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/

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Roy F. Weston, Inc.

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WESTON.

SOURCE EMISSIONS COMPLIANCE TEST REPORT
SULFURIC ACID STACK
DECEMBER 1991

Prepared for:

GENERAL CHEMICAL CORPORATION
Claymont, Delaware

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SECTION 1
SUMMARY

General Chemical Corporation retained Roy F. Weston, Inc. (WESTON) to perform a source compliance testing and analysis program at its sulfuric acid production facility in Claymont, Delaware.

The objective of the program was to determine the compliance status of the sulfuric acid stack relevant to sulfuric acid mist and sulfur dioxide emissions in accordance with the permit issued by the State of Delaware Department of Natural Resources and Environmental Control (DNREC). Also, additional SO_2 measurements were obtained to demonstrate the relative accuracy of the sulfuric acid stack SO_2 continuous emission monitor (CEM) and to verify the concentration of the SO_2 CEM calibration gas cylinder.

Testing and analytical procedures specified by the U.S. Environmental Protection Agency (EPA), as approved by the DNREC, were used throughout the test program. A total of three (3) EPA Method 8 and eight (8) EPA Method 6 tests were conducted on the sulfuric acid stack during the program.

An additional six (6) EPA Method 6 tests were performed on the SO_2 CEM calibration gas cylinder.

Representatives of DNREC were present during the test program.

A summary of the sulfuric acid mist and sulfur dioxide test results is presented in Table 1. A summary of the CEM relative accuracy for SO_2 is presented in Table 2. Table 3 presents a summary of the analysis of the standard gas cylinder and Table 4 presents a summary of EPA Method 6 and 8 SO_2 test results. Detailed test data and test results summaries are included in Tables 5 through 7 of the test results and discussion section.

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TABLE 1

SUMMARY OF EPA METHOD 8 SULFURIC ACID MIST
AND SULFUR DIOXIDE TEST RESULTS
SULFURIC ACID PLANT
DELAWARE VALLEY WORKS

Test #	Calculated H_2SO_4 Production ton/Hr[1] Plant Data	Emission Test Results				SO_2 Mass Emissions Rate from Recording Monitor lb/hr Plant Data
		Sulfuric Acid Mist			Sulfur Dioxide	
		H_2SO_4 Lb/hr	Lb/ton H_2SO_4 Produced Plant Data	Gm/Kg H_2SO_4 Produced Plant Data	SO_2 lb/hr	
1	48.17	5.72	0.12	0.06	55.65	69.09
2	48.17	4.65	0.10	0.05	50.23	61.75
3	45.46	10.77	0.24	0.12	46.52	52.09
Avg.	47.27	7.05	0.15	0.08	50.80	60.98

[1] A summary of production rates is provided in Appendix C.

gc016a.tab

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TABLE 2

RELATIVE ACCURACY OF THE SO_2 MONITOR

RUN #	Date	Time	RM[1] ppm	M[2]	Difference (D)	Difference $(D)^2$
1	11/19/91	0910 - 1042	119	140	21	441
2	11/19/91	1200 - 1322	105	124	19	361
3	11/19/91	1455 - 1618	95	108	13	169
4	11/20/91	0800 - 0820	112	116	4	16
5	11/20/91	0900 - 0920	111	119	8	64
6	11/20/91	1005 - 1025	106	113	7	49
7	11/20/91	1100 - 1120	117	120	3	9
8	11/20/91	1200 - 1220	112	130	18	324
9	11/20/91	1302 - 1322	121	131	10	100
10	11/20/91	1415 - 1435	107	128	21	441
11	11/20/91	1505 - 1525	124	120	-4	16
	Totals	-	1,229	1,349	120	1,990
	Average	-	112	123	11	181

Standard Deviation[3] = 8.3

Confidence Coefficient = 6

Monitor Relative Accuracy (percent) = 15

[1] RM = Measured sulfur dioxide concentration by Method 6 and 8 test train (ppm/v).

[2] M = Average concentration measured by SO_2 monitor during test period (ppm/v).

[3] See Appendix C for example calculation.

