN
DELTA P ?
           1.4500      RUN
STACK TEMP ?
          81.0000      RUN
```

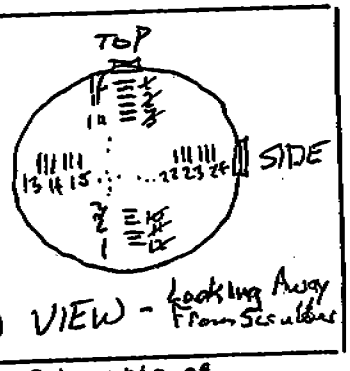
```
DELTA P ?
            .9600      RUN
STACK TEMP ?
          81.0000      RUN
DELTA P ?
            .9500      RUN
STACK TEMP ?
          82.0000      RUN
DELTA P ?
            .9500      RUN
STACK TEMP ?
          81.0000      RUN
DELTA P ?
            .8700      RUN
STACK TEMP ?
          81.0000      RUN
DELTA P ?
            .7800      RUN
STACK TEMP ?
          82.0000      RUN
DELTA P ?
            .8300      RUN
STACK TEMP ?
          82.0000      RUN

SQRT PSTS = 26.6170
AVE STK TEMP = 81.3333
```

```
                    ON
          XROM "MASSFLO"
RUN NUMBER          CHS
0-4                 RUN

VOL MTR STD ?
     140.8920000    RUN
STACK DSCFM ?
     17,998.00000   RUN
FRONT 1/2 MG ?
          .1024800  RUN
BACK 1/2 MG ?       RUN

F  GR/DSCF = 0.0000112
F  MG/MMM = 0.0256862
F  LB/HR = 0.0017316
F  KG/HR = 0.0007855
```

```
                    XROM "METH 5"
RUN NUMBER

0-4                 RUN
METER BOX Y?
           1.0090   RUN
DELTA H?
           3.9600   RUN
BAR PRESS ?
          30.1800   RUN
METER VOL ?
         147.4970   RUN
MTR TEMP ?
         108.0000   RUN
STATIC HOH IN ?
            .6600   RUN
STACK TEMP.
          81.0000   RUN
ML. WATER ?
          77.3000   RUN

SAT % = 8.5

IMP. % HOH = 2.5
% HOH=2.5

% CO2?
            .7000   RUN
% OXYGEN?
         21.0000    RUN
% CO ?              RUN

MWd =28.95
MW WET=28.68

SQRT PSTS ?
         26.6170    RUN
COS SQRT PSTS ?     RUN
TIME MIN ?
         120.0000   RUN
NOZZLE DIA ?
            .2377   RUN
STK DIA INCH ?
          29.6875   RUN

* VOL MTR STD = 140.892
  STK PRES ABS = 30.23
  VOL HOH GAS = 3.64
  % MOISTURE = 2.52
  MOL DRY GAS = 0.975
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.68
  VELOCITY FPS = 64.92
  STACK AREA = 4.81
  STACK ACFM = 18,724.
* STACK DSCFM = 17,998.
  % ISOKINETIC = 101.82

END OF FIELD DATA
```

FIELD DATA

Plant: Fusion, Inc
Date: 5-21-89 Job No. 2958
Sampling Location: Scrubber Inlet
Sample Type: Modified Method 5 - Chrome
Run Number: I-5
Operator: SIMON
Ambient Temperature: 85°F
Barometric Pressure: 30.18
Static Pressure (P_s): -3.4" H_2O
Filter Number(s): Not Applicable
Pretest Leak Rate = 0.008 cfm @ 15.0 in. Hg
Pretest Pitot Leak Check: O.K.
Pretest Orsat Leak Check: N.A.
Read and Record all Data Every 5 Minutes



Schematic of Traverse Point Layout

Probe Length and Type: 5' glass-lined, SS nozzle
Pitot Tube I.D. No.: 5-4A Cp: 0.84
Nozzle I.D.: | | | Avg. 0.243
Assumed Moisture, %: 2.50
Temp. Readout S/N: N.A.
Meter Box Number: MB-3
Meter $\Delta H_@$: 1.987
C Factor: 1.15
Meter Gamma: 0.985
Heater Box Setting: N.A.
Reference Δp: 0.48
Post Test Leak Rate = 0.010 cfm @ 15 in. Hg
Post Test Pitot Leak Check:
Post Test Orsat Leak Check: N.A.

Page 1 of 2

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
	0	1347	604.678										
1	5	1354	610.7	1.40	5.49	5.50	90	93.6	88	6.0	—	77	—
2	10	1359	617.2	1.40	5.36	5.35	89	103.8	89.3	5.5	—	85	—
3	15	1404	623.6	1.25	5.00	5.00	89	111.8	90	5.0	—	74	—
4	20	1409	629.8	1.20	4.81	4.80	89	113.1	90	4.5	—	69	—
5	25	1414	635.4	1.15	4.63	4.65	91	115.8	91	4.0	—	70	—
6	30	1419	641.4	1.20	4.81	4.80	91	114.7	93	4.0	—	69	—
7	35	1424	648.3	1.45	5.81	5.70	92	115.2	93	5.0	—	70	—
8	40	1429	656.3	1.50	6.03	6.00	92	119.3	94	6.50	—	66	—
9	45	1434	662.6	1.55	6.25	6.25	92	120.5	95	7.50	—	66	—
10	50	1439	669.8	1.60	6.46	6.45	92	122.3	95	8.50	—	67	—
11	55	1444	677.6	1.65	6.68	6.70	92	124.0	96	9.0	—	67	—
12	60	1449	684.727	1.40	5.69	5.70	91	126.1	97	6.0	—	67	—
						STOP - END OF FIRST HALF							

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: FUSION, inc. Test Date: 5-21-89

Run Number: I-5 Operator: SIMON

Page 2 of 2 Pre Traverse Leak Rate = 0.006 cfm at 15", Post test = 0.012 at 16.0 Post Test pitot check O.K

Traverse Point Number	Sampling Time, (min) /	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
	60	15:02	685.052										
13	65	15:07	694.1	1.70	6.66	6.65	95	99.0	91	9.0	—	62	—
14	70	15:12	700.8	1.60	6.37	6.35	95	114.3	93	8.0	—	57	—
15	75	1517	706.7	1.55	6.22	6.20	94	119.9	94	8.0	—	58	—
16	80	1522	714.4	1.55	6.22	6.20	95	121.3	95	8.0	—	59	—
17	85	1527	722.0	1.50	6.04	6.00	94	124.0	95	7.5	—	59	—
18	90	1532	728.6	1.45	5.84	5.85	95	125.0	96	4.5	—	60	—
19	95	1537	736.0	1.50	6.05	6.00	94	123.2	97	8.0	—	61	—
20	100	1542	742.5	1.30	5.25	5.25	94	124.4	97	5.0	—	62	—
21	105	1547	749.1	1.50	6.04	6.00	94	120.9	97	5.0	—	62	—
22	110	1552	756.6	1.50	6.04	6.00	95	123.8	97	5.0	—	63	—
23	115	1557	764.0	1.55	6.26	6.25	94	124.6	97	6.0	—	63	—
24	120	1602	771.734	1.55	6.27	6.25	94	125.6	98	6.0	—	63	—
				STOP - END OF TEST									
								AVE=	106°				
			86.682			5.83							
			166.731										

Pressure Drop Across Scrubber = 2.15 in H_2O (Whole Test)

B-37

SAMPLE RECOVERY DATA

Plant: Fusion, Inc. Run No.: I-5

Date: 5/21/89 Sample Box No.: RAC-1 Job No.: 2958

Sample Location: Scrubber Inlet

Sample Type: MM13B Filter No.:

Sample Recovery Person: HJO

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples stored and locked:

BACK HALF/MOISTURE

Container No: I-5

Liquid Level Marked: ✓ Sealed: ✓

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1			606.2	641.3	35.1
2			618.1	620.8	2.7
3			505.3	509.8	4.5
4			699.3	735.6	36.3
5					
6					
TOTAL					78.6

Description of Impinger Catch:

F1

```
XROM "PRESS"
NO. OF POINTS ?
24.0000
DELTA P ?                RUN
1.4000                   RUN
STACK TEMP ?
90.0000                  RUN
DELTA P ?
1.4000                   RUN
STACK TEMP ?
89.0000                  RUN
DELTA P ?
1.2500                   RUN
STACK TEMP ?
89.0000                  RUN
DELTA P ?
1.2000                   RUN
STACK TEMP ?
89.0000                  RUN
DELTA P ?
1.1500                   RUN
STACK TEMP ?
91.0000                  RUN
DELTA P ?
1.2000                   RUN
STACK TEMP ?
91.0000                  RUN
DELTA P ?
1.4500                   RUN
STACK TEMP ?
92.0000                  RUN
DELTA P ?
1.5000                   RUN
STACK TEMP ?
92.0000                  RUN
DELTA P ?
1.5500                   RUN
STACK TEMP ?
92.0000                  RUN
DELTA P ?
1.6000                   RUN
STACK TEMP ?
92.0000                  RUN
DELTA P ?
1.6500                   RUN
STACK TEMP ?
92.0000                  RUN
DELTA P ?
1.4000                   RUN
STACK TEMP ?
91.0000                  RUN
DELTA P ?
1.7000                   RUN
STACK TEMP ?
95.0000                  RUN
DELTA P ?
1.6000                   RUN
STACK TEMP ?
95.0000                  RUN
DELTA P ?
1.5500                   RUN
STACK TEMP ?
94.0000                  RUN
DELTA P ?
1.5500                   RUN
STACK TEMP ?
95.0000                  RUN
DELTA P ?
1.5000                   RUN
STACK TEMP ?
94.0000                  RUN
DELTA P ?
1.4500                   RUN
STACK TEMP ?
95.0000                  RUN
DELTA P ?
1.5000                   RUN
STACK TEMP ?
94.0000                  RUN
```

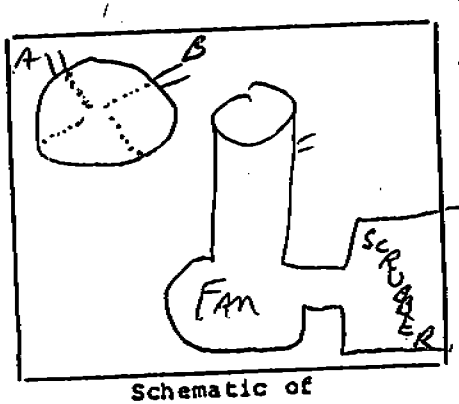
```
DELTA P ?
1.3000                   RUN
STACK TEMP ?
94.0000                  RUN
DELTA P ?
1.5000                   RUN
STACK TEMP ?
94.0000                  RUN
DELTA P ?
1.5000                   RUN
STACK TEMP ?
95.0000                  RUN
DELTA P ?
1.5500                   RUN
STACK TEMP ?
94.0000                  RUN
DELTA P ?
.0000                    CLX
.0000                    CLX
1.5500                   RUN
STACK TEMP ?
94.0000                  RUN
SQRT PSTS = 28.3545
AVE STK TEMP = 92.6252
```

```
XROM "MASSFLO"
RUN NUMBER
I-5
                         RUN
VOL MTR STD ?
156.719                  RUN
STACK DSCFM ?
19,156.00                RUN
FRONT 1/2 MG ?
2.5549                   RUN
BACK 1/2 MG ?
                         RUN
F  GR/DSCF = 2.52E-4
F  MG/MMM = 0.58
F  LB/HR = 0.04
F  KG/HR = 0.02
                         FIX 7
                         RUN
B  GR/DSCF = 0.0000000
B  MG/MMM = 0.0000000
B  LB/HR = 0.0000000
B  KG/HR = 0.0000000
I  GR/DSCF = 0.0002516
I  MG/MMM = 0.5757039
I  LB/HR = 0.0413081
I  KG/HR = 0.0187374
```

```
XROM "METH 5"
RUN NUMBER
I-5
METER BOX Y?             RUN
.9850                    RUN
DELTA H?
5.8000                   RUN
BAR PRESS ?
30.1800                  RUN
METER VOL ?
166.7310                 RUN
MTR TEMP F?
106.0000                 RUN
STATIC HOH IN ?
-3.4000                  RUN
STACK TEMP.
93.0000                  RUN
ML. WATER ?
78.6000                  RUN

SAT % = 5.2

IMP. % HOH = 2.3
% HOH=2.3

% CO2?
.7000                    RUN
% OXYGEN?
21.0000                  RUN
% CO ?
                         RUN

MWd =28.95
MW WET=28.70

SQRT PSTS ?
28.3545                  RUN
COS SQRT PSTS ?
                         RUN
TIME MIN ?
120.0000                 RUN
NOZZLE DIA ?
.2430                    RUN
STK DIA INCH ?
30.0500                  RUN

* VOL MTR STD = 156.719
  STK PRES ABS = 29.93
  VOL HOH GAS = 3.70
  % MOISTURE = 2.31
  MOL DRY GAS = 0.977
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.70
  VELOCITY FPS = 69.47
  STACK AREA = 4.93
  STACK ACFM = 20,530.
* STACK DSCFM = 19,156.
  % ISOKINETIC = 104.32

END OF FIELD DATA
```

FIELD DATA

Plant: Fusion Inc.
Date: 5-21-89 Job No. 2958
Sampling Location: Scrubber Outlet
Sample Type: Chromic
Run Number: 0-5
Operator: Gerber, Thomas
Ambient Temperature: 93
Barometric Pressure: 30.18
Static Pressure (P_s): -1.67
Filter Number(s): N/A
Pretest Leak Rate = 0.015 cfm @ 16 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check: N/A
Read and Record all Data Every 5 Minutes



Schematic of Traverse Point Layout

Probe Length and Type: 3' Glass
Pitot Tube I.D. No. 5-6 Cp .84
Nozzle I.D. .239 | .236 | .238 | Avg. .2377
Assumed Moisture, % 2.5
Temp. Readout S/N: Omega
Meter Box Number: MB-4
Meter $\Delta H_@$: 1.441
C Factor: 0.90
Meter Gamma: 1.009
Heater Box Setting: N/A
Reference Δp: 0.63
Post Test Leak Rate = 0.015 cfm @ 11 in. Hg
Post Test Pitot Leak Check: OK
Post Test Orsat Leak Check: N/A

Page 1 of 2

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
A 1	0	13:49	848.104	2.1	6.1	6.1	83	94	92	10		64	
2	5	13:54	855.749	2.0	5.85	5.85	82	103	92	10		63	
3	10	13:59	863.252	1.9	5.7	5.7	82	103	94	10		66	
4	15	14:04	870.680	1.8	5.35	5.35	82	119	95	9		66	
5	20	14:09	877.922	1.7	5.0	5.0	83	122	99	8		69	
6	25	14:14	884.938	1.5	4.3	4.3	83	124	99	7		68	
7	30	14:19	891.450	0.99	2.9	2.9	83	123	100	4		66	
8	35	14:24	896.863	0.96	2.85	2.85	83	122	100	4		64	
9	40	14:29	902.124	0.96	2.85	2.85	84	122	101	4		65	
10	45	14:34	907.335	0.99	2.9	2.9	84	122	102	4		66	
11	50	14:39	912.684	0.99	2.3	2.3	85	122	102	3		67	
12	55	14:44	917.499	0.88	2.6	2.6	84	121	102	4		67	
B 13	60	15:02	922.452	1.9	5.7	5.7	84	104	98	9		65	
14	65	15:07	929.700	1.9	5.7	5.7	84	110	99	9		65	
15	70	15:12	936.995	1.7	5.0	5.0	84	118	99	8		62	
16	75	15:17	943.933	1.5	4.3	4.3	85	120	100	7		62	
17	80	15:22	950.360	1.5	4.3	4.3	84	123	100	6		60	
18	85	15:27	956.745	1.4	4.1	4.1	84	122	101	6		61	
19	90	15:32	962.960	0.91	2.7	2.7	84	122	101	4		62	
20	95	15:37	968.053	0.91	2.7	2.7	84	122	102	4		62	

PACIFIC ENVIRONMENTAL SERVICES INC.

Plant Name: Fusion Tec

Run Number: 0-5

Test Date: 5-21-89

Operator: Gerber, Thomas

Page 2 of 2

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Im-pinger Temp. °F	Probe Temp °F
21	100	15:42	973.135	0.88	2.6	2.6	83	120	101	4		63	
22	105	15:47	978.122	0.81	2.4	2.4	83	119	101	3		63	
23	110	15:52	983.014	0.71	2.1	2.1	84	119	101	3		63	
24	115	15:57	987.579	~~0.65~~ 0.75	~~1.95~~	~~1.95~~	84	119	102	3		63	
OFF	120	16:02	992.195		2.2	2.2							
								AVE=108					
			144.091		AVE=	3.85							

PACIFIC ENVIRONMENTAL SERVICES, INC.

SAMPLE RECOVERY DATA

Plant: Fosion, Inc Run No.: 0-5

Date: 5/21/89 Sample Box No.: RAL-2 Job No.: 2958

Sample Location: Scrubber Outlet

Sample Type: HM13B Filter No.:

Sample Recovery Person: HJD

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples stored and locked:

BACK HALF/MOISTURE

Container No: 0-5

Liquid Level Marked: ✓ Sealed: ✓

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1			590.0	636.7	46.7
2			607.7	616.1	8.4
3			455.8	460.4	4.6
4			647.3	673.6	26.3
5					
6					
TOTAL					86.0

Description of Impinger Catch:

F1

```
XROM "PRESS"
NO. OF POINTS ?
          84.0000     RUN
DELTA P ?
           .1000      RUN
STACK TEMP ?
          83.0000     RUN
DELTA P ?
          2.0000      RUN
STACK TEMP ?
          82.0000     RUN
DELTA P ?
          1.9000      RUN
STACK TEMP ?
          82.0000     RUN
DELTA P ?
          1.8000      RUN
STACK TEMP ?
          82.0000     RUN
DELTA P ?
          1.7000      RUN
STACK TEMP ?
          82.0000     RUN
DELTA P ?
          1.5000      RUN
STACK TEMP ?
          83.0000     RUN
DELTA P ?
           .9900      RUN
STACK TEMP ?
          83.0000     RUN
DELTA P ?
           .9600      RUN
STACK TEMP ?
          83.0000     RUN
DELTA P ?
           .9600      RUN
STACK TEMP ?
          84.0000     RUN
DELTA P ?
           .9900      RUN
STACK TEMP ?
          84.0000     RUN
DELTA P ?
           .7900      RUN
STACK TEMP ?
          85.0000     RUN
DELTA P ?
           .8800      RUN
STACK TEMP ?
          84.0000     RUN
DELTA P ?
          1.9000      RUN
STACK TEMP ?
          84.0000     RUN
DELTA P ?
          1.9000      RUN
STACK TEMP ?
          84.0000     RUN
DELTA P ?
          1.7000      RUN
STACK TEMP ?
          84.0000     RUN
DELTA P ?
          1.5000      RUN
STACK TEMP ?
          85.0000     RUN
DELTA P ?
          1.5000      RUN
STACK TEMP ?
          84.0000     RUN
DELTA P ?
          1.4000      RUN
STACK TEMP ?
          84.0000     RUN
DELTA P ?
           .9100      RUN
STACK TEMP ?
          84.0000     RUN
```

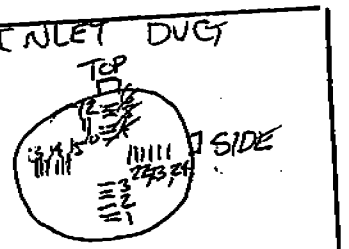
```
DELTA P ?
           .9100      RUN
STACK TEMP ?
          84.0000     RUN
DELTA P ?
           .8800      RUN
STACK TEMP ?
          83.0000     RUN
DELTA P ?
           .8100      RUN
STACK TEMP ?
          83.0000     RUN
DELTA P ?
           .7100      RUN
STACK TEMP ?
          84.0000     RUN
DELTA P ?
           .7500      RUN
STACK TEMP ?
          84.0000     RUN

SQRT PSTS = 26.2610
AVE STK TEMP = 83.5000
```

```
                      RUN
RUN NUMBER
0-5                   RUN

VOL MTR STD ?
     137.6190000      RUN
STACK DSCFM ?
     17,610.00000     RUN
FRONT 1/2 MG ?
          .0840900    RUN
BACK 1/2 MG ?         RUN

F  GR/DSCF = 0.0000094
F  MG/MMM = 0.0215781
F  LB/HR = 0.0014233
F  KG/HR = 0.0006456
```

```
XROM "METH 5"
RUN NUMBER
                      CHS
0-5                   RUN
METER BOX Y?
          1.0090      RUN
DELTA H?
          3.9000      RUN
BAR PRESS ?
         30.1800      RUN
METER VOL ?
        144.0910      RUN
MTR TEMP F?
        108.0000      RUN
STATIC HOH IN ?
           .6700      RUN
STACK TEMP.
         84.0000      RUN
ML. WATER ?
         86.0000      RUN

SAT % = 3.9

IMP. % HOH = 2.9
% HOH=2.9

% CO2?
           .7000      RUN
% OXYGEN?
        21.0000       RUN
% CO ?
                      RUN

MWd =28.95
MW WET=28.64

SQRT PSTS ?
        26.2610       RUN
COS SQRT PSTS ?
                      RUN
TIME MIN ?
       120.0000       RUN
NOZZLE DIA ?
           .2377      RUN
STK DIA INCH ?
        29.6875       RUN

* VOL MTR STD = 137.619
  STK PRES ABS = 30.23
  VOL HOH GAS = 4.05
  % MOISTURE = 2.86
  MOL DRY GAS = 0.971
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.64
  VELOCITY FPS = 64.09
  STACK AREA = 4.81
  STACK ACFM = 18,486.
* STACK DSCFM = 17,610.
  % ISOKINETIC =  101.65


END OF FIELD DATA
```

FIELD DATA

Plant: Fusion, Inc.
Date: 3-21-88 Job No. 2958
Sampling Location: SCRUBBER INLET
Sample Type: MODIFIED METHOD 5 - Chrome
Run Number: I-6
Operator: S. MON
Ambient Temperature: 80
Barometric Pressure: 30.09
Static Pressure (P_s): -3.6" H_2O
Filter Number(s): Not Used
Pretest Leak Rate = 0.010 cfm @ 15.5 in. Hg
Pretest Pitot Leak Check: O.K.
Pretest Orsat Leak Check: N.A.
Read and Record all Data Every 5 Minutes



Schematic of Traverse Point Layout

Probe Length and Type: 5'
Pitot Tube I.D. No. S-4A Cp 0.84
Nozzle I.D. | | | Avg. 0.243" SS
Assumed Moisture, %: 2.50
Temp. Readout S/N: N.A.
Meter Box Number: MB-3
Meter $\Delta H_@$: 1.987
C Factor: 1.15
Meter Gamma: 0.985
Heater Box Setting: N.A.
Reference Δp: 0.98
Post Test Leak Rate = 0.010 cfm @ 15.0 in. Hg
Post Test Pitot Leak Check:
Post Test Orsat Leak Check: N.A.

Page 1 of 2

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min) / Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
	0 / 1737	771.912										
1	5 / 1742	778.1	1.25	4.83	4.85	94	90.5	85.0	3.0	—	63	—
2	10 / 1747	783.3	1.20	4.69	4.70	94	98.0	86	3.5	—	57	—
3	15 / 1752	789.4	1.25	4.91	4.90	93	103.0	86	3.5	—	65	—
4	20 / 1757	791.5	1.20	4.76	4.75	91	107.7	88	3.5	—	68	—
5	25 / 1802	795.7	1.10	4.37	4.40	91	109.6	88	2.5	—	69	—
6	30 / 1807	801.1	1.25	5.00	5.00	89	110.8	89	3.5	—	65	—
7	35 / 1812	807.4	1.35	5.41	5.40	89	112.3	90	4.0	—	64	—
8	40 / 1817	814.2	1.45	5.82	5.80	89	114.4	91	5.0	—	65	—
9	45 / 1822	821.8	1.50	6.03	6.05	89	116.0	91	5.5	—	66	—
10	50 / 1827	835.6	1.65	6.65	6.65	89	117.8	92	6.5	—	68	—
11	55 / 1832	842.6	1.50	6.08	6.10	88	120.5	93	6.0	—	67	—
12	60 / 1837	849.751	1.3	5.30	5.30	85	119.2	94	4.5	—	69	—
	/		END OF FIRST HALF									
	/											
	/	V_m = 164.537										
	/											
	/											
	/											
	/											
	/											

Plant Name: Fusion, Inc Test Date: 5-21-89

Run Number: I-6 Operator: Simo

Page 2 of 2 Pre-traverse Leak Check = 0.005 at 15" Post Test = 0.006 at 16" Pitot Check O.K.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Im-pinger Temp. °F	Probe Temp °F
	60	1849	850.004										
13	65	1854	857.4	1.65	6.72	6.70	87	100.4	90	7.0	—	66	—
14	70	1859	865.0	1.65	6.61	6.60	87	109.1	90	7.0	—	63	—
15	75	1904	872.5	1.55	6.26	6.25	86	115.6	90	6.0	—	65	—
16	80	1909	880.6	1.55	6.27	6.25	86	116.8	91	6.0	—	65	—
17	85	1914	887.2	1.50	6.09	6.10	85	117.4	92	6.0	—	64	—
18	90	1919	894.2	1.50	6.08	6.10	86	117.3	92	6.0	—	65	—
19	95	1924	901.0	1.40	5.69	5.70	85	117.5	92	5.0	—	65	—
20	100	1929	908.5	1.40	5.66	5.65	87	116.2	92	5.0	—	66	—
21	105	1934	915.2	1.45	5.88	5.90	86	117.4	93	5.0	—	66	—
22	110	1939	922.1	1.45	5.88	5.90	86	116.2	93	5.0	—	67	—
23	115	1944	929.3	1.50	6.09	6.10	85	116.2	93	5.5	—	69	—
24	120	1949	936.702	1.45	5.89	5.90	85	117.3	92	5.0	—	70	—
					STOP-END OF TEST								

Pressure Drop Across Scrubber = 2.15" H2O (Whole Test)

PACIFIC ENVIRONMENTAL SERVICES, INC.

SAMPLE RECOVERY DATA

Plant: Fusion, Inc. Run No.: I-6

Date: 5/21/89 Sample Box No.: PAC 1 Job No.: 2958

Sample Location: Scrubber Inlet

Sample Type: MM13B Filter No.:

Sample Recovery Person: HJO

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples stored and locked:

BACK HALF/MOISTURE

Container No: O-6

Liquid Level Marked: ✓ Sealed: ✓

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1			579.6	617.5	
2			606.9	613.5	
3			473.9	477.3	
4			695.8	733.0	
5					
6					
TOTAL					

Description of Impinger Catch:

F1

```
XROM "PRESS"
NO. OF POINTS ?
24.00      RUN
DELTA P ?
FIX 4
1.2500     RUN
STACK TEMP ?
94.0000    RUN
DELTA P ?
1.2000     RUN
STACK TEMP ?
94.0000    RUN
DELTA P ?
1.2500     RUN
STACK TEMP ?
93.0000    RUN
DELTA P ?
1.2000     RUN
STACK TEMP ?
91.0000    RUN
DELTA P ?
1.1000     RUN
STACK TEMP ?
91.0000    RUN
DELTA P ?
1.2500     RUN
STACK TEMP ?
89.0000    RUN
DELTA P ?
1.3500     RUN
STACK TEMP ?
89.0000    RUN
DELTA P ?
1.4500     RUN
STACK TEMP ?
89.0000    RUN
DELTA P ?
1.5000     RUN
STACK TEMP ?
89.0000    RUN
DELTA P ?
1.6500     RUN
STACK TEMP ?
89.0000    RUN
DELTA P ?
1.5000     RUN
STACK TEMP ?
88.0000    RUN
DELTA P ?
1.3000     RUN
STACK TEMP ?
85.0000    RUN
DELTA P ?
1.6500     RUN
STACK TEMP ?
87.0000    RUN
DELTA P ?
1.6500     RUN
STACK TEMP ?
87.0000    RUN
DELTA P ?
1.5500     RUN
STACK TEMP ?
86.0000    RUN
DELTA P ?
1.5500     RUN
STACK TEMP ?
86.0000    RUN
DELTA P ?
1.5000     RUN
STACK TEMP ?
85.0000    RUN
DELTA P ?
1.5000     RUN
STACK TEMP ?
86.0000    RUN
```

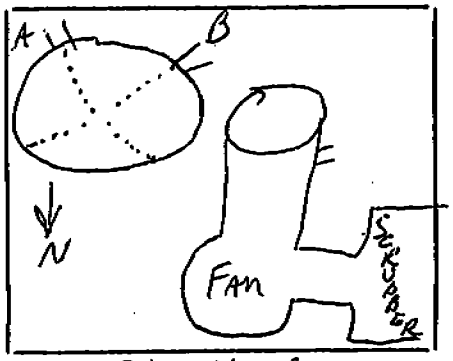
```
DELTA P ?
1.4000     RUN
STACK TEMP ?
85.0000    RUN
DELTA P ?
1.4000     RUN
STACK TEMP ?
87.0000    RUN
DELTA P ?
1.4500     RUN
STACK TEMP ?
86.0000    RUN
DELTA P ?
1.4500     RUN
STACK TEMP ?
86.0000    RUN
DELTA P ?
1.5000     RUN
STACK TEMP ?
85.0000    RUN
DELTA P ?
1.4500     RUN
STACK TEMP ?
85.0000    RUN

SQRT PSTS = 27.8413
AVE STK TEMP = 88.0000
```

```
XROM "MASSFLO"
RUN NUMBER
I-6                RUN

VOL MTR STD ?
155.491            RUN
STACK DSCFM ?
18,913.00          RUN
FRONT 1/2 MG ?
2.5477             RUN
BACK 1/2 MG ?      RUN

F  GR/DSCF = 2.53E-4
F  MG/MMM = 0.58
F  LB/HR = 0.04
F  KG/HR = 0.02
FIX 7
                   RUN
B  GR/DSCF = 0.0000000
B  MG/MMM = 0.0000000
B  LB/HR = 0.0000000
B  KG/HR = 0.0000000

T  GR/DSCF = 0.0002529
T  MG/MMM = 0.5786153
T  LB/HR = 0.0409904
T  KG/HR = 0.0185932
```

```
XROM "METH 5"
RUN NUMBER
I-#6               RUN
METER BOX Y?
.9850              RUN
DELTA H?
5.7100             RUN
BAR PRESS ?
30.0800            RUN
METER VOL ?
164.5370           RUN
MTR TEMP F?
101.0000           RUN
STATIC HOH IN ?
-3.6000            RUN
STACK TEMP ?
88.0000            RUN
ML. WATER ?
85.1000            RUN

SAT % = 4.5

IMP. % HOH = 2.5
% HOH=2.5

% CO2?
.7000              RUN
% OXYGEN?
21.0000            RUN
% CO ?             RUN
                   RUN

MWd =28.95
MW WET=28.68

SQRT PSTS ?
27.8413            RUN
COS SQRT PSTS ?    RUN
TIME MIN ?
120.0000           RUN
NOZZLE DIA ?
.2430              RUN
STK DIA INCH ?
30.0500            RUN

* VOL MTR STD = 155.491
  STK PRES ABS = 29.82
  VOL HOH GAS = 4.01
  % MOISTURE = 2.51
  MOL DRY GAS = 0.975
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.68
  VELOCITY FPS = 68.38
  STACK AREA = 4.93
  STACK ACFM = 20,205.
* STACK DSCFM = 18,913.
  % ISOKINETIC = 104.83

END OF FIELD DATA
```

FIELD DATA

Plant: Fusion Inc.
Date: 5-21-89 Job No. 2958
Sampling Location: Scrubber Outlet
Sample Type: Chrome
Run Number: 0-6
Operator: Gerber, Thomas
Ambient Temperature: 91
Barometric Pressure: 30.08
Static Pressure (P_s): +.64
Filter Number(s): N/A
Pretest Leak Rate = 0.017 cfm @ 16 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check: N/A
Read and Record all Data Every 5 Minutes



Schematic of Traverse Point Layout

Probe Length and Type: 3' Glass
Pitot Tube I.D. No. 5-6 Cp .84
Nozzle I.D. .239 | .236 | .235 Avg. .2377
Assumed Moisture, % 2.5
Temp. Readout S/N: Omega
Meter Box Number: MB-4
Meter $\Delta H_@$: 1.441
C Factor: 0.90
Meter Gamma: 1.009
Heater Box Setting: N/A
Reference Δp: .63
Post Test Leak Rate = 0.010 cfm @ 7 in. Hg
Post Test Pitot Leak Check: OK
Post Test Orsat Leak Check: N/A

Page 1 of 2

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
A 1	0	117:37	992.503	2.0	5.8	5.8	84	90	89	5		67	
2	5	117:42	999.992	1.9	5.65	5.65	84	100	89	5		65	
3	10	117:47	1007.325	1.9	5.65	5.65	83	109	90	5		66	
4	15	117:52	1014.678	1.8	5.3	5.3	83	115	92	5		65	
5	20	117:57	1021.889	1.7	4.95	4.95	83	119	94	4		66	
6	25	118:02	1029.169	1.4	4.15	4.15	83	121	96	4		65	
7	30	118:07	1035.240	1.1	3.25	3.25	82	121	97	3		62	
8	35	118:12	1040.967	1.0	2.95	2.95	83	120	98	3		61	
9	40	118:17	1046.361	1.05	3.1	3.1	83	120	99	3		61	
10	45	118:22	1051.937	0.97	2.9	2.9	83	120	99	3		61	
11	50	118:27	1057.255	1.05	3.1	3.1	83	120	99	3		62	
12	55	118:32	1062.764	1.05	3.1	3.1	83	121	100	3		63	
B 13	60	118:49	1068.272	1.7	4.95	4.95	83	100	95	4		68	
14	65	118:54	1075.131	1.8	5.25	5.25	82	110	95	4		61	
15	70	118:59	1082.132	1.65	4.85	4.85	82	118	98	4		64	
16	75	119:04	1088.989	1.6	4.7	4.7	82	118	98	4		63	
17	80	119:09	1095.698	1.5	4.35	4.35	82	120	99	4		64	
18	85	119:14	1102.222	1.4	4.1	4.1	81	120	99	4		65	
19	90	119:19	1108.560	0.95	2.8	2.8	82	120	99	3		64	
20	95	119:24	1113.858	0.96	2.85	2.85	82	119	99	3		64	

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Fusion Inc.

Run Number: 0-6

Page 2 of 2

Test Date: 5-21-89

Operator: Gerber, Thomas

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
21	100	119:29	1119.065	0.92	2.7	2.7	81	118	99	3		64	
22	105	119:34	1124.223	0.80	2.4	2.4	81	118	99	2		64	
23	110	119:39	1129.072	0.80	2.4	2.4	81	118	99	3		64	
24	115	119:44	1134.000	0.69	2.0	2.0	81	117	98	2		65	
OFF	120	119:49	1138.284		AVE	3.88		AVE=106					
			145.781										

PACIFIC ENVIRONMENTAL SERVICES, INC.

SAMPLE RECOVERY DATA

Plant: Fusion, Inc Run No.: 0-6

Date: 5/21/89 Sample Box No.: RAC-2 Job No.: 2958

Sample Location: Scrubber Outlet

Sample Type: MM13B Filter No.:

Sample Recovery Person: HJO

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples stored and locked:

BACK HALF/MOISTURE

Container No: 0-6

Liquid Level Marked: ✓ Sealed: ✓

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1			596.7	640.1	43.4
2			589.3	604.5	15.2
3			468.5	473.0	4.5
4			738.3	768.7	30.4
5					
6					
TOTAL					93.5

Description of Impinger Catch:

F1

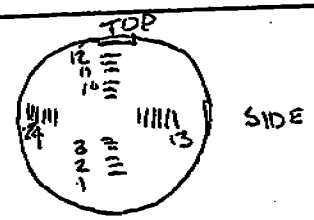
```
                XROM "PRESS"
NO. OF POINTS ?
              24.0000000      RUN
DELTA P ?
                              FIX 4
               2.0000         RUN
STACK TEMP ?
              84.0000         RUN
DELTA P ?
               1.9000         RUN
STACK TEMP ?
              84.0000         RUN
DELTA P ?
               1.9000         RUN
STACK TEMP ?
              83.0000         RUN
DELTA P ?
               1.8000         RUN
STACK TEMP ?
              83.0000         RUN
DELTA P ?
               1.7000         RUN
STACK TEMP ?
              83.0000         RUN
DELTA P ?
               1.4000         RUN
STACK TEMP ?
              83.0000         RUN
DELTA P ?
               1.1000         RUN
STACK TEMP ?
              82.0000         RUN
DELTA P ?
               1.0000         RUN
STACK TEMP ?
              83.0000         RUN
DELTA P ?
               1.0500         RUN
STACK TEMP ?
              83.0000         RUN
DELTA P ?
                .9700         RUN
STACK TEMP ?
              83.0000         RUN
DELTA P ?
               1.0500         RUN
STACK TEMP ?
              83.0000         RUN
DELTA P ?
               1.0500         RUN
STACK TEMP ?
              83.0000         RUN
DELTA P ?
               1.7000         RUN
STACK TEMP ?
              83.0000         RUN
DELTA P ?
               1.8000         RUN
STACK TEMP ?
              82.0000         RUN
DELTA P ?
               1.6500         RUN
STACK TEMP ?
              82.0000         RUN
DELTA P ?
               1.6000         RUN
STACK TEMP ?
              82.0000         RUN
DELTA P ?
               1.5000         RUN
STACK TEMP ?
              82.0000         RUN
DELTA P ?
               1.4000         RUN
STACK TEMP ?
              81.0000         RUN
DELTA P ?
                .9500         RUN
STACK TEMP ?
              82.0000         RUN
DELTA P ?
                .9600         RUN
STACK TEMP ?
              82.0000         RUN
DELTA P ?
                .9200         RUN
STACK TEMP ?
              81.0000         RUN
DELTA P ?
                .8000         RUN
STACK TEMP ?
              81.0000         RUN
DELTA P ?
                .8000         RUN
STACK TEMP ?
              81.0000         RUN
DELTA P ?
                .6900         RUN
STACK TEMP ?
              81.0000         RUN

SQRT PSTS = 26.4383
AVE STK TEMP = 82.3750
```

```
                XROM "MASSFLO"
RUN NUMBER
0-6
                              FIX 7
                               RUN
VOL MTR STD ?
          139.2630000         RUN
STACK DSCFM ?
         17,733.00000         RUN
FRONT 1/2 MG ?
              .0858200        RUN
BACK 1/2 MG ?
                               RUN

F  GR/DSCF = 0.0000095
F  MG/MMM = 0.0217620
F  LB/HR = 0.0014455
F  KG/HR = 0.0006557
```

```
                XROM "METH 5"
RUN NUMBER
0-6                           RUN
METER BOX Y?
               1.0090         RUN
DELTA H?
               3.8900         RUN
BAR PRESS ?
              30.0800         RUN
METER VOL ?
             145.7810         RUN
MTR TEMP F?
             106.0000         RUN
STATIC HOA IN ?
                .6400         RUN
STACK TEMP.
              82.0000         RUN
ML. WATER ?
              93.5000         RUN

SAT % = 3.7

IMP. % HOH = 3.1

% HOH=3.1

% CO2?
                .7000         RUN
% OXYGEN?
             21.0000          RUN
% CO ?                        RUN

MWd =28.95
MW WET=28.62

SQRT PSTS ?
             26.4383          RUN
COS SQRT PSTS ?               RUN
TIME MIN ?
            120.0000          RUN
NOZZLE DIA ?
                .2377         RUN
STK DIA INCH ?
             29.6875          RUN

* VOL MTR STD = 139.263
  STK PRES ABS = 30.13
  VOL HOH GAS = 4.40
  % MOISTURE = 3.06
  MOL DRY GAS = 0.969
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.62
  VELOCITY FPS = 64.66
  STACK AREA = 4.81
  STACK ACFM = 18,650.
* STACK DSCFM = 17,733.
  % ISOKINETIC =  102.14