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TABLE 3

ANALYSIS OF STANDARD GAS CYLINDER

Method 6 Test Number	Measured SO_2 Concentration (ppm)	Certified Value (ppm)
1	599	---
2	640	---
3	662	---
4	637	---
5	612	---
6	622	---
Average	629	701.8

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CLAYMONT DELAWARE

TABLE 4
SUMMARY OF EPA METHOD 6 AND METHOD 8
SULFUR DIOXIDE TEST RESULTS

Test Run No.	Test Location	Test Date	Test Period	Measured Sulfur Dioxide Concentration[1] (ppm/v)
1	Stack	11/19/91	0910 - 1042	119
2	Stack	11/19/91	1200 - 1322	105
3	Stack	11/19/91	1455 - 1618	95
4	Stack	11/20/91	0800 - 0820	112
5	Stack	11/20/91	0900 - 0920	111
6	Stack	11/20/91	1005 - 1025	106
7	Stack	11/20/91	1100 - 1120	117
8	Stack	11/20/91	1200 - 1220	112
9	Stack	11/20/91	1302 - 1322	121
10	Stack	11/20/91	1415 - 1435	107
11	Stack	11/20/91	1505 - 1525	124
Series Avg.	---	---	---	112
1	Cylinder Gas	11/18/91	1230 - 1250	599
2	Cylinder Gas	11/18/91	1255 - 1315	640
3	Cylinder Gas	11/18/91	1320 - 1340	662
4	Cylinder Gas	11/18/91	1345 - 1405	637
5	Cylinder Gas	11/18/91	1410 - 1430	612
6	Cylinder Gas	11/18/91	1435 - 1455	622
Series Avg.	---	---	---	629

[1] ppm/v = parts per million by volume dry basis at standard conditions of 68°F and 29.92 inches Hg.

SECTION 2
INTRODUCTION

General Chemical Corporation retained WESTON to conduct a source testing and analysis program at its Claymont, Delaware sulfuric acid production facility.

The primary objective of the survey was to determine the sulfuric acid mist and sulfur dioxide compliance status of the sulfuric acid stack with DNREC limits. Additional SO_2 test runs were performed on the sulfuric acid stack and SO_2 calibration gas cylinder for the purpose of determining the relative accuracy of the SO_2 CEM. These results are summarized in Tables 1 through 4 of the summary section.

State of Delaware approved test methods were used throughout the program. All tests were performed during the period of November 18-20, 1991, by WESTON Air Quality Testing Services personnel.