END OF FIELD DATA
```

FIELD DATA

Plant: Fusion, Inc.
Date: 5-23-89 Job No. 2758
Sampling Location: Scrubber Inlet
Sample Type: Mod. Meth. 5, Chrome
Run Number: I-7
Operator: Simon
Ambient Temperature: 85°F
Barometric Pressure: 30.11" Hg
Static Pressure (P_s): -3.6" H_2O
Filter Number(s): N.A.
Pretest Leak Rate = 0.006 cfm @ 15.0 in. Hg
Pretest Pitot Leak Check: O.K.
Pretest Orsat Leak Check: N.A.
Read and Record all Data Every 4 Minutes



SIDE VIEW - Looking away from Scrubber

Schematic of Traverse Point Layout

Probe Length and Type: 5' glass-lined w/ SS nce.
Pitot Tube I.D. No. S-4A Cp 0.84
Nozzle I.D. | | | Avg. 0.243"
Assumed Moisture, % ~~2.50~~ 2.40
Temp. Readout S/N: T-2
Meter Box Number: MB-3
Meter $\Delta H_@$: 1.987
C Factor: 1.15
Meter Gamma: 0.985
Heater Box Setting: N.A.
Reference Δp: 0.48
Post Test Leak Rate = 0.002 cfm @ 15.0 in. Hg
Post Test Pitot Leak Check: O.K.
Post Test Orsat Leak Check: N.A.

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Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
	0	0938	936.929				85	84.8	89	6.0	—	58	—
1	4	0942	942.1	1.45	5.71	5.70	85	96.1	91	6.0	—	55	—
1	8	0946	947.1	1.40	5.59	5.60	85	103.4	92	5.0	—	62	—
2	12	0950	952.4	1.30	5.21	5.20	86	106.7	93	5.0	—	64	—
2	16	0954	956.1	1.30	5.23	5.20	86	108.7	93	4.5	—	65	—
3	20	0958	961.7	1.25	5.04	5.00	86	110.1	93	4.5	—	66	—
3	24	1002	967.0	1.25	5.05	5.05	86	112.2	93	4.5	—	67	—
4	28	1006	972.1	1.10	4.45	4.45	86	111.7	93	4.5	—	68	—
4	32	1010	977.0	1.10	4.49	4.45	87	111.9	93	4.5	—	63	—
5	36	1014	980.4	1.10	4.44	4.45	87	112.6	93	4.5	—	62	—
5	40	1018	985.3	1.10	4.44	4.45	87	113.4	93	4.5	—	62	—
6	44	1022	989.6	1.15	4.65	4.65	87	113.5	93	4.5	—	62	—
6	48	1026	994.6	1.20	4.85	4.85	88	115.2	93	5.0	—	63	—
7	52	1030	000.1	1.35	5.46	5.45	88	115.5	93	5.5	—	64	—
7	56	1034	005.0	1.40	5.66	5.65	88	117.3	93	6.0	—	66	—
8	60	1038	010.8	1.50	5.85	5.80	88	118.4	93	7.0	—	65	—
8	64	1042	016.2	1.50	6.09	6.10	87	119.7	94	8.5	—	65	—
9	68	1046	021.9	1.60	6.51	6.50	87	121.8	94	8.5	—	67	—
9	72	1050	028.2	1.55	6.32	6.30	87	122.8	94	9.5	—	64	—
10	76	1054	033.6	1.60	6.53	6.50	87	123.5	95	8.0	—	65	—
10	80	1058	039.6	1.50	6.13	6.15	87						

NOTE: DELTAH PROGRAM ON HP CALCULATOR WAS USED DURING THIS TEST.

PACIFIC ENVIRONMENTAL SERVICES, INC.

Plant Name: Fusion, Inc.

Run Number: I-7

Page 2 of 2

Test Date: 5-23-89

Operator: SIMON

Traverse Point Number	Sampling Time, (min) / Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
	80 / 10:58	039.6										
10 11	84 / 11:02	045.7	1.60	6.52	6.50	88	123.2	95	8.5	—	65	—
11	88 / 11:06	051.4	1.60	6.53	6.50	88	124.0	96	8.5	—	65	—
12	92 / 1110	058.3	1.45	5.92	5.90	88	124.4	96	7.0	—	64	—
12	96 / 1114	063.953	1.45	5.93	5.90	88	122.9	97	7.0	—	65	—
			STOP - END OF FIRST HALF OF TEST.					Leak Checks: Post.		Pitot at 15.0	Imp. 0.06	at 16.0"
	/											
—	/											
	96 / 1128	~~064.172~~	064.296	—	—	—	—	—	—	—	—	—
13	100 / 11:34	Not observed	1.70	6.75	6.75	88	96.3	90	9.0	—	67	—
13	104 / 11:38	076.2	1.70	6.76	6.75	88	109.0	92	9.0	—	58	—
14	108 / 1142	081.3	1.70	6.88	6.90	88	117.1	92	9.5	—	61	—
14	112 / 1146	088.2	1.70	6.91	6.90	89	122.6	93	9.5	—	63	—
15	116 / 1150	094.3	1.65	6.74	6.75	88	126.3	94	9.5	—	65	—
15	120 / 1154	100.6	1.60	6.54	6.50	88	125.6	95	9.0	—	64	—
16	124 / 1158	107.2	1.55	6.34	6.35	89	127.3	96	8.5	—	64	—
16	128 / 1202	112.4	1.55	6.33	6.30	89	125.8	97	8.5	—	63	—
17	132 / 1206	118.4	1.55	6.34	6.35	89	127.0	97	8.5	—	64	—
17	136 / 1208	123.9	1.55	6.33	6.35	89	125.6	97	8.5	—	64	—
18	140 / 1212 1174	130.6	1.50	6.12	6.10	90	125.8	97	8.0	—	64	—
18	144 / 1216 1177	136.5	1.55	6.33	6.30	89	125.5	97	8.5	—	64	—
19	148 / 1220 1183	141.2	1.50	6.13	6.15	89	125.3	97	8.5	—	64	—
19	152 / 1224 1187	147.9	1.50	6.13	6.15	89	125.3	97	8.5	—	65	—
20	156 / 1228	153.2	1.55	6.32	6.35	90	125.5	97	8.5	—	66	—
20	160 / 1232	159.8	1.55	6.34	6.35	89 90	126.2	97	8.5	—	65	—
21	164 / 1236	165.8	1.55	6.33	6.35	90	126.5	98	8.5	—	64	—
21	168 / 1240	172.0	1.55	6.33	6.35	90	126.7	98	8.5	—	62	—
22	172 / 1244	177.9	1.50	6.13	6.15	90	126.7	98	8.0	—	61	—
22	176 / 1248	184.2	1.55	6.33	6.35	90	126.4	98	8.5	—	60	—
23	180 / 1252	189.4	1.60	6.54	6.55	90	126.5	99	8.5	—	60	—
23	184 / 1256	197.0	1.65	6.75	6.75	90	127.3	99	9.0	—	60	—
24	188 / 1300	201.9	1.65	6.76	6.75	90	128.5	99	9.0	—	61	—
24	192 / 1304	209.208	1.65	6.76	6.75	90	129.8	99	9.0	—	61	—

STOP - END OF TEST

V_{m_f} = 272.279 ft³

PACIFIC ENVIRONMENTAL SERVICES, INC.

SAMPLE RECOVERY DATA

Plant: Fusion, Inc Run No.: I-7

Date: Sample Box No.: RAC-1 Job No.: 2958

Sample Location: Scrubber Inlet

Sample Type: MM13B Filter No.:

Sample Recovery Person:

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples stored and locked:

BACK HALF/MOISTURE

Container No: I-7

Liquid Level Marked: ✓ Sealed: ✓

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1			607.1	678.0	
2			617.5	611.1	
3			505.1	514.1	
4			748.1	803.9	
5					
6					
TOTAL					

Description of Impinger Catch:

F1

```
XROM "PRESS"
NO. OF POINTS ?
          48.00      RUN
DELTA P ?
                     FIX 4
          1.4500     RUN
STACK TEMP ?
          85.0000    RUN
DELTA P ?
          1.4000     RUN
STACK TEMP ?
          85.0000    RUN
DELTA P ?
          1.3000     RUN
STACK TEMP ?
          86.0000    RUN
DELTA P ?
          1.3000     RUN
STACK TEMP ?
          86.0000    RUN
DELTA P ?
          1.2500     RUN
STACK TEMP ?
          86.0000    RUN
DELTA P ?
          1.2500     RUN
STACK TEMP ?
          86.0000    RUN
DELTA P ?
          1.1000     RUN
STACK TEMP ?
          86.0000    RUN
DELTA P ?
          1.1000     RUN
STACK TEMP ?
          87.0000    RUN
DELTA P ?
          1.1000     RUN
STACK TEMP ?
          87.0000    RUN
DELTA P ?
          1.1000     RUN
STACK TEMP ?
          87.0000    RUN
DELTA P ?
          1.1500     RUN
STACK TEMP ?
          87.0000    RUN
DELTA P ?
          1.2000     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.3500     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.4000     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.5000     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.5000     RUN
STACK TEMP ?
          87.0000    RUN
DELTA P ?
          1.6000     RUN
STACK TEMP ?
          87.0000    RUN
DELTA P ?
          1.5500     RUN
STACK TEMP ?
          87.0000    RUN
DELTA P ?
          1.6000     RUN
STACK TEMP ?
          87.0000    RUN
DELTA P ?
          1.5000     RUN
STACK TEMP ?
          87.0000    RUN
DELTA P ?
          1.6000     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.6000     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.4500     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.4500     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.7000     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.7000     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.7000     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.7000     RUN
STACK TEMP ?
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DELTA P ?
          1.7000     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.7000     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.7000     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.7000     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.7000     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.7000     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.7000     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.6500     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.6000     RUN
STACK TEMP ?
          88.0000    RUN
DELTA P ?
          1.5500     RUN
STACK TEMP ?
          89.0000    RUN
DELTA P ?
          1.5500     RUN
STACK TEMP ?
          89.0000    RUN
DELTA P ?
          1.5500     RUN
STACK TEMP ?
          89.0000    RUN
DELTA P ?
          1.5000     RUN
STACK TEMP ?
          90.0000    RUN
DELTA P ?
          1.5500     RUN
STACK TEMP ?
          89.0000    RUN
DELTA P ?
          1.5500     RUN
STACK TEMP ?
          89.0000    RUN
DELTA P ?
          1.5000     RUN
STACK TEMP ?
          89.0000    RUN
DELTA P ?
          1.5000     RUN
STACK TEMP ?
          89.0000    RUN
DELTA P ?
          1.5500     RUN
STACK TEMP ?
          90.0000    RUN
DELTA P ?
          1.5500     RUN
STACK TEMP ?
          90.0000    RUN
DELTA P ?
          1.5500     RUN
STACK TEMP ?
          90.0000    RUN
DELTA P ?
          1.5000     RUN
STACK TEMP ?
          90.0000    RUN
DELTA P ?
          1.5500     RUN
STACK TEMP ?
          90.0000    RUN
DELTA P ?
          1.6000     RUN
STACK TEMP ?
          90.0000    RUN
DELTA P ?
          1.6500     RUN
STACK TEMP ?
          90.0000    RUN
DELTA P ?
          1.6500     RUN
STACK TEMP ?
          90.0000    RUN
DELTA P ?
          1.6500     RUN
STACK TEMP ?
          90.0000    RUN

SQRT PSTS = 28.4031
AVE STK TEMP = 88.1042
```
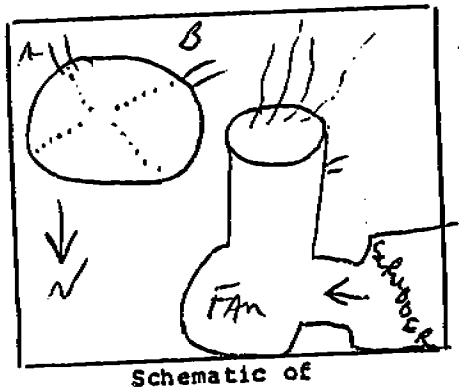

```
XROM "MASSFLO"
RUN NUMBER
I-7                  RUN

VOL MTR STD ?
     254.6820000     RUN
STACK DSCFM ?
     19,332.00000    RUN
FRONT 1/2 MG ?
       5.4262000     RUN
BACK 1/2 MG ?        RUN

F  GR/DSCF = 0.0003288
F  MG/MMM = 0.7523925
F  LB/HR = 0.0544819
F  KG/HR = 0.0247130
```

```
XROM "METH 5"
RUN NUMBER
I-7                  RUN
METER BOX Y?
          .9850      RUN
DELTA H?
        5.9800       RUN
BAR PRESS ?
       29.1190       RUN
METER VOL ?
      271.9360       RUN
MTR TEMP F?
       107.0000      RUN
STATIC POW IN ?
       -3.6000       RUN
STACK TEMP.
        88.0000      RUN
ML. WATER ?
       129.3000      RUN

SAT % = 4.5

IMP. % HOH = 2.3

% HOH=2.3

% CO2?
          .7000      RUN
% OXYGEN?
       21.0000       RUN
% CO ?                RUN

MWd =28.95
MW WET=28.70

SQRT PSTS ?
       28.4031       RUN
COS SQRT PSTS ?      RUN
TIME MIN ?
      192.0000       RUN
NOZZLE DIA ?
          .2430      RUN
STK DIA INCH ?
        30.0500      RUN

* VOL MTR STD = 254.682
  STK PRES ABS = 29.85
  VOL HOH GAS = 6.09
  % MOISTURE = 2.33
  MOL DRY GAS = 0.977
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.70
  VELOCITY FPS = 69.70
  STACK AREA = 4.93
  STACK ACFM = 20,596.
* STACK DSCFM = 19,332.
  % ISOKINETIC = 104.99

END OF FIELD DATA
```

FIELD DATA

Plant: Fusion Inc.
Date: 5-23-89 Job No. 2958
Sampling Location: Scrubber Outlet
Sample Type: Chrome
Run Number: 0-7
Operator: Gerber / Thomas
Ambient Temperature: 83
Barometric Pressure: 30.11
Static Pressure (P_s): -.64
Filter Number(s): N/A
Pretest Leak Rate = 0.014 cfm @ 16 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check: N/A
Read and Record all Data Every 4 Minutes



Schematic of Traverse Point Layout

Probe Length and Type: 3' Glass
Pitot Tube I.D. No. 5-6 Cp .84
Nozzle I.D. | | | Avg. .2322
Assumed Moisture, % 2.5
Temp. Readout S/N: Omega
Meter Box Number: MB-4
Meter $\Delta H_@$: 1.441
C Factor: 0.90
Meter Gamma: 1.009
Heater Box Setting: N/A
Reference Δp: 0.63
Post Test Leak Rate = 0.013 cfm @ 11 in. Hg
Post Test Pitot Leak Check: O.K.
Post Test Orsat Leak Check: N/A

Page 1 of 2 Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
A-1	0	19:38	138.804	.05	5.38	5.38	83	84	84	9		63	
	4	19:42	146.069	.0	5.28	5.28	82	87	84	8		54	
2	8	19:46	150.252	.0	5.35	5.35	81	100	84	9		60	
	12	19:50	155.922	1.95	5.25	5.25	81	106	86	9		64	
3	16	19:54	160.222	1.9	5.15	5.15	81	113	87	8		64	
	20	19:58	167.330	1.9	5.18	5.18	81	117	90	8		66	
4	24	110:02	173.169	1.8	4.93	4.93	82	121	92	8		67	
	28	110:06	178.642	1.75	4.81	4.81	82	123	94	8		67	
5	32	110:10	184.232	1.65	4.55	4.55	82	125	96	7		69	
	36	110:14	189.636	1.7	4.7	4.7	81	126	96	7		64	
6	40	110:18	195.106	1.45	4.01	4.01	82	126	98	6		61	
	44	110:22	200.215	1.45	4.02	4.02	81	126	99	6		61	
7	48	110:26	205.293	1.15	3.19	3.19	81	126	99	5		61	
	52	110:30	209.844	1.15	3.19	3.19	81	124	100	5		61	
8	56	110:34	214.498	1.1	3.04	3.04	81	123	100	5		61	
	60	110:38	218.777	1.1	3.04	3.04	82	123	101	5		61	
9	64	110:42	223.184	1.05	2.91	2.91	81	124	102	4		63	
	68	110:46	227.526	1.0	2.77	2.77	82	124	102	4		63	
10	72	110:50	231.113	0.93	2.58	2.58	81	123	102	4		64	
	76	110:54	235.839	0.92	2.55	2.55	81	123	102	4			

PACIFIC ENVIRONMENTAL SERVICES INC

Plant Name: Fusion Inc.

Run Number: 0-7

Page 2 of 2

Test Date: 5-23-89

Operator: Gerber / Thomas

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
												64	65
11	80	110:58	239.857	0.99	2.74	2.74	82	123	102	4		64	
	84	111:02	243.983	0.97	2.69	2.69	81	124	102	4		64	
12	88	111:06	248.144	0.88	2.44	2.44	82	124	103	4		65	
	92	111:10	252.178	0.89	2.47	2.47	82	124	103	4		63	
B 13	96	111:28	256.022	1.85	5.01	5.01	82	102	99	8		53	
	100	111:32	261.523	1.85	5.04	5.04	82	108	100	8		58	
14	104	111:36	267.237	1.8	4.94	4.94	82	116	100	8		58	
	108	111:40	272.585	1.8	4.96	4.96	82	121	100	8		59	
15	112	111:44	278.101	1.7	4.7	4.7	82	124	100	7		60	
	116	111:48	283.584	1.7	4.7	4.7	82	123	100	7		59	
16	120	111:52	288.842	1.6	4.44	4.44	82	127	102	7		60	
	124	111:56	294.044	1.55	4.3	4.3	82	127	102	7		60	
17	128	112:00	299.184	1.5	4.17	4.17	82	127	103	6		61	
	132	112:04	304.252	1.55	4.31	4.31	82	127	103	6		61	
18	136	112:08	309.393	1.4	3.89	3.89	82	127	104	6		61	
	140	112:12	314.294	1.4	3.9	3.9	81	127	104	6		61	
19	144	112:16	319.202	0.97	2.7	2.7	82	127	104	4		61	
	148	112:20	323.400	0.97	2.7	2.7	81	126	104	4		61	
20	152	112:24	327.429	0.98	2.72	2.72	81	123	104	4		63	
	156	112:28	331.520	0.98	2.71	2.71	82	122	102	4		63	
21	160	112:32	335.578	0.95	2.63	2.63	81	122	102	4		63	
	164	112:36	339.560	0.97	2.68	2.68	81	121	102	4		64	
22	168	112:40	343.582	0.77	2.13	2.13	81	122	103	3		64	
	172	112:44	347.150	0.78	2.15	2.15	82	120	103	3		64	
23	176	112:48	350.817	0.73	2.01	2.01	82	120	102	3		65	
	180	112:52	354.318	0.75	2.07	2.07	83	120	102	3		66	
24	184	112:56	357.826	0.70	1.92	1.92	84	119	102	3		69	
	188	113:00	361.237	0.71	1.95	1.95	83	119	101				
OFF	192	113:04	364.653										

PACIFIC HYDROCARBON STUDIES INC

SAMPLE RECOVERY DATA

Plant: Fusion, Inc. Run No.: 0-7

Date: Sample Box No.: RAC-2 Job No.: 2958

Sample Location: Scrubber Outlet

Sample Type: MM13B Filter No.:

Sample Recovery Person: KJO

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples stored and locked:

BACK HALF/MOISTURE

Container No: 0-7

Liquid Level Marked: ✓ Sealed: ✓

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1			591.8	664.0	
2			607.1	619.1	
3			455.5	461.7	
4			734.6	778.6	
5					
6					
TOTAL					

Description of Impinger Catch:

F1

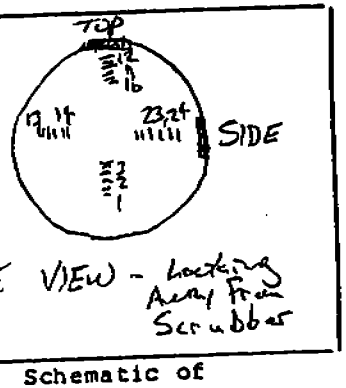
```
XROM "PRESS"
NO. OF POINTS ?
          48.00      RUN
DELTA P ?
                     FIX 4
          2.0500     RUN
STACK TEMP ?
         83.0000     RUN
DELTA P ?
          2.0000     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
          2.0000     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
          1.9500     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
          1.9000     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
          1.9000     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
          1.8000     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
          1.7500     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
          1.6500     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
          1.7000     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
          1.4500     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
          1.4500     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
          1.1500     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
          1.1500     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
          1.1000     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
          1.1000     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
          1.0500     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
          1.0000     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
           .9300     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
           .9200     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
           .9900     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
           .9700     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
           .8800     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
           .8900     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
          1.8500     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
          1.8500     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
          1.8090     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
          1.8000     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
          1.7000     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
          1.7000     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
          1.6000     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
          1.5500     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
          1.5000     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
          1.5500     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
         11.4000     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
          1.4000     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
           .9700     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
           .9700     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
           .9800     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
           .9800     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
           .9500     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
           .9700     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
           .7700     RUN
STACK TEMP ?
         81.0000     RUN
DELTA P ?
           .7800     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
           .7300     RUN
STACK TEMP ?
         82.0000     RUN
DELTA P ?
           .7500     RUN
STACK TEMP ?
         83.0000     RUN
DELTA P ?
           .7000     RUN
STACK TEMP ?
         84.0000     RUN
DELTA P ?
           .7100     RUN
STACK TEMP ?
         83.0000     RUN

SQRT PSTS = 26.4521
AVE STK TEMP = 81.7083
```

```
XROM "MASSFLO"
RUN NUMBER
0-7                  RUN

VOL MTR STD ?
        214.324      RUN
STACK DSCFM ?
      17,781.00      RUN
FRONT 1/2 MG ?
        .13798       RUN
BACK 1/2 MG ?
                     FIX 7
                     RUN

F  GR/DSCF = 0.0000099
F  MG/MMM = 0.022349
F  LB/HR = 0.0015142
F  KG/HR = 0.0006868
```

```
XROM "METH 5"
RUN NUMBER
0-7                  RUN
METER BOX Y?
          1.0090     RUN
DELTA H?
          3.6500     RUN
BAR PRESS ?
         30.1100     RUN
METER VOL ?
        225.8490     RUN
MTR TEMP F?
        110.0000     RUN
STATIC HOH IN ?
           .6400     RUN
STACK TEMP
         82.0000     RUN
ML. WATER ?
        134.4000     RUN

SAT % = 3.6

IMP. % HOH = 2.9
% HOH=2.9

% CO2?
           .7000     RUN
% OXYGEN?
         21.0000     RUN
% CO ?               RUN

MWd =28.95
MW WET=28.64

SQRT PSTS ?
         26.4521     RUN
COS SQRT PSTS ?      RUN
TIME MIN ?
        192.0000     RUN
NOZZLE DIA ?
           .2377     RUN
STK DIA INCH ?
         29.6875     RUN

* VOL MTR STD = 214.324
  STK PRES ABS = 30.16
  VOL HOH GAS = 6.33
  % MOISTURE = 2.87
  MOL DRY GAS = 0.971
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.64
  VELOCITY FPS = 64.64
  STACK AREA = 4.81
  STACK ACFM = 18,643.
* STACK DSCFM = 17,780.
  % ISOKINETIC =  97.99

END OF FIELD DATA
```

FIELD DATA

Plant: Fusion, Inc.
Date: 5-23-87 Job No. 2958
Sampling Location: SCRUBBER INLET
Sample Type: MOD. METHOD 5 - CHROME
Run Number: I-8
Operator: SIMON
Ambient Temperature: 85°F
Barometric Pressure: 30.11
Static Pressure (P_s): -3.6" H_2O
Filter Number(s): N.A.
Pretest Leak Rate = 0.005 cfm @ 16.0 in. Hg
Pretest Pitot Leak Check: O.K
Pretest Orsat Leak Check: N.A.
Read and Record all Data Every 5 Minutes



Schematic of Traverse Point Layout

Probe Length and Type: 5' glass-Lined w/SS nozz.
Pitot Tube I.D. No. S-4A Cp 0.84
Nozzle I.D. | | | Avg. 0.243
Assumed Moisture, % 2.40
Temp. Readout S/N T-2
Meter Box Number MB-3
Meter $\Delta H_@$ 1.997
C Factor 1.15
Meter Gamma 0.985
Heater Box Setting N.A.
Reference Δp 0.48
Post Test Leak Rate = 0.005 cfm @ 15.5 in. Hg
Post Test Pitot Leak Check
Post Test Orsat Leak Check N.A

Page 1 of 2 Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min) / Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Im-pinger Temp. °F	Probe Temp °F
	0 / 14:41	209.428										
1	5 / 14:46	215.2	1.35	5.25	5.25	94	90.9	87	2.5	—	75	—
2	10 / 14:51	221.6	1.30	5.12	5.10	93	100.5	88	2.5	—	74	—
3	15 / 14:56	228.3	1.20	4.74	4.75	93	105.8	88	2.0	—	73	—
4	20 / 15:04	233.8	1.15	4.58	4.60	92	110.9	90	2.0	—	64	—
5	25 / 15:09	240.0	1.15	4.60	4.60	91	111.7	91	2.0	—	64	—
6	30 / 15:14	246.8	1.25	5.00	5.00	92	113.0	92	2.0	—	65	—
7	35 / 15:19	252.5	1.35	5.41	5.40	92	114.1	93	2.5	—	65	—
8	40 / 15:24	258.4	1.30	5.22	5.20	92	116.6	93	2.0	—	65	—
9	45 / 15:29	265.4	1.40	5.64	5.65	91	117.0	94	2.5	—	65	—
10	50 / 15:34	272.6	1.60	6.46	6.45	91	118.3	95	3.5	—	64	—
11	55 / 15:39	280.1	1.50	6.07	6.10	91	121.0	95	3.0	—	66	—
12	60 / 15:44	287.064	1.30	5.27	5.25	91	120.9	96	3.0	—	67	—
	/											
	/											
	/											
	/											
	/											
	/											
	/											
	/											

PACIFIC ENVIRONMENTAL SERVICES INC.

Plant Name: Fusion Inc.

Test Date: 5-23-89

Run Number: I-8

Operator: SIMON

Page 2 of 2

Pre-Traverse leak rate = 0.007 at 15.0", Post rate = 0.005 at 16.0"

Traverse Point Number	Sampling Time, (min)	/ Clock / Time / (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Im-pinger Temp. °F	Probe Temp °F
	60	/ 15:52	287.272										
13	65	/ 1557	294.6	1.65	6.55	6.55	90	98.8	93	3.50	—	67	—
14	70	/ 1602	301.9	1.80	7.25	7.25	91	115.8	95	4.50	—	59	—
15	75	/ 1607	309.5	1.60	6.48	6.50	91	121.4	95	4.0	—	62	—
16	80	/ 1612	318.1	1.60	6.49	6.50	91	122.0	96	4.0	—	61	—
17	85	/ 1617	325.1	1.50	6.08	6.10	91	122.1	96	3.5	—	62	—
18	90	/ 1622	322.6	1.60	6.50	6.50	90	120.9	97	3.5	—	62	—
19	95	/ 1627	339.3	1.35	5.48	5.50	91	121.8	97	2.5	—	62	—
20	100	/ 1632	346.7	1.50	6.09	6.10	90	119.9	97	3.5	—	62	—
21	105	/ 1637	354.4	1.60	6.49	6.50	91	120.9	97	4.0	—	62	—
22	110	/ 1642	363.0	1.60	6.49	6.50	91	122.0	97	4.0	—	63	—
23	115	/ 1647	369.7	1.65	6.70	6.70	91	122.8	97	4.0	—	63	—
24	120	/ 1652	377.078	1.40	5.69	5.70	91	123.9	97	2.5	—	63	—
-	-	/ -	-	STOP-END of TEST			-	-	-	-	-	-	-
		/											
		/											
		/											
		/	V_m = 167.442										
		/											
		/											
		/											
		/											
		/											
		/											
		/											
		/											
		/											
		/											
		/											
		/											

PACIFIC ENVIRONMENTAL SERVICES, INC.

SAMPLE RECOVERY DATA

Plant: FUSION, INC. Run No.: I-8

Date: 5/23/89 Sample Box No.: RAC-1 Job No.: 2958

Sample Location: SCRUBBER INLET

Sample Type: MM13B Filter No.: _____

Sample Recovery Person: _____

Comments: _____

FRONT HALF

Acetone Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: _____ _____ _____ Sealed: _____

Description of Filter: _____

Samples stored and locked: _____

BACK HALF/MOISTURE

Container No: _____ _____ _____

Liquid Level Marked: _____ Sealed: _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams) INITIAL	FINAL	NET
1	.1N NaOH	100	590.1	621.0	
2	.1N NaOH	100	588.2	598.4	
3	MT	0	467.8	471.7	
4	SIL. GEL		700.9	734.6	
5					
6					
TOTAL					

Description of Impinger Catch: _____

F1

```
XROM "COS"
NO. OF POINTS ?
24.00      RUN
DELTA P ?
1.35       RUN
STACK TEMP ?
94.00      RUN
DELTA P ?
1.30       RUN
STACK TEMP ?
93.00      RUN
DELTA P ?
1.20       RUN
STACK TEMP ?
93.00      RUN
DELTA P ?
1.15       RUN
STACK TEMP ?
92.00      RUN
DELTA P ?
1.15       RUN
STACK TEMP ?
91.00      RUN
DELTA P ?
1.25       RUN
STACK TEMP ?
92.00      RUN
DELTA P ?
1.35       RUN
STACK TEMP ?
92.00      RUN
DELTA P ?
1.30       RUN
STACK TEMP ?
92.00      RUN
DELTA P ?
1.40       RUN
STACK TEMP ?
91.90      RUN
DELTA P ?
1.60       RUN
STACK TEMP ?
91.00      RUN
DELTA P ?
1.50       RUN
STACK TEMP ?
91.00      RUN
DELTA P ?
1.30       RUN
STACK TEMP ?
91.00      RUN
DELTA P ?
1.65       RUN
STACK TEMP ?
90.00      RUN
DELTA P ?
1.80       RUN
STACK TEMP ?
91.00      RUN
DELTA P ?
1.60       RUN
STACK TEMP ?
91.00      RUN
DELTA P ?
1.60       RUN
STACK TEMP ?
91.00      RUN
DELTA P ?
1.50       RUN
STACK TEMP ?
91.00      RUN
DELTA P ?
1.60       RUN
STACK TEMP ?
90.00      RUN
DELTA P ?
1.35       RUN
STACK TEMP ?
91.00      RUN
```

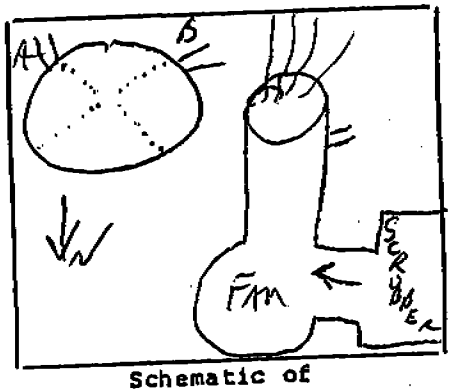
```
DELTA P ?
1.50       RUN
STACK TEMP ?
90.00      RUN
DELTA P ?
1.60       RUN
STACK TEMP ?
91.00      RUN
DELTA P ?
1.60       RUN
STACK TEMP ?
91.90      RUN
DELTA P ?
1.65       RUN
STACK TEMP ?
91.00      RUN
DELTA P ?
                FIX 4
1.4000     RUN
STACK TEMP ?
91.0000    RUN

SQRT PSTS = 28.1809
AVE STK TEMP = 91.3333
```

```
XROM "MASSFLO"
RUN NUMBER
I-8                RUN

VOL MTR STD ?
157.3120000        RUN
STACK DSCFM ?
19,082.00000       RUN
FRONT 1/2 MG ?
3.0853800          RUN
BACK 1/2 MG ?      RUN

F  GR/DSCF = 0.0003027
F  MG/MBM = 0.6926179
F  LB/HR = 0.0495050
F  KG/HR = 0.0224555
```

```
XROM "METH 5"
RUN NUMBER
I-8                COS
                   RUN
METER BOX Y?
.9850              RUN
DELTA H?
5.8200             RUN
BAR PRESS ?
30.1100            RUN
METER VOL ?
157.4420           RUN
MTR TEMP F?
105.0000           RUN
STATIC HOH IN ?
-3.6000            RUN
STACK TEMP
91.0000            RUN
ML. WATER ?
78.7000            RUN

SAT % = 4.9

IMP. % HOH = 2.3
% HOH=2.3

% CO2?
.7000              RUN
% OXYGEN?
21.0000            RUN
% CO ?             RUN

MWd =28.95
MW WET=28.70

SQRT PSTS ?
28.1809            RUN
COS SQRT PSTS ?    RUN
TIME MIN ?
120.0000           RUN
NOZZLE DIA ?
.2430              RUN
STK DIA INCH ?
30.0500            RUN

* VOL MTR STD = 157.312
  STK PRES ABS = 29.85
  VOL HOH GAS = 3.70
  % MOISTURE = 2.30
  MOL DRY GAS = 0.977
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.70
  VELOCITY FPS = 69.15
  STACK AREA = 4.93
  STACK ACFM = 20,433.
* STACK DSCFM = 19,082.
  % ISOKINETIC = 105.12

END OF FIELD DATA
```

FIELD DATA

Plant: Fusion Inc.
Date: 5-23-89 Job No. 2958
Sampling Location: Scrubber Outlet
Sample Type: Chroma
Run Number: 0-8
Operator: Gerber / Thomas
Ambient Temperature: 91
Barometric Pressure: 30.11
Static Pressure (P_s): -.66
Filter Number(s): N/A
Pretest Leak Rate = 0.016 cfm @ 16 in. Hg
Pretest Pitot Leak Check: OK
Pretest Orsat Leak Check: N/A
Read and Record all Data Every 5 Minutes



Schematic of Traverse Point Layout

Probe Length and Type: 3' G/155
Pitot Tube I.D. No. 5-6 Cp .84
Nozzle I.D. | | | Avg. .2377
Assumed Moisture, % 2.87
Temp. Readout S/N: Omega
Meter Box Number: MB-4
Meter $\Delta H_@$: 1.41
C Factor: 0.90
Meter Gamma: 1.004
Heater Box Setting: N/A
Reference Δp: 0.63
Post Test Leak Rate = 0.010 cfm @ 6 in. Hg
Post Test Pitot Leak Check: OK
Post Test Orsat Leak Check: N/A

Page 1 of 2

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F	Probe Temp °F
1	0	114:41	365.008	2.15	5.71	5.71	82	90	90	5		66	
2	5	114:46	372.269	2.1	5.63	5.63	82	100	90	5		58	
3	10	114:51	379.510	1.95	5.26	5.26	82	108	90	5		65	
4	15	114:56	386.618	1.9	5.2	5.2	81	117	94	4		63	
5	20	115:01	393.608	1.75	4.8	4.8	82	121	96	4		66	
6	25	115:06	400.435	1.5	4.14	4.14	81	124	98	4		64	
7	30	115:11	406.755	1.1	3.04	3.04	81	124	99	3		65	
8	35	115:16	412.251	0.99	2.74	2.74	81	123	100	3		65	
9	40	115:21	417.410	0.98	2.7	2.7	82	122	100	3		61	
10	45	115:26	422.533	0.99	2.74	2.74	82	123	102	3		60	
11	50	115:31	427.701	0.98	2.71	2.71	82	124	102	3		61	
12	55	115:36	432.802	0.98	2.70	2.70	85	125	102	3		61	
B 13	60	115:52	437.878	1.9	5.16	5.16	82	104	100	5		62	
14	65	115:57	444.916	1.9	5.15	5.15	82	103	100	5		54	
15	70	116:02	451.872	1.7	4.69	4.69	82	121	101	4		58	
16	75	116:07	458.575	1.6	4.43	4.43	81	124	102	4		57	
17	80	116:12	465.077	1.55	4.30	4.30	81	125	102	4		58	
18	85	116:17	471.488	1.4	3.89	3.89	81	126	102	3		58	
19	90	116:22	477.665	0.93	2.58	2.58	81	126	103	3		60	
20	95	116:27	482.751	0.94	2.6	2.61	81	125	104	3		61	

PACIFIC ENVIRONMENTAL SERVICES, INC.

```
                XROM "PRESS"
NO. OF POINTS ?
                24.00      RUN
DELTA P ?
                 2.15      RUN
STACK TEMP ?
                82.00      RUN
DELTA P ?
                 2.10      RUN
STACK TEMP ?
                82.00      RUN
DELTA P ?
                 1.95      RUN
STACK TEMP ?
                82.00      RUN
DELTA P ?
                 1.90      RUN
STACK TEMP ?
                81.00      RUN
DELTA P ?
                 1.75      RUN
STACK TEMP ?
                82.00      RUN
DELTA P ?
                 1.50      RUN
STACK TEMP ?
                81.00      RUN
DELTA P ?
                 1.10      RUN
STACK TEMP ?
                81.00      RUN
DELTA P ?
                  .99      RUN
STACK TEMP ?
                81.00      RUN
DELTA P ?
                  .98      RUN
STACK TEMP ?
                82.00      RUN
DELTA P ?
                  .99      RUN
STACK TEMP ?
                82.00      RUN
DELTA P ?
                  .98      RUN
STACK TEMP ?
                82.00      RUN
DELTA P ?
                  .98      RUN
STACK TEMP ?
                85.00      RUN
DELTA P ?
                 1.90      RUN
STACK TEMP ?
                82.00      RUN
DELTA P ?
                 1.90      RUN
STACK TEMP ?
                82.00      RUN
DELTA P ?
                 1.70      RUN
STACK TEMP ?
                82.00      RUN
DELTA P ?
                 1.60      RUN
STACK TEMP ?
                81.00      RUN
DELTA P ?
                 1.55      RUN
STACK TEMP ?
                 1.00      CLX
                81.00      RUN
DELTA P ?
                 1.40      RUN
STACK TEMP ?
                81.00      RUN
DELTA P ?
                  .93      RUN
STACK TEMP ?
                81.00      RUN
```

```
DELTA P ?
                  .94      RUN
STACK TEMP ?
                81.00      RUN
DELTA P ?
                  .91      RUN
STACK TEMP ?
                81.00      RUN
DELTA P ?
                  .86      RUN
STACK TEMP ?
                81.00      RUN
DELTA P ?
                  .76      RUN
STACK TEMP ?
                81.00      RUN
DELTA P ?
                  .67      RUN
STACK TEMP ?
                81.00      RUN

SQRT PSTS = 26.67
AVE STK TEMP = 81.58
```

```
                XROM "MASSFLO"
RUN NUMBER
0-8
                           RUN

VOL MTR STD ?
          134.3130000      RUN
STACK DSCFM ?
        17,930.00000       RUN
FRONT 1/2 MG ?
             .0765600      RUN
BACK 1/2 MG ?              RUN

F  GR/DSCF = 0.0000088
F  MG/MMM = 0.0201294
F  LB/HR = 0.0013519
F  KG/HR = 0.0006132
```

```
                XROM "METH 5"
RUN NUMBER
0-8
                           RUN
METER BOX Y?
                 1.0090    RUN
DELTA H?
                 3.7100    RUN
BAR PRESS ?
                30.1100    RUN
METER VOL ?
               141.2670    RUN
MTR TEMP F?
               109.0000    RUN
STATIC HOH IN ?
                  .6600    RUN
STACK TEMP.
                82.0000    RUN
ML. WATER ?
                83.9000    RUN

SAT % = 3.6

IMP. % HOH = 2.9
% HOH=2.9

% CO2?
                  .7000    RUN
% OXYGEN?
               21.0000     RUN
% CO ?                     RUN

MWd =28.95
MW WET=28.64

SQRT PSTS ?
               26.6719     RUN
COS SQRT PSTS ?            RUN
TIME MIN ?
              120.0000     RUN
NOZZLE DIA ?
                  .2377    RUN
STK DIA INCH ?
               29.6875     RUN

* VOL MTR STD = 134.313
  STK PRES ABS = 30.16
  VOL H2O GAS = 3.85
  % MOISTURE = 2.86
  MOL DRY GAS = 0.971
  % NITROGEN = 78.30
  MOL WT DRY = 28.95
  MOL WT WET = 28.64
  VELOCITY FPS = 65.17
  STACK AREA = 4.81
  STACK ACFM = 18,797
* STACK DSCFM = 17,930
  % ISOKINETIC =  97.43

END OF FIELD DATA
```

DataChem

Project No.: 890337

DATA TABLE

Field#	DataChem#	Type	Sample Volume	Analyte	Conc. (mg/sample)
I-2	89-3379	Water	950ml	Chromium	3.53
O-2	89-3380	Water	825ml	Chromium	0.25
2-I	89-3381	Water	400ml	Chromium	1.52
2-O	89-3382	Water	355ml	Chromium	0.13
I-5	89-3383	Water	960ml	Chromium	3.16
O-5	89-3384	Water	880ml	Chromium	0.19
5-I	89-3385	Water	435ml	Chromium	2.18
5-O	89-3386	Water	425ml	Chromium	0.13

Limit of Detection: 0.1 mg/L.

ND = Not Detected.
NA = Not Applicable or Available.

David G. Palmer
Analyst

Salt Lake City, Utah
801 266-7700
800 356-9135

4388 Glendale-Milford Road
Cincinnati, Ohio 45242

Cincinnati, Ohio
513 733-5336
800 458-1493

Total Chromium Calculations

```
XROM "MASSFLO"

RUN NUMBER
                    COS
I-2                 RUN

VOL MTR STD ?
     160.6910000    RUN
STACK DSCFM ?
     18,944.00000   RUN
FRONT 1/2 MG ?
       3.5900000    RUN
BACK 1/2 MG ?       RUN

F  GR/DSCF = 0.0003448
F  MG/MMM = 0.7889506
F  LB/HR = 0.0559826
F  KG/HR = 0.0253937
```

```
XROM "MASSFLO"

RUN NUMBER
I-5                 RUN

VOL MTR STD ?
     156.7190000    RUN
STACK DSCFM ?
     19,156.00000   RUN
FRONT 1/2 MG ?
       3.2500000    RUN
BACK 1/2 MG ?       RUN

F  GR/DSCF = 0.0003200
F  MG/MMM = 0.7323330
F  LB/HR = 0.0525466
F  KG/HR = 0.0238351
```

```
                    RUN

RUN NUMBER
O-2                 RUN

VOL MTR STD ?
     140.1400000    RUN
STACK DSCFM ?
     17,880.00000   RUN
FRONT 1/2 MG ?
        .2700000    RUN
BACK 1/2 MG ?       RUN

F  GR/DSCF = 0.0000297
F  MG/MMM = 0.0680375
F  LB/HR = 0.0045567
F  KG/HR = 0.0020669
```

```
XROM "MASSFLO"

RUN NUMBER
O-5                 RUN

VOL MTR STD ?
     137.6190000    RUN
STACK DSCFM ?
     17,610.00000   RUN
FRONT 1/2 MG ?
        .2100000    RUN
BACK 1/2 MG ?       RUN