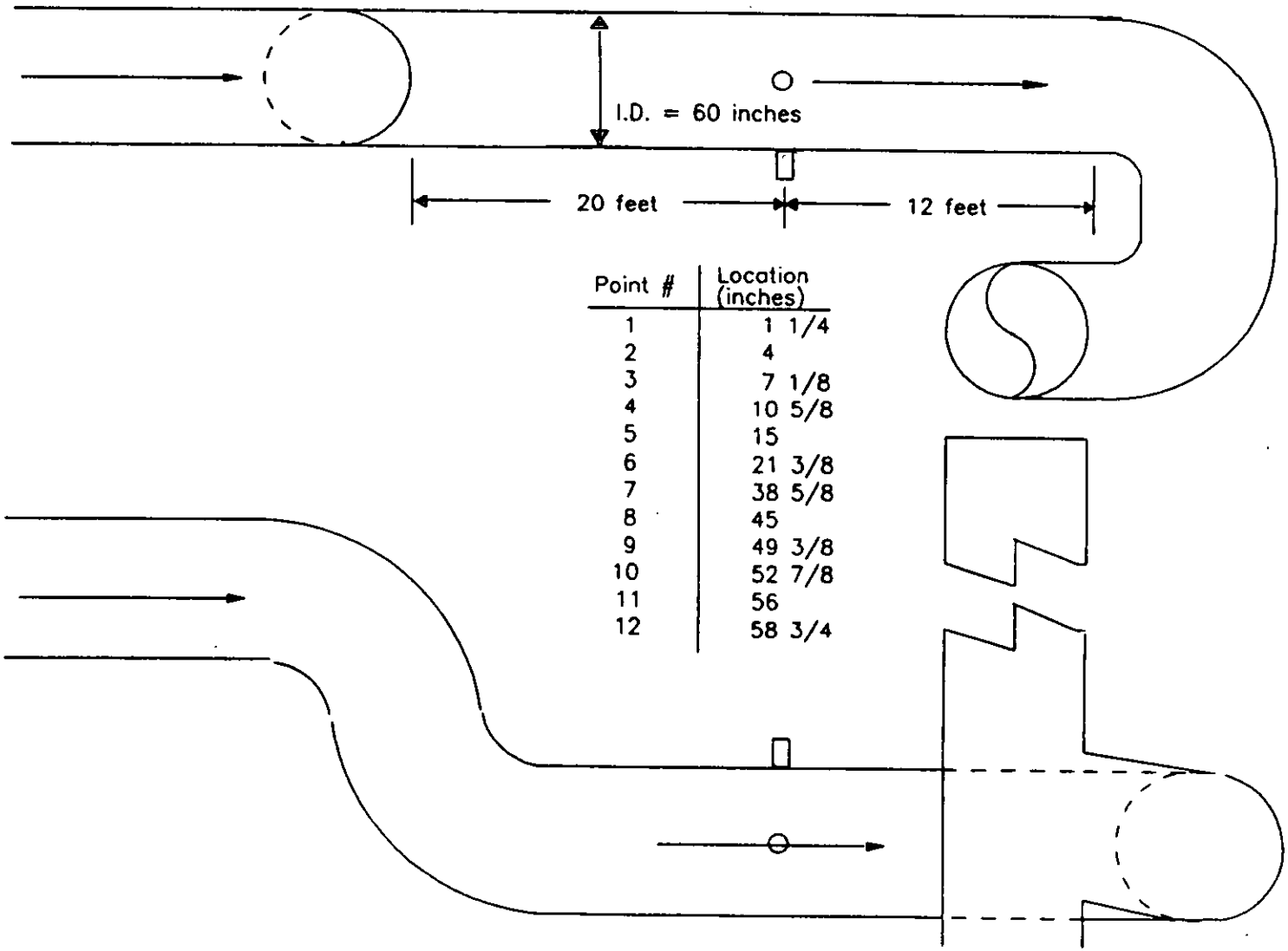
Detailed test data and test result summaries are presented in Tables 5 through 7 of this report. Descriptions of the test location, test equipment, test procedures, sample recovery techniques and analytical methods used during the survey are also included herein. Raw test data, laboratory reports, process conditions and sample calculations, equipment calibration records and a list of WESTON project participants are provided in Appendices A through E, respectively.

SECTION 3
DESCRIPTION OF TEST LOCATION

3.1 SULFURIC ACID STACK

Two test ports, 90° apart, were installed on a horizontal straight section of the duct (60"ID) leading to the brick sulfuric acid stack. The ports are located at a site which is 4.0 diameters from the nearest upstream disturbance. The ports are 2.4 diameters upstream from a bend leading to the brick stack. Twenty-four (24) traverse points, 12 per port axis, were utilized for the Method 8 testing as required in EPA Reference Method 1. A schematic showing the location of the sampling ports and the traverse point distances is presented in Figure 1.

GENERAL CHEMICAL CORPORATION
SULFURIC ACID STACK



Point #	Location (inches)
1	1 1/4
2	4
3	7 1/8
4	10 5/8
5	15
6	21 3/8
7	38 5/8
8	45
9	49 3/8
10	52 7/8
11	56
12	58 3/4

FIGURE 1: SAMPLING PORT AND POINT LOCATION

SECTION 4
DESCRIPTION OF SAMPLING TRAINS

4.1 METHOD 8 - SULFURIC ACID MIST/SULFUR DIOXIDE STACK LOCATION

The sampling train utilized to perform the combined H_2SO_4/SO_2 sampling was an EPA Method 8 train, modified with the use of a heated Teflon line between the sample probe and the first impinger.

A calibrated stainless steel nozzle was attached to a heated (~250°F) borosilicate probe 6 feet in length. The probe was connected to the first of four impingers by means of a heated flexible Teflon line. The first impinger contained 200 ml of 80 percent isopropyl