F  GR/DSCF = 0.0000235
F  MG/MMM = 0.0538875
F  LB/HR = 0.0035545
F  KG/HR = 0.0016123
```

APPENDIX C

Draft Method - Determination of Hexavalent Chromium in Dry Particulate Emissions from Stationary Sources

DRAFT METHOD - DETERMINATION OF HEXAVALENT CHROMIUM IN DRY PARTICULATE EMISSIONS FROM STATIONARY SOURCES

1.0 APPLICABILITY AND PRINCIPLE

1.1 Applicability

This method applies to the determination of hexavalent chromium (Cr^{+6}) in dry particulate emissions only from specified stationary sources whose emissions do not contain acids or organics.

1.2 Principle

Particulate emissions are collected from the source by use of Method 5. (Appendix A, 40 CFR Part 60). The collected samples are digested in an alkaline solution and analyzed for Cr^{+6} by the diphenylcarbazide colorimetric method.

2.0 RANGE, SENSITIVITY, PRECISION, AND INTERFERENCES

2.1 Range

A straight-line response curve can be obtained in the range 5 μg Cr^{+6}/100 mℓ to 100 μg Cr^{+6}/100 mℓ. For a minimum analytical accuracy of ±10 percent, the lower limit of the range is 10 μg/100 mℓ. The upper limit can be extended by appropriate dilution.

2.2 Sensitivity

A minimum detection limit of 1 μg Cr^{+6}/100 mℓ has been observed.

2.3 Precision

The overall precision for sample collection and analysis for Cr^{+6} in dry particulate emissions was determined at a ferrochrome smelter, a chemical plant, and a refractory brick plant. Replicate Method 5 filters

with both high and low particulate loadings were analyzed. The relative standard deviations were less than 10 percent in all cases.

2.4 Interference

Molybdenum, mercury and vanadium react with diphenylcarbazide to form a color; however, approximately 20 mg of these elements can be present in a sample without creating a problem. Iron produces a yellow color, but this effect is not measured photometrically at 540 nm. No interference was observed at the sources listed in Section 2.3.

3.0 APPARATUS

3.1 Sampling Train

Same as Method 5, Section 2.1.

3.2 Sample Recovery

Same as Method 5, Section 2.2.

3.3 Analysis

The following equipment is needed.

3.3.1 Beakers--

Borosilicate, 250-mℓ, with watchglass covers.

3.3.2 Filtration Apparatus--

Vacuum unit constructed of plastic or glass, to accommodate 47-mm diameter, 3.0-μg size Teflon filters (NOTE: Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency).

3.3.3 Volumetric Flasks--

100-mℓ and other appropriate volumes.

3.3.4 Hot Plate

3.3.5 Pipettes--

Assorted sizes, as needed.

3.3.6 Spectrophotometer--

To measure absorbance at 540 nm.

4.0 REAGENTS

Unless otherwise indicated, all reagents shall conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society. Where such specifications are not available, use the best available grade.

4.1 Sampling

Same as Method 5, Section 3.1.

4.2 Sample Recovery

Same as Method 5, Section 3.2.

4.3 Analysis

The following reagents are required.

4.3.1 Water--

Deionized distilled, meeting American Society for Testing and Materials (ASTM) specifications for type 2 reagent - ASTM Test Method D 1193-77 (incorporated by reference - see Section 61.18).

4.3.2 Digestion Solution--

Dissolve 20.0 g NaOH and 30.0 g anhydrous Na_2CO_3 in water in a 1-liter volumetric flask, and dilute to the mark. Store the solution in a tightly capped polyethylene bottle. Prepare fresh monthly.

4.3.3 Potassium Dichromate Stock Solution--

Dissolve 141.4 mg of analytical reagent grade $K_2Cr_2O_7$ in water, and dilute to 1 liter (1 mℓ = 50 μg Cr^{+6}).

4.3.4 Potassium Dichromate Standard Solution--

Dilute 10.00 mℓ $K_2Cr_2O_7$ stock solution to 100 mℓ (1 mℓ = 5 μg Cr^{+6}) with water.

4.3.5 Sulfuric Acid, 10 percent (v/v)--

Dilute 10 mℓ H_2SO_4 to 100 mℓ in water.

4.3.6 Acetone--

Same as Method 5, Section 3.2.

4.3.7 Diphenylcarbazide Solution--

Dissolve 250 mg of 1, 5-diphenylcarbazide in 50 mℓ acetone. Store in a brown bottle. Discard when the solution becomes discolored.

5.0 PROCEDURE

5.1 Sampling

Same as Method 5, Section 4.1.

5.2 Sample Recovery

Same as Method 5, Section 4.2.

5.3 Preservation

Tests with dry particulate source samples from the sources described in Section 2.3 demonstrated that the Cr^{+6} content of the samples was stable. Nevertheless, all samples should be protected from extreme heat, kept dry and should be analyzed within 1 month of collection.

5.4 Sample Digestion and Preparation

Place the contents of Container Number 2 (the acetone probe rinse) in a 250-mℓ beaker. Evaporate to dryness. Place the contents of Container Number 1 in the same beaker (cut the filter into small pieces). Add 40 mℓ of digestion solution (Section 4.3.2). Cover the beaker with the watchglass, and heat to near boiling on a hot plate with constant stirring for 30 minutes. Do not allow the solution to evaporate to dryness.

Cool the solution, and transfer it quantitatively to the filtration apparatus with water. Filter the solution through the 47-mm Teflon filter. Transfer the filtrate from the filter flask quantitatively to a 100 mℓ volumetric flask. Fill to the mark with water.

5.5 Reagent Blank Preparation

Take a representative amount of acetone and a blank Method 5 filter and proceed as in Section 5.4.

5.6 Silica Gel Weighing

Weigh the spent silica gel (Container Number 3) or silica gel plum impinger to the nearest 0.5 g using a balance. This step may be conducted in the field.

5.7 Analysis

5.7.1 Color Development and Measurement--

Transfer a 50-mℓ or smaller aliquot of the prepared sample to a 100 mℓ volumetric flask and add sufficient water to bring the volume to approximately 80 mℓ. Adjust the pH to 2 $\pm$ 0.5 with 10 percent H_2SO_4, add 2.0 mℓ of diphenylcarbazide solution, and dilute to volume with water. Allow the solution to stand about 10 minutes for color development. For each set of samples analyzed, treat an identical aliquot of reagent blank solution in the same way. Transfer a portion of the sample to a 1-cm absorption cell and measure the absorbance a the optimum wavelength (Section 6.2.1). Measure and subtract the reagent blank absorbance reading, if any, to obtain a net reading. If the absorbance of the sample exceeds the absorbance of the 100 µg Cr^{+6} standard as determined in Section 6.2.2, dilute the sample and the reagent blank with equal volumes of water.

5.7.2 Check for Matrix Effects on the Cr^{+6} Results--

Since the analysis for Cr^{+6} by colorimetry is sensitive to the chemical composition of the sample (matrix effects), the analyst shall check

at least one sample from each source using the method of additions as follows:

Obtain two equal volume aliquots of the same sample solution. The aliquots should contain between 30 and 50 µg of Cr^{+6} (less is acceptable if not possible). Spike one of the aliquots with an aliquot of standard solution that contains between 30 and 50 µg of Cr^{+6}. Now treat both the spiked and unspiked sample aliquots as described in Section 5.7.1.

Next, calculate the Cr^{+6} mass (C_s), in µg in the aliquot of the unspiked sample solution by using the following equation.

$$C_s = C_a \frac{A_s}{A_t - A_s} \qquad \text{Eq. 1-1}$$

Where:

C_a = Cr^{+6} in the standard solution, µg.
A_s = Absorbance of the unspiked sample solution.
A_t = Absorbance of the spiked sample solution.

Volume corrections will not be required since the solutions as analyzed have been made to the same final volume. If the results of the method of additions procedure used on the single source sample do not agree to within 10 percent of the value obtained by the routine spectrophotometric analysis, then reanalyze all samples from the source using this method of additions procedure.

6.0 CALIBRATION

6.1 Sampling Train

Perform all of the calibrations described in Method 5, Section 5.

6.2 Spectrophotometer Calibration

6.2.1 Optimum Wavelength Determination--

Calibrate the wavelength scale of the spectrophotometer every 6 months. The calibration may be accomplished by using an energy source with an intense line emission such as a mercury lamp, or by using a series of glass filters spanning the measuring range of the spectrophotometer. Calibration materials are available commercially and from the National Bureau of Standards. Specific details on the use of such materials are normally supplied by the vendor; general information about calibration techniques can be obtained from general reference books on analytical chemistry. The wavelength scale of the spectrophotometer shall read correctly within ±5 nm, at all calibration points; otherwise, repair and recalibrate the spectrophotometer. Once the wavelength scale of the spectrophotometer is in proper calibration, use 540 nm as the optimum wavelength for the measurement of the absorbance of the standards and samples.

Alternatively, a scanning procedure may be employed to determine the proper measuring wavelength. If the instrument is a double-beam spectrophotometer, scan the spectrum between 530 and 550 nm using the 50 µg Cr^{+6} standard solution (Section 4.3.4) in the sample cell and a blank solution in the reference cell. If a peak does not occur, the spectrophotometer is malfunctioning. When a peak is obtained within the 530 to 550 nm range, record and use the wavelength at which this peak occurs as the optimum wavelength for the measurement of absorbance of both the standards and the samples. For a single-beam spectrophotometer, follow the scanning procedure described above, except scan the blank and standard solutions separately. For this instrument, the optimum wavelength is the wavelength at which the maximum difference in absorbance between the standard and the blank occurs.

6.2.2 Spectrophotometer Calibration--

Alternative calibration procedures are allowed provided acceptable accuracy and precision can be demonstrated. Add 0.0 mℓ, 1 mℓ, 2 mℓ,

5 mℓ, 10 mℓ, 15 mℓ, and 20 mℓ of the working standard solution (1 mℓ = 5 μg Cr^{+6}) to a series of seven 100-ml volumetric flasks. Dilute each to mark with water. Analyze these calibration standards as in Section 5.7.1. This calibration procedure must be repeated on each day that samples are analyzed. Calculate the spectrophotometer calibration factor K_C as follows:

$$K_C = 5 \frac{A_1 + 2A_2 + 5A_3 + 10A_4 + 15A_5 + 20A_6}{A_1^2 + A_2^2 + A_3^2 + A_4^2 + A_5^2 + A_6^2}$$

where:

K_C = Calibration factor.
A_1 = Absorbance of the 5 μg Cr^{+6}/100 mℓ standard.
A_2 = Absorbance of the 10 μg Cr^{+6}/100 mℓ standard.
A_3 = Absorbance of the 25 μg Cr^{+6}/100 mℓ standard.
A_4 = Absorbance of the 50 μg Cr^{+6}/100 mℓ standard.
A_5 = Absorbance of the 75 μg Cr^{+6}/100 mℓ standard.
A_6 = Absorbance of the 100 μg Cr^{+6}/100 mℓ standard.

6.2.2.1 Spectrophotometer Calibration Quality Control--Multiply the absorbance value obtained for each standard by the K_C factor (least squares slope) to determine the distance each calibration point lies from the theoretical calibration line. These calculated concentration values shall not differ from the actual concentrations (i.e., 5, 10, 25, 50, 75, and 100 μg Cr^{+6}/100 ℓ) by more than ___ percent (to be determined) for five of the six standards.

7.0 EMISSION CALCULATIONS

Carry out the calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculations.

7.1 Total Cr^{+6} in Sample.

Calculate m, the total μg Cr^{+6} in each sample, as follows:

$$m = \frac{100\ K_c\ AF}{v_a}$$

Where:

100 = Volume in mℓ of total sample.

A = Absorbance of sample.

F = Dilution factor (required only if sample dilution was needed to reduce the absorbance into the range of calibration).

v_a = Volume in mℓ of aliquot analyzed.

7.2 Average Dry Gas Meter Temperature and Average Orifice Pressure Drop

Same as Method 5, Section 6.2.

7.3 Dry Gas Volume, Volume of Water Vapor, Moisture Content

Same as Method 5, Section 6.3, 6.4, and 6.5, respectively.

7.4 Cr^{+6} Emission Concentration

Calculate c_s (g/dscm), the Cr^{+6} concentration in the stack gas, dry basis, corrected to standard conditions, as follows:

$$c_s = 10^{-6} g/\mu g)(m/V_{m(std)})$$

7.5 Isokinetic Variation, Acceptable Results

Same as Method 5, Sections 6.11 and 6.12, respectively.

8.0 BIBLIOGRAPHY

1. Test Methods for Evaluating Solid Waste. U.S. Environmental Protection Agency. SW-846, 2nd Edition. July 1982.

2. Cox, X.B., R.W. Linton, and F.E. Butler. Determination of Chromium Speciation in Environmental Particles - A Multitechnique Study of Ferrochrome Smelter Dust. Accepted for publication in Environmental Science and Technology.

3. Same as in Bibliography of Method 5, Citations 2 to 5 and 7.

CHROMIUM

Method 218.1 (Atomic Absorption, direct aspiration)

STORET NO. Total 01034
Dissolved 01030
Suspended 01031

Optimum Concentration Range: 0.5–10 mg/1 using a wavelength of 357.9 nm
Sensitivity: 0.25 mg/1
Detection Limit: 0.05 mg/1

Preparation of Standard Solution

1. Stock Solution: Dissolve 1.923 g of chromium trioxide (CrO_3, reagent grade) in deionized distilled water. When solution is complete, acidify with redistilled HNO_3 and dilute to 1 liter with deionized distilled water. 1 ml = 1 mg Cr (1000 mg/1).
2. Prepare dilutions of the stock solution to be used as calibration standards at the time of analysis. The calibration standards should be prepared using the same type of acid and at the same concentration as will result in the sample to be analyzed either directly or after processing.

Sample Preservation

1. For sample handling and preservation, see part 4.1 of the Atomic Absorption Methods section of this manual.

Sample Preparation

1. The procedures for preparation of the sample as given in parts 4.1.1 thru 4.1.4 of the Atomic Absorption Methods section of this manual have been found to be satisfactory.

Instrumental Parameters (General)

1. Chromium hollow cathode lamp
2. Wavelength: 357.9 nm
3. Fuel: Acetylene
4. Oxidant: Nitrous oxide
5. Type of flame: Fuel rich

Analysis Procedure

1. For analysis procedure and calculation, see "Direct Aspiration", part 9.1 of the Atomic Absorption Methods section of this manual.

Approved for NPDES and SDWA
Issued 1971
Editorial revision 1974 and 1978

Notes

1. The following wavelengths may also be used:
   359.3 nm Relative Sensitivity 1.4
   425.4 nm Relative Sensitivity 2
   427.5 nm Relative Sensitivity 3
   428.9 nm Relative Sensitivity 4

2. The fuel rich air–acetylene flame provides greater sensitivity but is subject to chemical and matrix interference from iron, nickel, and other metals. If the analysis is performed in a lean flame the interference can be lessened but the sensitivity will also be reduced.
3. The suppression of both Cr (III) and Cr (VI) absorption by most interfering ions in fuel rich air-acetylene flames is reportedly controlled by the addition of 1% ammonium bifluoride in 0.2% sodium sulfate [Talanta 20, 631 (1973)]. A 1% oxine solution is also reported to be useful.
4. For levels of chromium between 50 and 200 ug/1 where the air-acetylene flame can not be used or for levels below 50 ug/1, either the furnace procedure or the extraction procedure is recommended. See Method 218.2 for the furnace procedure and Method 218.3 for the chelation–extraction procedure.
5. For quality control requirements and optional recommendations for use in drinking water analyses, see part 10 of the Atomic Absorption Methods section of this manual.
6. Data to be entered into STORET must be reported as ug/1.

Precision and Accuracy

1. An interlaboratory study on trace metal analyses by atomic absorption was conducted by the Quality Assurance and Laboratory Evaluation Branch of EMSL. Six synthetic concentrates containing varying levels of aluminum, cadmium, chromium, copper, iron, manganese, lead and zinc were added to natural water samples. The statistical results for chromium were as follows:

Number of Labs	True Values ug/liter	Mean Value ug/liter	Standard Deviation ug/liter	Accuracy as % Bias
74	370	353	105	–4.5
76	407	380	128	–6.5
72	74	72	29	–3.1
70	93	84	35	–10.2
47	7.4	10.2	7.8	37.7
47	15.0	16.0	9.0	6.8

APPENDIX D
CHAIN OF CUSTODY SHEETS

MASTER SAMPLE LOG

Plant Fusion, Inc. Page 1 of 2

Location Houston, Texas Project Number ~~299~~ 2958

Sample Number	Run Code	Date	Sample Type	Container Type #/Size	Disposition
I-1		5/19/89	0.1 N NaOH	1000 ml/poly	
O-1 ~~I-2~~		"	" "	"	
Scr. H_2O #1		"	Scrubber water	"	
PS-1		"	Plating Sol'n.	500 ml/poly	
I-2		"	0.1 N NaOH	1000 ml/poly	
O-2		"	"	"	
Scr. H_2O #2		"	Scrubber water	500 ml/poly	
PS-2		"	Plating Sol'n	" "	
I-3		5/20/89	0.1 N NaOH	1000 ml/poly	
O-3		"	"	" "	
Scr. H_2O #3		"	Scrubber water	1000 ml/poly	
PS-3		"	Plating Sol'n	" "	
I-4		5/21/89	0.1 N NaOH	1000 ml/poly	
O-4		"	"	" "	
Scr. H_2O #4		"	Scrubber water	1000 ml/poly	
PS-4		"	Plating Sol'n	" "	

MASTER SAMPLE LOG

Plant Fusion Inc. Page 2 of 2

Location Houston, Texas Project Number 2958

Sample Number	Run Code	Date	Sample Type	Container Type #/Size	Disposition
I-5		5/21/89	0.1 N NaOH	1000 ml/poly	
O-5		"	"	"	
Scru H_2O#5		"	Scrubber water	500 ml/poly	
~~Pla~~ PS-5		"	Plating Sol'n	"	
I-6		"	0.1 N NaOH	1000 ml/poly	
O-6		"	"	"	
Scr. H_2O#6		"	Scrubber water	"	
PS-6		"	Plating Sol'n	"	
I-7		5/22/89	0.1 N NaOH	"	
O-7		"	"	"	
Scr. H_2O#7		"	Scrubber H_2O	"	
PS-7		"	Plating Sol'n	"	
I-8		"	0.1 N NaOH	"	
O-8		"	" "	"	
Scr. H_2O#8		"	Scrubber water	"	
PS-8		"	Plating Sol'n	"	

SAMPLE CHAIN OF CUSTODY

Plant: Fusion, Inc. Test Number: 2958

Date Sampled: 5/19/89 Run Number: 1

SAMPLE RECOVERY

Container Code	Description
I-1	sample train rinse
O-1	" " "
Scrubber H_2O #1	scrubber rinse water
PS-1	plating bath

Person Engaged in Sample Recovery

Signature: Helen Owens

Title: Sample Analyst

Location at which Recovery was Done: plant

Date and Time of Recovery: 5/19/89 1530

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature:

Title:

Date and Time of Receipt:

Sample Storage:

Laboratory Person Receiving Sample

Signature: Helen Owens

Title: Analyst

Date and Time of Receipt: 5/19/89

Sample Storage: trailer

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst
PS-1	Colorimetric - Cr^{+6}	5/21/89 - 9:00	Helen Owens
I-1	" "	" "	
O-1	" "	" "	
Scr. H_2O#1	" "	" "	

SAMPLE CHAIN OF CUSTODY

Plant: Fisim, Inc. Test Number: 2958

Date Sampled: 5/19/89 Run Number: 2

SAMPLE RECOVERY

Container Code	Description
I-2	Sample train rinse
O-2	" " "
Scr. H_2O #2	Scrubber washdown H_2O
PS-2	plating bath solution

Person Engaged in Sample Recovery

Signature: Nelly Owens

Title: Analyst

Location at which Recovery was Done: plant

Date and Time of Recovery: 5/19/89 19.30

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature:

Title:

Date and Time of Receipt:

Sample Storage:

Laboratory Person Receiving Sample

Signature: Nelly Owens

Title: Analyst

Date and Time of Receipt: 5/19/89 1930

Sample Storage: trailer

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst
I-2	Colorimetric Cr+6	5/21/89 11.00	Nelly Owens
O-2			
Scr. H_2O #2			
PS-1			

SAMPLE CHAIN OF CUSTODY

Plant: Fisim, Inc. Test Number: 2958

Date Sampled: 5/~~21~~ 20/89 Run Number: 3

SAMPLE RECOVERY

Container Code	Description
I-3	13B train rinse
O-3	" " "
Scr. H_2O #3	scrubber washdown water
PS-3	plating bath soln

Person Engaged in Sample Recovery

Signature: Helen Owens

Title: Analyst

Location at which Recovery was Done: plant

Date and Time of Recovery: 5/20/89 1730

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature:

Title:

Date and Time of Receipt:

Sample Storage:

Laboratory Person Receiving Sample

Signature: Helen Owens

Title: Analyst

Date and Time of Receipt: 5/20/89 1730

Sample Storage: trailer

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst
I-~~#~~3	Gravimetric	5/21/89	
~~O~~ O-~~#~~3	Crty	12:00	Helen Owens
Scr. H_2O #~~#~~3	" "		
PS-~~#~~3	" "		

SAMPLE CHAIN OF CUSTODY

Plant: Fusion Inc Test Number: 2958

Date Sampled: 5/21/89 Run Number: 4

SAMPLE RECOVERY

Container Code	Description
I-4	13B train nose
O-4	" " "
Scr. H_2O#4	scrubber washdown water
PS#4	plating bath soln

Person Engaged in Sample Recovery

Signature: Helen Owens

Title: Analyst

Location at which Recovery was Done: plant

Date and Time of Recovery: 5/21/89 1400

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature:

Title:

Date and Time of Receipt:

Sample Storage:

Laboratory Person Receiving Sample

Signature: Helen Owens

Title: Analyst

Date and Time of Receipt: 5/21/89 1400

Sample Storage: trailer

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst
I-4	Colorimetric	5/21/89	Helen Owens
O-4	Cr^{+6}	1400	
Scr. H_2O#4			
PS-4			

SAMPLE CHAIN OF CUSTODY

Plant: Fusion, Inc. Test Number: 2958

Date Sampled: 5/21/89 Run Number: 5

SAMPLE RECOVERY

Container Code	Description
I-5	
O-5	
Scr. H_2O #5	
PS-5	

Person Engaged in Sample Recovery

Signature: Helen J Owens

Title: Analyst

Location at which Recovery was Done: Plant

Date and Time of Recovery: 5/21/89 1100

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature:

Title:

Date and Time of Receipt:

Sample Storage:

Laboratory Person Receiving Sample

Signature: Helen Owens

Title: Analyst

Date and Time of Receipt: 5/21/89 1100

Sample Storage: trailer

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst
I-5	Colorimetric	5/21/89	
O-5	Cr^{+6}	1300	Helen Owens
Scr. H_2O #5			
PS-5			

SAMPLE CHAIN OF CUSTODY

Plant: Fusion, Inc. Test Number: 2958

Date Sampled: 5/21/89 Run Number: 6

SAMPLE RECOVERY

Container Code	Description
I-6	BB train rinse
O-6	" " "
Scr. H_2O #6	Scrubber washdown water
PS-6	plating bath soln

Person Engaged in Sample Recovery

Signature: Helen Owens

Title: Analyst

Location at which Recovery was Done: plant

Date and Time of Recovery: 5/21/89 2000

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature:

Title:

Date and Time of Receipt:

Sample Storage:

Laboratory Person Receiving Sample

Signature: Helen Owens

Title: Analyst

Date and Time of Receipt: 5/21/89 2000

Sample Storage: trailer

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst
I-6	Colorimetric	5/21/89	Helen Owens
O-6	Cr+6	2000	
Scr. H_2O #6			
PS-6			

SAMPLE CHAIN OF CUSTODY

Plant: Fusion, Inc. Test Number: 2958

Date Sampled: 5/23/89 Run Number: 7

SAMPLE RECOVERY

Container Code	Description
I-7	13B train rinse
O-7	" " "
Scr. H_2O #7	scrubber washdown water
PS-7	plating bath solution

Person Engaged in Sample Recovery

Signature: Helen Owens

Title: Analyst

Location at which Recovery was Done: plant

Date and Time of Recovery: 5/23/89 1100

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature:

Title:

Date and Time of Receipt:

Sample Storage:

Laboratory Person Receiving Sample

Signature: Helen Owens

Title: Analyst

Date and Time of Receipt: 5/23/89 1100

Sample Storage: trailer

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst
I-~~E~~7	Colorimetric	5/23/89	Helen Owens
~~E-7~~ O-7	Cr+6	1100	
Scr. H_2O #7			
PS-7			

SAMPLE CHAIN OF CUSTODY

Plant: Fusion Inc Test Number: 2958

Date Sampled: 5/23/89 Run Number: 8

SAMPLE RECOVERY

Container Code	Description
I-8	13B train rinse
O-8	" " "
Scr. H_2O #8	scrubber washdown water
PS-8	plating bath solution

Person Engaged in Sample Recovery

Signature: Helen Owens

Title: Analyst

Location at which Recovery was Done: plant

Date and Time of Recovery: 5/23/89 1530

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature:

Title:

Date and Time of Receipt:

Sample Storage:

Laboratory Person Receiving Sample

Signature: Helen Owens

Title: Analyst

Date and Time of Receipt: 5/23/89 1530

Sample Storage: trailer

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst
I-8	Colorimetric	5/23/89	Helen Owens
O-8	Cr^{+6}	1530	
Scr. H_2O #8			
PS-8			

SAMPLE CHAIN OF CUSTODY

Plant: Fusion, Inc. Test Number: 2958

Date Sampled: 5/19/89 Run Number: 2

SAMPLE RECOVERY

Container Code	Description
I-2	MH13 Main rinse
O-2	" " "

Person Engaged in Sample Recovery

Signature: Helen Owens

Title: Analyst

Location at which Recovery was Done: Plant

Date and Time of Recovery: 5/19/89 1930

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature:

Title:

Date and Time of Receipt:

Sample Storage:

Laboratory Person Receiving Sample

Signature:

Title:

Date and Time of Receipt:

Sample Storage:

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst

SAMPLE CHAIN OF CUSTODY

Plant: Fusion, Inc. Test Number: 2958

Date Sampled: ~~5/21/89~~ 5/19/89 Run Number: 2

SAMPLE RECOVERY

Container Code	Description
~~2~~ 2-I	Screening Method train rinse
2-O	" " " "

Person Engaged in Sample Recovery

Signature: J. Brown / EPA

Title:

Location at which Recovery was Done:

Date and Time of Recovery:

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature: Helen Owens

Title: Analyst

Date and Time of Receipt: 5/19/89 1930

Sample Storage: trailer

Laboratory Person Receiving Sample

Signature:

Title: Group Leader - Inorganics

Date and Time of Receipt: 5/30/89 / 1450

Sample Storage: Refrigerator

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst

SAMPLE CHAIN OF CUSTODY

Plant: Fusion Inc Test Number: 2958

Date Sampled: 5/21/89 Run Number: 5

SAMPLE RECOVERY

Container Code	Description
I-5	MM13B train rinse
O-5	" " "

Person Engaged in Sample Recovery

Signature: [illegible] Owens

Title: Analyst

Location at which Recovery was Done: Plant

Date and Time of Recovery: 5/21/89 1110

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature:

Title:

Date and Time of Receipt:

Sample Storage:

Laboratory Person Receiving Sample

Signature: [illegible]

Title:

Date and Time of Receipt:

Sample Storage:

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst

SAMPLE CHAIN OF CUSTODY

Plant: Fusion, Inc. Test Number: 2958

Date Sampled: 5/21/89 Run Number: 5

SAMPLE RECOVERY

Container Code	Description
S-I	Screening Methods train rinse
S-O	" " " "

Person Engaged in Sample Recovery

Signature: J. Brown / EPA

Title:

Location at which Recovery was Done:

Date and Time of Recovery:

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature: Helen J. Owens

Title: Analyst

Date and Time of Receipt: 5/21/89 1100

Sample Storage: trailer

Laboratory Person Receiving Sample

Signature:

Title:

Date and Time of Receipt:

Sample Storage:

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst

SAMPLE CHAIN OF CUSTODY

Plant: FUSION INC. Test Number: _____

Date Sampled: 5/19/ - 23/89 Run Number: 1-8

SAMPLE RECOVERY

Container Code	Description
I-1 - I-8	MMB13B TRAIN RINSE

Person Engaged in Sample Recovery

Signature: HELEN OWENS

Title: _____

Location at which Recovery was Done: _____

Date and Time of Recovery: 5/19/ - 5/23/89

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature: Andrew W. Wilson

Title: Project Manager

Date and Time of Receipt: 5/31/89

Sample Storage: PEER STORAGE ROOM

Laboratory Person Receiving Sample

Signature: David D. [illegible]

Title: Lab Supervisor

Date and Time of Receipt: 6/29/89 14:38

Sample Storage: general

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst

SAMPLE CHAIN OF CUSTODY

Plant: FUSION INC. Test Number: _____

Date Sampled: 5/19-23/89 Run Number: 1-I - 8-I

SAMPLE RECOVERY

Container Code	Description
1-I - 8-I	SCREENING METHOD RINSES

Person Engaged in Sample Recovery

Signature: JOHN BROWN / EPA

Title: _____

Location at which Recovery was Done: _____

Date and Time of Recovery: _____

Sample(s) Recipient Upon Recovery if Not Recovery Person

Signature: Andrew N. Wilson

Title: PROJECT MANAGER

Date and Time of Receipt: 6/26/89

Sample Storage: EPA CUSTODY

Laboratory Person Receiving Sample

Signature: [illegible]

Title: Lab Supervisor

Date and Time of Receipt: 6/29/89 14:38

Sample Storage: [illegible]

ANALYSIS

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst

APPENDIX E
EQUIPMENT CALIBRATION DATA

POSTTEST DRY GAS METER CALIBRATION DATA FORM

Test numbers I1 - I8 Date 6/5/89 Meter box number MB-4 Plant Fusion, Inc.

Barometric pressure, P_b = 29.10 in. Hg Dry gas meter number _____ Pretest Y 1.009

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Average[a] (t_d), °F	Time (θ), min	Vacuum setting, in. Hg	Y_i	$Y_i \frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
3.91	25.735	557.518	74	106	82	88	11	11	0.971	(13.144)(29.10)(548) / (13.759)(29.39)(534)
	12.591	543.759	73	84	80					
3.91	40.593	573.106	75	118	87	99	23	11	0.986	(14.858)(29.10)(559) / (15.588)(29.39)(535)
	25.735	557.518	74	108	82					
3.91	52.528	585.719	75	120	91	101	10.1	11	0.982	(11.935)(29.10)(561) / (12.613)(29.39)(535)
	40.593	573.106	75	106	87					
									Y = 0.980	

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

V_w = Gas volume passing through the wet test meter, ft^3.

V_d = Gas volume passing through the dry gas meter, ft^3.

t_w = Temperature of the gas in the wet test meter, °F.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o}, °F.

ΔH = Pressure differential across orifice, in H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y $\pm$0.05Y

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

PACIFIC ENVIRONMENTAL SERVIC

PITOT TUBE CALIBRATION DATA SHEET

Calibrated By: T. Miller

Date: 3/2/89

Pitot I.D. No.: S-4A

Effective Length: 3'

Pitot Tube Assembly Level? Yes ✓ No ____

Pitot Tube Openings Damaged? Yes (explain below) ____ No ✓

α_1 = 1 ° (<10°) α_2 = 1 ° (<10°)

β_1 = 0 ° (<5°) β_2 = 0 ° (<5°)

γ = 0 ° θ = 1 ° A = 1.111 °

z = A sin γ = 0 cm (in.) 0.32 cm (<1/8 in.)

w = A sin θ = 0.019 cm (in.) 0.08 cm (<1/32 in.)

P_A = 0.555 cm (in.)

P_B = 0.556 cm (in.)

D_t = 0.377 cm (in.)

Comments: ____

Calibration Required? Yes ____ No ✓

PITOT TUBE CALIBRATION DATA SHEET

Calibrated By: T. Miller

Date: 3/3/89

Pitot I.D. No.: S-6

Effective Length: 3' attached to 4' glass probe

Pitot Tube Assembly Level? Yes ✓ No

Pitot Tube Openings Damaged? Yes (explain below) No ✓

α_1 = 1 ° (<10°) α_2 = 0 ° (<10°)

β_1 = 1 ° (<5°) β_2 = 0 ° (<5°)

γ = 0 ° θ = 0 ° A = 0.933 °

z = A sin γ = 0 cm (in.) 0.32 cm (<1/8 in.)

w = A sin θ = 0 cm (in.) 0.08 cm (<1/32 in.)

P_A = 0.4666 cm (in.)

P_B = 0.467 cm (in.)

D_t = 0.378 cm (in.)

Comments:

Calibration Required? Yes No ✓

TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 10-13-88 Thermocouple number SH-1

Ambient temperature 71 °F Barometric pressure 29.50 in. Hg

Calibrator T. Miller Reference: mercury-in-glass ASTM 3F 34078

Description SAMPLE HEAD other

Reference point number[a]	Source[b] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[c] %
1	ice bath	32	31	0.2
2	ambient	67	74	6.6
3	boiling water	212	210	0.3

[a]Every 30°C (50°F) for each reference point.

[b]Type of calibration system used.

[c] $\left[\frac{(\text{ref temp, °C} + 273) - (\text{test thermom temp, °C} + 273)}{\text{ref temp, °C} + 273}\right] 100 \leq 1.5\%.$

TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 4-4-89 Thermocouple number SH-5

Ambient temperature 70 °F Barometric pressure 29.21 in. Hg

Calibrator T. Miller Reference: mercury-in-glass ASTM 3F 34078

SAMPLE HEAD other

Reference point number[a]	Source[b] (specify)	Reference thermometer temperature, °F	Thermocouple potentiometer temperature, °F	Temperature difference,[c] %
1	ambient air	73	75	-0.4
2	ice bath	32	31	0.2

[a]Every 30°C (50°F) for each reference point.

[b]Type of calibration system used.

[c] $\left[\frac{(\text{ref temp, °C} + 273) - (\text{test thermom temp, °C} + 273)}{\text{ref temp, °C} + 273}\right] 100 \leq 1.5\%.$

Date 1-27-89 Meter box number MB-3

Barometric pressure, P_b = 29.56 in. Hg Calibrated by T. Miller

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Ref. meter (V_R), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperatures: Ref. meter (t_R), °F	Temperatures: Dry gas meter: Inlet (t_{d_i}), °F	Temperatures: Dry gas meter: Outlet (t_{d_o}), °F	Temperatures: Dry gas meter: Avg[a] (t_d), °F	Time (Θ), min	Y_i	ΔH@ in. H_2O
0.5	967.852 975.288	166.000 171.586	69/71	85/99	74/83	85°F 545°R	15.0	0.994	2.120
1.0	976.242 983.925	172.569 180.671	72/72	104/117	85/97	101°F 561°R	15.0	0.986	2.101
1.5	984.310 990.544	181.028 187.779	72/72	114/123	99/102	110°F 570°R	10.0	0.982	2.094
2.0	990.862 998.000	188.113 195.842	72/72	123/128	102/107	115°F 575°R	10.0	0.982	2.111
4.0	999.937 010.995	197.957 208.993	72/72	133/144	108/113	125°F 585°R	10.0	0.989	1.729
6.0	011.287 024.674	210.416 225.218	72/72	129/147	114/117	127°F 587°R	10.0	0.978	1.760
							Avg	0.985	1.986

Y = Ratio of reading of wet test meter to dry test meter; tolerance for individual values ±0.02 from average

$\Delta H_@$ = Orifice pressure differential that equates to 0.75 cfm of Air @ 68°F and 29.92 inches of mercury, in. H_2O; tolerance for individual values ±0.20 from average

$$Y_i = \frac{V_R\, P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})\,(t_R + 460)} \qquad \Delta H@_i = \frac{0.0317\, \Delta H}{P_b\,(t_d + 460)} \left[\frac{(t_R + 460)\,\Theta}{V_R}\right]^2$$

TEMPERATURE SENSOR CALIBRATION DATA FORM

Meter In MB-3-I Meter Outlet MB-3-O Date 10-13-88

Ambient temperature 80 °F Barometric pressure 29.58 in. Hg

Calibrator T. Miller Reference: mercury-in-glass ASTM 3F 34078

Reference Point Number	Source (specify)	Reference thermometer temperature, °F	Thermocouple potentiometer temperature °F	Temperature difference, %
Meter In	Ice Water	34	34	0
	Ambient	80	76	0.7
	Heated Water	152	152	0
Meter Out	Ice Water	33	34	0.2
	Ambient	80	76	0.7
	Heated Water	150	149	0.2

$$\left[\frac{(\text{ref. temp, °F} + 460) - (\text{test thermom, °F} + 460)}{\text{ref. temp, °F} + 460}\right] 100 \leq 1.5\%$$

Date 1/29/89 Meter box number MB-4

Barometric pressure, P_b = 29.61 in. Hg Calibrated by FM 7M

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Ref. meter (V_R), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperatures: Ref. meter (t_R), °F	Temperatures: Dry gas meter Inlet (t_{d_i}), °F	Temperatures: Dry gas meter Outlet (t_{d_o}), °F	Temperatures: Dry gas meter Avg[a] (t_d), °F	Time (Θ), min	Y_i	ΔH@ in. H_2O
0.5	200.207 / 205.558	215.926 / 221.308	71 / 72	89 / 94	79 / 80	86 / 546	12.0	1.019	1.40
1.0	206.538 / 211.596	222.300 / 227.400	72 / 72	94 / 101	80 / 81	89 / 549	8.0	1.021	1.38
1.5	211.880 / 217.156	227.700 / 233.080	72 / 73	99 / 106	81 / 82	92 / 552	7.0	1.012	1.45
2.0	193.574 / 199.658	209.182 / 215.378	71 / 71	83 / 95	79 / 79	84 / 544	7.0	1.001	1.47
4.0	217.668 / 223.732	233.600 / 239.865	73 / 73	105 / 116	82 / 84	97 / 557	5.0	1.002	1.48
6.0	231.844 / 237.687	248.282 / 254.383	73 / 73	118 / 124	87 / 89	105 / 565	4.0	1.000	1.51
							Avg	1.009	1.45

Y = Ratio of reading of wet test meter to dry test meter; tolerance for individual values ±0.02 from average

$\Delta H_@$ = Orifice pressure differential that equates to 0.75 cfm of Air @ 68°F and 29.92 inches of mercury, in. H_2O; tolerance for individual values ±0.20 from average

$$Y_i = \frac{V_R\, P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})\,(t_R + 460)} \qquad \Delta H@_i = \frac{0.0317\ \Delta H}{P_b\,(t_d + 460)} \left[\frac{(t_R + 460)\ \Theta}{V_R}\right]^2$$

TEMPERATURE SENSOR CALIBRATION DATA FORM

Meter In _____ Meter Outlet _____ Date _____

Ambient temperature _____ °F Barometric pressure _____ in. Hg

Calibrator _____ Reference: mercury-in-glass _____

Reference Point Number	Source (specify)	Reference thermometer temperature, °F	Thermocouple potentiometer temperature °F	Temperature difference, %
Meter In	Ice Water			
	Ambient			
	Heated Water			
Meter Out	Ice Water			
	Ambient			
	Heated Water			

$$\left[\frac{(\text{ref. temp, °F} + 460) - (\text{test thermom, °F} + 460)}{\text{ref. temp, °F} + 460}\right] 100 \leq 1.5\%$$

POSTTEST DRY GAS METER CALIBRATION DATA FORM

Test numbers 0-1 thru 0-8 Date 6/2/89 Meter box number MB-3 Plant Fusion, Inc., Houston TX

Barometric pressure, P_b = 29.14 in. Hg Dry gas meter number _____ Pretest Y 0.985

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Average[a] (t_d), °F	Time (θ), min	Vacuum setting, in. Hg	Y_i	Y_i $\frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
	936.502	427.854	77	107.7	79					(13.887)(29.14)(547)
5.77	922.615	413.323	77	86.2	75	87	10.5	9.5	0.956	(14.531)(29.56)(537)
	963.498	455.800	75	104.3	76					(15.925)(29.14)(547)
5.77	947.573	439.260	76	95.6	73	87	12.0	9.5	0.969	(16.540)(29.56)(536)
	976.732	469.618	75	107.4	78					(13.234)(29.14)(551)
5.77	963.498	455.800	75	100.6	76	91	10.0	9.5	0.972	(13.818)(29.56)(535)
									Y = 0.966	

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

V_w = Gas volume passing through the wet test meter, ft^3.

V_d = Gas volume passing through the dry gas meter, ft^3.

t_w = Temperature of the gas in the wet test meter, °F.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o}, °F.

ΔH = Pressure differential across orifice, in H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y ±0.05Y

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

PACIFIC ENVIRONMENTAL SERVICES, INC.

APPENDIX F
PROJECT PARTICIPANTS AND ACTIVITY LOG

PROJECT PARTICIPANTS

Name	Title	Responsibility
Frank Clay	U.S. EPA Task Manager Test Observationist	Observed test activity and on-site data reduction and calculations
John Brown	U.S. EPA, Technician	Conducted Screening Methods tests
Andrew Weisman	PEER Consultants, P.C. Project Leader	Coordinated test activity with plant and contractors Data reduction and report preparation
Eric Hollins	PEER Consultants, P.C. Technician	Assisted in site set-up, sampling, sample recovery
Robert Mentzer	PEER Consultants, P.C. Technician	Assisted in site set-up, sampling, sample recovery
Nancy Thomas	PEER Consultants, P.C. Technician	Assisted in site set-up, sampling, sample recovery
Mark Simon	Pacific Environmental Services	Conducted emission sampling, sample train set-up and recovery
Helen Owens	Pacific Environmental Services Project Leader	On site analysis
Bruce Gerber	Pacific Environmental Services Technician	Conducted emission sampling, sample train set-up and recovery
Robin Barker	MRI NESHAPS Contractor	Monitored process operation

ACTIVITY LOG

5/17	Test crew travels to site
5/18	Site set-up, testing rained out
5/19	Conduct 2 MM13B tests, 2 screening methods and analyses
5/20	Conduct 1 MM13B test, 1 screening method and analyses
5/21	Conduct 3 MM13B tests, 3 screening methods and analyses
5/22	No testing
5/23	Conduct 2 MM13B tests, 2 screening methods and analyses
5/24	Dismantle site and travel

APPENDIX G
DATACHEM QUALITY CONTROL PLAN

DATACHEM, INC.

INDUSTRIAL HYGIENE ANALYTICAL CHEMISTRY QUALITY CONTROL PLAN

May 23, 1988

Charles L. Geraci, Ph.D., CIH
Laboratory Director

David G. Palmer
Quality Assurance Coordinator

DataChem, Inc.
4388 Glendale-Milford Road
Cincinnati, Ohio 45242

laboratory procedures. It is also utilized to identify specific problems with respect to analytical methodology.

4. The QAC applies appropriate statistical procedures for the calculation of control limits and the production of quality control charts and utilizes such in the evaluation of laboratory data, and assists laboratory personnel in the proper use of report forms, record keeping methods, and administrative policy.

5. The QAC is responsible for administering the AIHA Proficiency Analytical Testing (PAT) Program, the EPA/NBS Bulk Asbestos Accreditation Program, the AIHA Asbestos Analyst Registry program, and all other interlaboratory certification programs.

6. The QAC assists in the maintenance of instrumentation records. This includes both regular periodic quality control checks to assure that instruments perform within specifications, and the maintenance of records pertaining to instrumentation.

7. The QAC is responsible to assure that high quality chemicals, reagents, and solvents are utilized in the laboratory.

Quality Control Sample Analyses

At least one blank sample and one reagent blank are included with each set of analyses and processed through the complete analytical procedure in order to detect any contamination in either collection media or reagents. In addition, replicate analyses are accomplished on a minimum of 10% of all samples submitted from the field. Internal quality control samples, generated in the laboratory and containing known quantities of specified analyte(s), are run at the rate of 10% of the total field sample workload.

Data Reduction

A significant fraction of the laboratory's work involves data processing. Mathematical models, based upon analysis of standard solutions or samples, are generated in order to determine the quantity of analyte present in the samples. Considerable time and effort is saved by the utilization of automated data processing procedures. Data processing by the computer can include, for example, calculations, generation of standard calibration curves, mathematical modeling of standard curves, statistical analyses, and the generation of hard copy output. Advantages intrinsic to the use of an automated system include more accurate calculations, immediate and accurate generation of the data plots, and fewer transcription errors after programs have been verified and documented.

The Cincinnati laboratory makes use of two QC data systems which allow a timely evaluation of results obtained for QC samples. The first system is a well documented computer system used in the Salt Lake City laboratory as a central data system. This system serves to evaluate interlaboratory performance by means of samples sent to the QA Coordinator by the QA Section Manager. QC sample results are entered into the system and the Cincinnati laboratory performance is evaluated against calculated control limits. A detailed description of the program is contained in the DataChem Quality Assurance Manual.

The second QC data system evaluates the intralaboratory performance of the Cincinnati division. This system consists of a program of internally generated QC samples, replicate analysis of field samples, and media and reagent blank analysis. QC samples are introduced into field sample sets on both a known and blind basis at a rate of at least 10% of the number of samples. Replicate analyses are performed at a minimum rate of 10%. QC data are recorded on the DataChem Analytical Laboratory Quality Control Data Sheet. These data are then entered into a computerized control chart generating program. Warning and control limits are established and data points are plotted by analyst for accuracy and precision. Warning and control limits for common analytes are updated on a regular

basis. QC Data Sheets are reviewed by the QAC prior to final report preparation and the QC data evaluated for accuracy and precision.

Data Review and Reporting

At the completion of the analysis of a sample set, each chemist calculates his or her results and reports the results on the DataChem Analytical Report Form. Results for replicated samples and internal quality control samples are reported on the Quality Control Data Sheet. Before the results are submitted to the Group Leader, an additional chemist (peer) is assigned to check the results for possible errors in calculations. The peer reviewer must approve results reported on both the quality control report and the sample results report. The Group Leader, after his evaluation of the data, gives the reports to the QAC for evaluation, and implementation of any required action.

Specific steps are followed when any QC result is out of control in connection with the analysis of a field sample set. Quality control charts with control limits of $\pm$ 3 standard deviations are generally used to determine whether a result is in control or not. If QC results are in control, the QAC approves the report. It is then reviewed by the Laboratory Director for accuracy and reasonableness. Upon final approval of the reports by the QAC and the Director, the reports are sent to the client. A copy of all reports is placed in a master file for storage and retrieval of information as required. This file is organized and maintained according to project number. Material filed for each sample set includes reports of (1) analytical results; (2) methodology; and (3) QC results.

Each chemist maintains a bound laboratory notebook in which is detailed events related to sample analyses. Completed notebooks are filed by each chemist. At termination of employment, all laboratory notebooks are placed in a permanent file.

The paperwork containing the raw data for a sample set (i.e., recorder and computer readouts, calibration curves, tables of data, etc.) are collected and placed in an 8 1/2" by 11" envelope which has been labeled with project number, sample numbers, analyst, and date, and other pertinent information. The envelopes are filed by project number for possible future reference and data retrieval. Raw data for each sample analysis are therefore readily available, if needed.

Data Acceptance Rejection Criteria

It is established DataChem policy that no analytical data are reported by the laboratory until approved by the QAC or his designee. The criteria for acceptance of field sample analysis data are based upon replicate analyses of the field samples and/or analyses of internally generated QC samples.

For any single sample, the range of the replicate analytical values is divided by the average of the values, resulting in a measure of the precision of the analysis. This precision value is evaluated using precision control limits established previously from the analysis of quality control samples of the same analyte analyzed by the same method. If quality control limits are not available for a particular analyte, an evaluation is made employing control limits established for a similar compound, analyzed by the same method.

Since the "true" analyte values for field samples are not known, no accuracy measurement can be made using field sample analyses. Although actual acceptable precision measurements are indicative of an analytical system that is in control, the accuracy of the data generation for field samples is assessed through the analysis of QC samples processed with the field samples. Unacceptable results for accuracy in the analysis of internal quality control samples analyzed with a field sample set will generally override any acceptability based upon field sample precision measurements.

Data from the analysis of QC samples are evaluated against established Quality Control Limits and determined to be either in control within warning limits, or out of control. Specific steps as outlined in the QA Manual are followed when any one QC sample analysis result is determined to be out of control in connection with the analysis of a field sample set.

If QC results are in control, the QAC approves the analytical report. It is then reviewed by the Director for accuracy of the results. After approval, the completed report is sent to the client.

Auxiliary Quality Control Programs and Procedures

In addition to internally generated quality control data, other information concerning quality control is provided by the participation of DataChem in several interlaboratory quality control programs: AIHA Proficiency Analytical Testing (PAT) Program; the EPA/NBS Asbestos Bulk Accreditation Program; and the AIHA Asbestos Analyst Registry. DataChem also sponsors an interlaboratory round-robin program for asbestos by PCM using both DataChem laboratories and a minimum of four external laboratories.

Quality Control Procedures for Nonroutine I.H. Samples

DataChem determines a percent recovery for methods used for the analysis of samples which are of a nonroutine nature. This is accomplished using one or both of two different approaches:

1. Standard additions.
2. The introduction of synthetic samples of known composition into the analytical scheme.

The number of samples for which recoveries are determined is approximately 20% of the number of field samples processed. Sample results are corrected for percent recovery, and methods yielding a recovery of less than 80% are generally not used.

Procedures Manuals

A complete set of laboratory procedures and analytical methods is maintained in the Director's Office. A set of methods manuals and group-specific procedures is maintained by each Group Leader. The Field Services Department maintains procedural manuals for field activities. Additional manuals and resource materials are held in the resource center. The procedures and methods manuals maintained in the Director's Office are designated as the official, current documents and are consulted first prior to sample analysis.

Methods are occasionally revised. Revisions, generally developed by the chemists, are reviewed by the appropriate Group Leader and the Laboratory Director. Refinements frequently occur as a result of these reviews. The final method is approved by the Laboratory Director and placed in the manual. Any methods which are replaced are filed.

New methods are reviewed and approved by the appropriate Group Leader and the Laboratory Director prior to inclusion in the manual.

For industrial hygiene analyses, DataChem employs analytical methodologies published in: "The NIOSH Manual of Analytical Methods,Third Edition" [DHHS (NIOSH) Publication No. 84-100]; The OSHA Manual of Analytical Methods; Methods of Air Sampling and Analysis--Second Edition, APHA Intersociety Committee; and internal DataChem analytical methods.

The DataChem, Inc. Cincinnati, Ohio laboratory includes a consulting industrial hygiene field operations group. All sampling equipment and accessories are maintained in a 200 square foot industrial hygiene field laboratory which is part of the overall laboratory facility. DataChem industrial hygienists routinely use OSHA and/or NIOSH sampling methods for conducting any in-field consulting work. The selection of the appropriate sampling methods and sampling equipment is made during a pre-survey meeting between the industrial hygiene consultant, manager of Field Services and the laboratory director. All sampling equipment is calibrated before and after each use. Equipment calibration is also routinely spot-checked during operation using the OSHA compliance protocol. Sampling pumps are calibrated using a primary standard or accurately calibrated secondary standard. Direct-reading instruments, including detector tubes, are calibrated using a known concentration of the gas or vapor of interest prepared by a laboratory chemist. Other field instruments (e.g. noise dosimeters) are calibrated using the manufacturers' recommendations. A copy of the DataChem Calibration Record Form is attached.

The DataChem analytical laboratory supplies all sampling media used by the industrial hygiene field operations group. Media are bought from manufacturers ready for use or are prepared from components in a laboratory clean bench. The DataChem Sampling Media Request Form is attached.

Appropriate Chain of Custody from the field to the DataChem, laboratory is maintained using the DataChem Chain of Custody Record Form (attached).

DataChem analytical reports to the field operations group includes mass determined (as corrected by desorption efficiency, calibration standards, media blanks, etc.). The industrial hygiene consultant is responsible for correcting for field blanks and calculating the airborne concentration. Their calculations are reviewed by the Manager of Field Services for accuracy.

APPENDIX H
CALCULATION CHECKS

SAMPLING ARY SHEET

PLANT FUSION INCORPORATED LOCATION HOUSTON, TEXAS

SAMPLED SOURCE SCRUBBER INLET — NO OVERHEAD WASHDOWN

Run	Date	N_p	(3) Y_m	(4) ΔH	(5) P Bar.	(6) V_m	(7) T_m	(8) V_m Std.	(9) %	(10) P_{st}	17 P_s	(18) T_s	(19) VP	(20) V_w	21 $V_{w_{gas}}$	22 %M	23 M_d
I-1	19MAY89	24	.985	6.2	30.05	173.083	103	163.018		-3.6	29.79	85		86.4	4.07	2.43	.976
I-2	19MAY89	24	.985	6.1	30.05	170.665	103	160.702		-3.4	29.80	83		83.7	3.94	2.39	.976
I-3	20MAY89	24	.985	5.9	30.15	169.420	106	159.128		-3.6	29.89	88		92.9	4.37	2.67	.973

Run	(24) CO_2	(25) O_2	26 N_2	(27) CO	(28) —	29 MW_d	30 MW	(31) C_p	(32) $\sqrt{\Delta P_s (T_s + 460)}$	(33) T_t	(34) D_n	35 V_s	(36) D_s	(37) Area	38 ACFM	(39) DSCFM	40 %I
I-1	0.7	21.0	78.3			28.95	28.69	.84	28.0539	120	.243	68.9	30.05	4.93	20367	19165	108.5
I-2	0.7	21.0	78.3			28.95	28.69	.84	27.6123	120	.243	67.8	30.05	4.93	20040	18944	108.2
I-3	0.7	21.0	78.3			28.95	28.66	.84	27.9222	120	.243	68.5	30.05	4.93	20247	18964	107.0

$$V_m \text{ Std.} = Y_m \frac{17.64 \times V_m \left(P \text{ Bar.} + \frac{\Delta H}{13.6}\right)}{(T_m + 460)}$$

$$V_{w_{gas}} = 0.0471\, V_w$$

$$MW_d = \%CO_2 \times .44 + (\%O_2 \times .32) + (\%CO + \%N_2) \times .28 + \left(\%\text{Other} \times \frac{\text{Mol. wt.}}{100}\right)$$

$$MW = MW_d \times M_d + 18(1 - M_d)$$

$$V_s = 85.49 \times C_p \sqrt{\Delta P_s (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{0.09450 \times (T_s + 460) \times V_m \text{ Std.}}{V_s \times T_t \times P_s \times M_d \times A_n}$$

$$\%M = \frac{100 \times V_{w_{gas}}}{V_m \text{ Std.} + V_{w_{gas}}}$$

$$M_d = \frac{100 - \%M}{100}$$

$$P_s = P \text{ Bar.} \pm \frac{P_{st}}{13.6}$$

N_p = Total No. of Sampling points

Y_m = Meter Box Correction Factor

ΔH = Average Orifice Pressure Drop, Inches H_2O

P Bar. = Barometric Pressure, Inches Hg, Absolute

V_m = Volume of Dry Gas at Meter Conditions, DCF

T_m = Average Meter Temperature, °F.

V_m Std. = Volume of Dry Gas at STP, DSCF[a]

I = Per Cent other gas removed before Dry Gas Meter

P_{st} = Static Pressure of Stack Gas, Inches H_2O

P_s = Stack Gas Pressure, Inches Hg.

T_s = Average Stack Temperature, °F

VP = Vapor Pressure of H_2O At Stack Temperature

V_w = Total H_2O Collected in Impingers and Silica Gel

$V_{w_{gas}}$ = Volume of water vapor collected at STP, SCF[b]

%M = Per Cent Moisture by volume

M_d = Mole Fraction of Dry Gas

$\%CO_2$ = Volume % Dry

$\%O_2$ = Volume % Dry

$\%N_2$ = Volume % Dry

%CO = Volume % Dry

MW_d = Molecular Weight of Stack Gas Dry Basis

MW = Molecular Weight of Stack Gas, Wet Basis

C_p = Pitot Tube Coefficient

$\sqrt{\Delta P (T + 460)}$ Is determined by averaging the square root of the product of the velocity head (P) and the absolute stack temperature from each sampling point.

T_t = Net time of test in minutes

D_n = Sampling Nozzle Diameter, inches

A_n = Area of Nozzle opening, ft^2.

V_s = Stack Gas Velocity at Stack Conditions, Feet per second.

D_s = Diameter of Stack, inches

Area = Area of duct in ft^2

ACFM = Actual Cubic Feet per minute

DSCFM = Dry Standard Cubic Feet per minute

%I = Per Cent Isokinetic

[a] Dry Standard Cubic Feet @ 68°F, 29.92 in. Hg.

[b] Standard Conditions @ 68°F, 29.92 in. Hg.

SUMMARY OF EMISSIONS

PLANT FUSION INCORPORATED LOCATION HOUSTON, TEXAS

SAMPLED SOURCE SCRUBBER INLET - NO OVERHEAD WASHDOWN

RUN	DATE	1 V_m Std.	2 DSCFM
I-1	19 MAY 89	163.018	19165
I-2	19 MAY 89	160.702	18944
I-3	20 MAY 89	159.128	18964

FRONT HALF MILLIGRAMS			
PROBE	CYCLONE	FILTER	3 TOTAL
			1.37941
			2.94111
			3.53060

Total Cr 4 ~~BACK HALF~~	5 FRONT + BACK TOTAL
3.53	3.53 / 3.9411 = 1,200

CONCENTRATIONS

RUN	FRONT HALF Gr/DSCF	Mg/M³	Lb/Hr	Kg/Hr
I-1	.0006136	.2988	.0215	.0097
I-2	.0002829	.6463	.0459	.0208
I-3	.0003424	.7835	.0557	.0252
	6	7	8	9

BACK HALF Gr/DSCF	Mg/M³	Lb/Hr	Kg/Hr
~~.0003390~~			
.0003390	.7757	.0550	.0250
10	17	18	19

TOTAL Gr/DSCF	Mg/M³	Lb/Hr	Kg/Hr
20	21	22	23

Remarks:

H-3

SAMPLING MARY SHEET

PLANT FUSION INCORPORATED LOCATION HOUSTON, TEXAS

SAMPLED SOURCE SCRUBBER INLET – PERIODIC OVERHEAD WASHDOWN

Run	Date	N_p	(3) Y_m	(4) ΔH	(5) P Bar.	(6) V_m	(7) T_m	(8) V_m Std.	(9) %	(10) P_{st}	17 P_s	(18) T_s	(19) VP	(20) V_w	21 $V_{w_{gas}}$	22 %M	23 M_d
I-4	5/21/89	24	.985	5.9	30.18	167.899	103	158.695		-3.4	29.93	87		79.6	3.75	2.31	.977
I-5	5/21/89	24	.985	5.8	30.18	166.731	106	156.719		-3.4	29.93	93		78.6	3.70	2.31	.977
I-6	5/21/89	24	.985	5.7	30.08	164.537	101	155.487		-3.6	29.82	88		85.1	4.01	2.51	.975

Run	(24) CO_2	(25) O_2	26 N_2	(27) CO	(28) —	29 MW_d	30 MW	(31) C_p	(32) $\sqrt{\Delta P_s (T_s + 460)}$	(33) T_t	(34) D_n	35 V_s	(36) D_s	(37) Area	38 ACFM	(39) DSCFM	40 %I
I-4	0.7	21.0	78.3			28.95	28.70	.84	28.2388	120	.243	69.2	30.05	4.93	20446	19288	104.9
I-5	0.7	21.0	78.3			28.95	28.70	.84	28.3545	120	.243	69.5	30.05	4.93	20530	19156	104.3
I-6	0.7	21.0	78.3			28.95	28.68	.84	27.8413	120	.243	68.4	30.05	4.93	20205	18913	104.8

$$V_m \text{ Std.} = Y_m \frac{17.64 \times V_m \left(P \text{ Bar.} + \frac{\Delta H}{13.6}\right)}{(T_m + 460)}$$

$$V_{w_{gas}} = 0.0471\ V_w$$

$$MW_d = \%CO_2 \times .44 + (\%O_2 \times .32) + (\%CO + \%N_2) \times .28 + \left(\%\text{Other} \times \frac{\text{Mol. wt.}}{100}\right)$$

$$MW = MW_d \times M_d + 18(1 - M_d)$$

$$V_s = 85.49 \times C_p \sqrt{\Delta P_s (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{0.09450 \times (T_s + 460) \times V_m \text{ Std.}}{V_s \times T_t \times P_s \times M_d \times A_n}$$

$$\%M = \frac{100 \times V_{w_{gas}}}{V_m \text{ Std.} + V_{w_{gas}}}$$

$$M_d = \frac{100 - \%M}{100}$$

$$P_s = P \text{ Bar.} \pm \frac{P_{st}}{13.6}$$

N_p = Total No. of Sampling points

Y_m = Meter Box Correction Factor

ΔH = Average Orfice Pressure Drop, inches H_2O

P Bar. = Barometric Pressure, Inches Hg, Absolute

V_m = Volume of Dry Gas at Meter Conditions, DCF

T_m = Average Meter Temperature, °F.

V_m Std. = Volume of Dry Gas at STP. DSCF[a]

I = Per Cent other gas removed before Dry Gas Meter

P_{st} = Static Pressure of Stack Gas, inches H_2O

P_s = Stack Gas Pressure, inches Hg.

T_s = Average Stack Temperature, °F

VP = Vapor Pressure of H_2O At Stack Temperature

V_w = Total H_2O Collected in Impingers and Silica Gel

$V_{w_{gas}}$ = Volum of water vapor collected at STP, SCF[b]

%M = Per Cent Moisture by volume

M_d = Mole Fraction of Dry Gas

$\%CO_2$ = Volume % Dry

$\%O_2$ = Volume % Dry

$\%N_2$ = Volume % Dry

%CO = Volume % Dry

MW_d = Molecular Weight of Stack Gas Dry Basis

MW = Molecular Weight of Stack Gas, Wet Basis

C_p = Pitot Tube Coefficient

$\sqrt{\Delta P (T_s + 460)}$ Is determined by averaging the square root of the product of the velocity head (P) and the absolute stack temperature from each sampling point.

T_t = Net time of test in minutes

D_n = Sampling Nozzle Diameter, inches

A_n = Area of Nozzle opening, ft^2.

V_s = Stack Gas Velocity at Stack Conditions, Feet per second.

D_s = Diameter of Stack, inches

Area = Area of duct in ft^2

ACFM = Actual Cubic Feet per minute

DSCFM = Dry Standard Cubic Feet per minute

%I = Per Cent Isokinetic

[a]Dry Standard Cubic Feet @ 68°F, 29.92 in. Hg.

[b]Standard Conditions @ 68°F. 29.92 in. Hg.

SUMMARY OF EMISSIONS

PLANT FUSION INCORPORATED

LOCATION HOUSTON, TEXAS

SAMPLED SOURCE SCRUBBER INLET – PERIODIC OVERHEAD WASHDOWN

RUN	DATE	(1) V_m Std.	(2) DSCFM
I-4	21 MAY 89	158.695	19288
I-5	21 MAY 89	156.719	19156
I-6	21 MAY 89	155.487	18913

FRONT HALF MILLIGRAMS			
PROBE	CYCLONE	FILTER	(3) TOTAL
			3.81890
			2.5549
			2.5477

(4) BACK HALF	5 FRONT + BACK TOTAL
3.16	3.16 / 2.5549

Total Cr

1.24

H-5

CONCENTRATIONS

RUN	FRONT HALF Gr/DSCF	FRONT HALF Mg/M³	FRONT HALF Lb/Hr	FRONT HALF Kg/Hr
I-4	.0003616	.8276	.0598	.0271
I-5	.0002516	.5757	.0413	.0187
I-6	.0002529	.5786	.0410	.0186
	6	7	8	9

BACK HALF Gr/DSCF	BACK HALF Mg/M³	BACK HALF Lb/Hr	BACK HALF Kg/Hr
.0003112	.7121	.0511	.0232
10	17	18	19

TOTAL Gr/DSCF	TOTAL Mg/M³	TOTAL Lb/Hr	TOTAL Kg/Hr
20	21	22	23

Remarks:

SAMPLING SUMMARY SHEET

PLANT: FUSION INCORPORATED

LOCATION: HOUSTON, TEXAS

SAMPLED SOURCE: SCRUBBER INLET – CONTINUOUS OVERHEAD WASHDOWN

Run	Date	N_p	3 Y_m	4 ΔH	5 P Bar.	6 V_m	7 T_m	8 V_m Std.	9 %	10 P_{st}	17 P_s	18 T_s	19 VP	20 V_w	21 $V_{w_{gas}}$	22 %M	23 M_d
I-7	23MAY89	24	.985	6.0	30.11	271.936	107	254.694		-3.6	29.85	88		129.3	6.09	2.33	.977
I-8	23MAY89	24	.985	5.8	30.11	167.442	105	157.305		-3.6	29.85	92		78.7	3.70	2.30	.977

Run	24 CO_2	25 O_2	26 N_2	27 CO	28 —	29 MW_d	30 MW	31 C_p	32 $\sqrt{\Delta P_s (T_s + 460)}$	33 T_t	34 D_n	35 V_s	36 D_s	37 Area	38 ACFM	39 DSCFM	40 %I
I-7	0.7	21.0	78.3			28.95	28.70	.84	28.4031	192	.243	69.7	30.05	4.93	20596	19333	105.0
I-8	0.7	21.0	78.3			28.95	28.70	.84	28.1857	120	.243	69.2	30.05	4.93	20437	19051	105.3

$$V_m \text{ Std.} = Y_m \frac{17.64 \times V_m \left(P \text{ Bar.} + \frac{\Delta H}{13.6}\right)}{(T_m + 460)}$$

$$\%H = \frac{100 \times V_{w_{gas}}}{V_m \text{ Std.} + V_{w_{gas}}}$$

$$V_{w_{gas}} = 0.0471\ V_w$$

$$M_d = \frac{100 - \%H}{100}$$

$$MW_d = \%CO_2 \times .44 + (\%O_2 \times .32) + (\%CO + \%N_2) \times .28 + \left(\%\text{Other} \times \frac{\text{Mol. wt.}}{100}\right)$$

$$MW = MW_d \times M_d + 18(1 - M_d)$$

$$P_s = P \text{ Bar.} \pm \frac{P_{st}}{13.6}$$

$$V_s = 85.49 \times C_p \sqrt{\Delta P_s (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{0.09450 \times (T_s + 460) \times V_m \text{ Std.}}{V_s \times T_t \times P_s \times M_d \times A_n}$$

N_p = Total No. of Sampling points

Y_m = Meter Box Correction Factor

ΔH = Average Orfice Pressure Drop, inches H_2O

P Bar. = Barometric Pressure, Inches Hg, Absolute

V_m = Volume of Dry Gas at Meter Conditions, DCF

T_m = Average Meter Temperature, °F.

V_m Std. = Volume of Dry Gas at STP, DSCF[a]

% = Per Cent other gas removed before Dry Gas Meter

P_{st} = Static Pressure of Stack Gas, inches H_2O

P_s = Stack Gas Pressure, inches Hg.

T_s = Average Stack Temperature, °F

VP = Vapor Pressure of H_2O At Stack Temperature

V_w = Total H_2O Collected in Impingers and Silica Gel

$V_{w_{gas}}$ = Volumn of water vapor collected at STP, SCF[b]

%H = Per Cent Moisture by volume

M_d = Mole Fraction of Dry Gas

$\%CO_2$ = Volume % Dry

$\%O_2$ = Volume % Dry

$\%N_2$ = Volume % Dry

%CO = Volume % Dry

MW_d = Molecular Weight of Stack Gas Dry Basis

MW = Molecular Weight of Stack Gas, Wet Basis

C_p = Pitot Tube Coefficient

$\sqrt{\Delta P (T_s + 460)}$ Is determined by averaging the square root of the product of the velocity head (P) and the absolute stack temperature from each sampling point.

T_t = Net time of test in minutes

D_n = Sampling Nozzle Diameter, inches

A_n = Area of Nozzle opening, ft^2.

V_s = Stack Gas Velocity at Stack Conditions, Feet per second.

D_s = Diameter of Stack, inches

Area = Area of duct in ft^2

ACFM = Actual Cubic Feet per minute

DSCFM = Dry Standard Cubic Feet per minute

%I = Per Cent Isokinetic

[a]Dry Standard Cubic Feet @ 68°F, 29.92 in. Hg.

[b]Standard Conditions @ 68°F, 29.92 in. Hg.

SUMMARY OF EMISSIONS

PLANT FUSION INCORPORATED LOCATION HOUSTON, TEXAS

SAMPLED SOURCE SCRUBBER INLET - CONTINUOUS OVERHEAD WASHDOWN

RUN	DATE	1 V_m Std.	2 DSCFM
I-7	23MAY89	254.694	19333
I-8	23MAY89	157.305	19051

FRONT HALF MILLIGRAMS				4	5
PROBE	CYCLONE	FILTER	3 TOTAL	BACK HALF	FRONT + BACK TOTAL
			5.42615		
			3.08538		

H-7

CONCENTRATIONS

FRONT HALF				BACK HALF				TOTAL			
RUN	Gr/DSCF	Mg/M^3	Lb/Hr	Kg/Hr	Gr/DSCF	Mg/M^3	Lb/Hr	Kg/Hr	Gr/DSCF	Mg/M^3	Lb/Hr	Kg/Hr
I-7	.0003288	.7524	.0545	.0247								
I-8	.0003027	.6926	.0494	.0224								
	6	7	8	9	10	17	18	19	20	21	22	23

Remarks:

SAMPLIN UMMARY SHEET

PLANT FUSION INCORPORATED LOCATION HOUSTON, TEXAS

SAMPLED SOURCE SCRUBBER OUTLET NO OVERHEAD WASHDOWN

Run	Date	N_p	(3) Y_m	(4) ΔH	(5) P Bar.	(6) V_m	(7) T_m	(8) V_m Std.	(9) %	(10) P_{st}	17 P_s	(18) T_s	(19) VP	(20) V_w	21 $V_{w_{gas}}$	22 %M	23 M_d
0-1	19MAY89	24	1.009	3.9	30.03	148.359	107	141.246		0.67	30.08	83		82.5	3.88	2.68	.973
0-2	19MAY89	24	1.009	3.8	30.00	147.888	109	140.130		0.66	30.05	82		92.5	4.35	3.01	.970
0-3	20MAY89	24	1.009	3.9	30.15	146.657	110	139.440		0.66	30.20	84		87.9	4.14	2.88	.971

Run	(24) CO_2	(25) O_2	26 N_2	(27) CO	(28) —	29 MW_d	30 MW	(31) C_p	(32) $\sqrt{\Delta P_s (T_s + 460)}$	(33) T_t	(34) D_n	35 V_s	(36) D_s	(37) Area	38 ACFM	(39) DSCFM	40 %I
0-1	0.7	21.0	78.3			28.95	28.66	.84	26.3306	120	.2377	64.4	29.6875	4.81	18575	17672	104.0
0-2	0.7	21.0	78.3			28.95	28.62	.84	26.6766	120	.2377	65.3	29.6875	4.81	18840	17877	102.0
0-3	0.7	21.0	78.3			28.95	28.64	.84	26.5685	120	.2377	64.9	29.6875	4.81	18713	17803	101.9

$$V_m \text{ Std.} = Y_m \frac{17.64 \times V_m \left(P \text{ Bar.} + \frac{\Delta H}{13.6}\right)}{(T_m + 460)}$$

$$V_{w_{gas}} = 0.0471\ V_w$$

$$MW_d = \%CO_2 \times .44 + (\%O_2 \times .32) + (\%CO + \%N_2) \times .28 + \left(\%\text{Other} \times \frac{\text{Mol. wt.}}{100}\right)$$

$$MW = MW_d \times M_d + 18(1 - M_d)$$

$$V_s = 85.49 \times C_p \sqrt{\Delta P_s (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{0.09450 \times (T_s + 460) \times V_m \text{ Std.}}{V_s \times T_t \times P_s \times M_d \times A_n}$$

$$\%M = \frac{100 \times V_{w_{gas}}}{V_m \text{ Std.} + V_{w_{gas}}}$$

$$M_d = \frac{100 - \%M}{100}$$

$$P_s = P \text{ Bar.} \pm \frac{P_{st}}{13.6}$$

N_p = Total No. of Sampling points

Y_m = Meter Box Correction Factor

ΔH = Average Orfice Pressure Drop, inches H_2O

P Bar. = Barometric Pressure, Inches Hg, Absolute

V_m = Volume of Dry Gas at Meter Conditions, DCF

T_m = Average Meter Temperature, °F.

V_m Std. = Volume of Dry Gas at STP, DSCF[a]

% = Per Cent other gas removed before Dry Gas Meter

P_{st} = Static Pressure of Stack Gas, Inches H_2O

P_s = Stack Gas Pressure, inches Hg.

T_s = Average Stack Temperature, °F

VP = Vapor Pressure of H_2O At Stack Temperature

V_w = Total H_2O Collected in Impingers and Silica Gel

$V_{w_{gas}}$ = Volumn of water vapor collected at STP, SCF[b]

%M = Per Cent Moisture by volume

M_d = Mole Fraction of Dry Gas

$\%CO_2$ = Volume % Dry

$\%O_2$ = Volume % Dry

$\%N_2$ = Volume % Dry

%CO = Volume % Dry

MW_d = Molecular Weight of Stack Gas Dry Basis

MW = Molecular Weight of Stack Gas, Wet Basis

C_p = Pitot Tube Coefficient

$\sqrt{\Delta P (T_s + 460)}$ Is determined by averaging the square root of the product of the velocity head (P) and the absolute stack temperature from each sampling point.

T_t = Net time of test in minutes

D_n = Sampling Nozzle Diameter, inches

A_n = Area of Nozzle opening, ft^2.

V_s = Stack Gas Velocity at Stack Conditions, Feet per second.

D_s = Diameter of Stack, inches

Area = Area of duct in ft^2

ACFM = Actual Cubic Feet per minute

DSCFM = Dry Standard Cubic Feet per minute

%I = Per Cent Isokinetic

[a] Dry Standard Cubic Feet @ 68°F, 29.92 in. Hg.

[b] Standard Conditions @ 68°F, 29.92 in. Hg.

SUMMARY EMISSIONS

PLANT FUSION INCORPORATED LOCATION HOUSTON, TEXAS

SAMPLED SOURCE SCRUBBER OUTLET NO OVERHEAD WASHDOWN

RUN	DATE	(1) V_m Std.	(2) DSCFM
0-1	19 MAY 89	141.246	17672
0-2	19 MAY 89	140.130	17877
0-3	20 MAY 89	139.440	17803

FRONT HALF MILLIGRAMS			
PROBE	CYCLONE	FILTER	(3) TOTAL
			.14996
			.15495
			.16423

(4) Total Cr BACK HALF	5 FRONT + BACK TOTAL
0.248	.248 / .15495

1.60

CONCENTRATIONS

FRONT HALF			
RUN	Gr/DSCF	Mg/M³	Lb/Hr	Kg/Hr
0-1	.0000164	.0375	.00248	.00113
0-2	.0000171	.0390	.00261	.00119
0-3	.0000182	.0416	.00277	.00126
	6	7	8	9

BACK HALF Total Cr			
Gr/DSCF	Mg/M³	Lb/Hr	Kg/Hr
.0000273	.0625	.00419	.00190
10	17	18	19

TOTAL			
Gr/DSCF	Mg/M³	Lb/Hr	Kg/Hr
20	21	22	23

Remarks:

SAMPLIN SUMMARY SHEET

PLANT FUSION INCORPORATED LOCATION HOUSTON, TEXAS

SAMPLED SOURCE SCRUBBER OUTLET PERIODIC OVERHEAD WASHDOWN

Run	Date	N_p	(3) Y_m	(4) ΔH	(5) P Bar.	(6) V_m	(7) T_m	(8) V_m Std.	(9) %	(10) P_{st}	17 P_s	(18) T_s	(19) VP	(20) V_w	21 $V_{w_{gas}}$	22 %M	23 N_d
0-4	21 MAY 89	24	1.009	4.0	30.18	147.497	108	140.906		0.67	30.23	81		77.3	3.64	2.52	.975
0-5	21 MAY 89	24	1.009	3.9	30.18	144.091	108	137.619		0.67	30.23	84		86.0	4.05	2.86	.971
0-6	21 MAY 89	24	1.009	3.9	30.08	145.781	106	132.266		0.64	30.13	82		93.5	4.40	3.06	.969

Run	(24) CO_2	(25) O_2	26 N_2	(27) CO	(28) —	29 MW_d	30 MW	(31) C_p	(32) $\sqrt{\Delta P_s (T_s + 460)}$	(33) T_t	(34) D_n	35 V_s	(36) D_s	(37) Area	38 ACFM	(39) DSCFM	40 %I
0-4	0.7	21.0	78.3			28.95	28.68	.84	26.6170	120	.2377	64.9	29.6875	4.81	18724	17998	101.8
0-5	0.7	21.0	78.3			28.95	28.64	.84	26.2610	120	.2377	64.1	29.6875	4.81	18486	17610	101.7
0-6	0.7	21.0	78.3			28.95	28.62	.84	26.1907	120	.2377	64.1	29.6875	4.81	18475	17567	103.1

$$V_m \text{ Std.} = Y_m \frac{17.64 \times V_m \left(P \text{ Bar.} + \frac{\Delta H}{13.6}\right)}{(T_m + 460)}$$

$$V_{w_{gas}} = 0.0471\ V_w$$

$$MW_d = CO_2 \times .44 + (O_2 \times .32) + (CO + N_2) \times .28 + \left(\%\text{Other} \times \frac{\text{Mol. wt.}}{100}\right)$$

$$MW = MW_d \times M_d + 18(1 - M_d)$$

$$V_s = 85.49 \times C_p \sqrt{\Delta P_s (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$I = \frac{0.09450 \times (T_s + 460) \times V_m \text{ Std.}}{V_s \times T_t \times P_s \times M_d \times A_n}$$

$$\%M = \frac{100 \times V_{w_{gas}}}{V_m \text{ Std.} + V_{w_{gas}}}$$

$$M_d = \frac{100 - \%M}{100}$$

$$P_s = P \text{ Bar.} \pm \frac{P_{st}}{13.6}$$

N_p = Total No. of Sampling points

Y_m = Meter Box Correction Factor

ΔH = Average Orifice Pressure Drop, inches H_2O

P Bar. = Barometric Pressure, inches Hg. Absolute

V_m = Volume of Dry Gas at Meter Conditions, DCF

T_m = Average Meter Temperature, °F.

V_m Std. = Volume of Dry Gas at STP. DSCF[a]

I = Per Cent other gas removed before Dry Gas Meter

P_{st} = Static Pressure of Stack Gas, inches H_2O

P_s = Stack Gas Pressure, inches Hg.

T_s = Average Stack Temperature, °F

VP = Vapor Pressure of H_2O At Stack Temperature

V_w = Total H_2O Collected in Impingers and Silica Gel

$V_{w_{gas}}$ = Volume of water vapor collected at STP, SCF[b]

%M = Per Cent Moisture by volume

M_d = Mole Fraction of Dry Gas

CO_2 = Volume % Dry

O_2 = Volume % Dry

N_2 = Volume % Dry

CO = Volume % Dry

MW_d = Molecular Weight of Stack Gas Dry Basis

MW = Molecular Weight of Stack Gas, Wet Basis

C_p = Pitot Tube Coefficient

$\sqrt{\Delta P (T_s + 460)}$ Is determined by averaging the square root of the product of the velocity head (P) and the absolute stack temperature from each sampling point.

T_t = Net time of test in minutes

D_n = Sampling Nozzle Diameter, inches

A_n = Area of Nozzle opening, ft^2.

V_s = Stack Gas Velocity at Stack Conditions, Feet per second.

D_s = Diameter of Stack, inches

Area = Area of duct in ft^2

ACFM = Actual Cubic Feet per minute

DSCFM = Dry Standard Cubic Feet per minute

I = Per Cent Isokinetic

[a]Dry Standard Cubic Feet @ 68°F, 29.92 in. Hg

[b]Standard Conditions @ 68°F. 29.92 in. Hg.

[redacted] SUMMARY [redacted]MIS[redacted]S [redacted]

PLANT FUSION INCORPORATED LOCATION HOUSTON, TEXAS

SAMPLED SOURCE SCRUBBER OUTLET PERIODIC OVERHEAD WASHDOWN

RUN	DATE	(1) V_m Std.	(2) DSCFM
0-4	21 MAY 89	140.906	17998
0-5	21 MAY 89	137.619	17610
0-6	21 MAY 89	132.266	17567

FRONT HALF MILLIGRAMS				(4) Total Cr BACK HALF	5 FRONT + BACK TOTAL
PROBE	CYCLONE	FILTER	(3) TOTAL		
			.10248		
			.08409	0.194	.194 / .08409 2.3
			.085816		

CONCENTRATIONS

RUN	FRONT HALF Gr/DSCF	FRONT HALF Mg/M³	FRONT HALF Lb/Hr	FRONT HALF Kg/Hr	BACK HALF Total Cr Gr/DSCF	BACK HALF Mg/M³	BACK HALF Lb/Hr	BACK HALF Kg/Hr	TOTAL Gr/DSCF	TOTAL Mg/M³	TOTAL Lb/Hr	TOTAL Kg/Hr
0-4	.0000112	.0257	.00173	.000785								
0-5	.0000094	.0216	.00142	.000646	.0000218	.0498	.00328	.00149				
0-6	.0000100	.0229	.00151	.000684								
	6	7	8	9	10	17	18	19	20	21	22	23

Remarks:

SAMPLING SUMMARY SHEET

PLANT: FUSION INCORPORATED

LOCATION: HOUSTON, TEXAS

SAMPLED SOURCE: SCRUBBER OUTLET

CONTINUOUS OVERHEAD WASHDOWN

Run	Date	N_p	(3) Y_m	(4) ΔH	(5) P Bar.	(6) V_m	(7) T_m	(8) V_m Std.	(9) %	(10) P_{st}	17 P_s	(18) T_s	(19) VP	(20) V_w	21 $V_{w_{gas}}$	22 %M	23 M_d
0-7	23MAY89	24	1.009	3.6	30.11	225.849	109	214.674	/	0.64	30.16	82	/	134.4	6.33	2.86	.971
0-8	23MAY89	24	1.009	3.7	30.11	141.267	109	134.310	/	0.46	30.16	82	/	83.9	3.95	2.86	.971

Run	(24) CO_2	(25) O_2	26 N_2	(27) CO	(28) —	29 MW_d	30 MW	(31) C_p	(32) $\sqrt{\Delta P_s (T_s + 460)}$	(33) T_t	(34) D_n	35 V_s	(36) D_s	(37) Area	38 ACFM	39 DSCFM	40 %I
0-7	0.7	21.0	78.3	/	/	28.95	28.64	.84	26.4521	192	.2377	64.6	29.6875	4.81	18643	17781	98.1
0-8	0.7	21.0	78.3	/	/	28.95	28.64	.84	26.6719	120	.2377	65.2	29.6875	4.81	18797	17930	97.4

$$V_m \text{ Std.} = Y_m \frac{17.64 \times V_m \left(P \text{ Bar.} + \frac{\Delta H}{13.6}\right)}{(T_m + 460)}$$

$$\%M = \frac{100 \times V_{w_{gas}}}{V_m \text{ Std.} + V_{w_{gas}}}$$

$$V_{w_{gas}} = 0.0471\ V_w$$

$$M_d = \frac{100 - \%M}{100}$$

$$MW_d = \%CO_2 \times .44 + (\%O_2 \times .32) + (\%CO + \%N_2) \times .28 + \left(\%\text{Other} \times \frac{\text{Mol. wt.}}{100}\right)$$

$$MW = MW_d \times M_d + 18(1 - M_d)$$

$$P_s = P \text{ Bar.} \pm \frac{P_{st}}{13.6}$$

$$V_s = 85.49 \times C_p \sqrt{\Delta P_s (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{0.09450 \times (T_s + 460) \times V_m \text{ Std.}}{V_s \times T_t \times P_s \times M_d \times A_n}$$

N_p = Total No. of Sampling points

Y_m = Meter Box Correction Factor

ΔH = Average Orifice Pressure Drop, Inches H_2O

P Bar. = Barometric Pressure, Inches Hg, Absolute

V_m = Volume of Dry Gas at Meter Conditions, DCF

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% = Per Cent other gas removed before Dry Gas Meter

P_{st} = Static Pressure of Stack Gas, Inches H_2O

P_s = Stack Gas Pressure, Inches Hg.

T_s = Average Stack Temperature, °F

VP = Vapor Pressure of H_2O At Stack Temperature

V_w = Total H_2O Collected in Impingers and Silica Gel

$V_{w_{gas}}$ = Volum of water vapor collected at STP, SCF[b]

%M = Per Cent Moisture by volume

M_d = Mole Fraction of Dry Gas

$\%CO_2$ = Volume % Dry

$\%O_2$ = Volume % Dry

$\%N_2$ = Volume % Dry

%CO = Volume % Dry

MW_d = Molecular Weight of Stack Gas Dry Basis

MW = Molecular Weight of Stack Gas, Wet Basis

C_p = Pitot Tube Coefficient

$\sqrt{\Delta P (T_s + 460)}$ Is determined by averaging the square root of the product of the velocity head (P) and the absolute stack temperature from each sampling point.

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D_n = Sampling Nozzle Diameter, inches

A_n = Area of Nozzle opening, ft^2.

V_s = Stack Gas Velocity at Stack Conditions, Feet per second.

D_s = Diameter of Stack, Inches

Area = Area of duct in ft^2

ACFM = Actual Cubic Feet per minute

DSCFM = Dry Standard Cubic Feet per minute

%I = Per Cent Isokinetic

[a]Dry Standard Cubic Feet @ 68°F, 29.92 in. Hg.

[b]Standard Conditions @ 68°F. 29.92 in. Hg.

SUMMARY OF EMISSIONS

PLANT FUSION INCORPORATED LOCATION HOUSTON, TEXAS

SAMPLED SOURCE SCRUBBER OUTLET CONTINUOUS OVERHEAD WASHDOWN

RUN	DATE	(1) V_m Std.	(2) DSCFM
0-7	23 MAY 89	214.674	17781
0-8	23 MAY 89	134.310	17930

FRONT HALF MILLIGRAMS			
PROBE	CYCLONE	FILTER	(3) TOTAL
			.137975
			.07456

(4) BACK HALF	5 FRONT + BACK TOTAL

CONCENTRATIONS

FRONT HALF				
RUN	Gr/DSCF	Mg/M^3	Lb/Hr	Kg/Hr
0-7	.0000099	.0227	.00151	.000686
0-8	.0000088	.0201	.00135	.000613
	6	7	8	9

BACK HALF			
Gr/DSCF	Mg/M^3	Lb/Hr	Kg/Hr
10	17	18	19

TOTAL			
Gr/DSCF	Mg/M^3	Lb/Hr	Kg/Hr
20	21	22	23

Remarks: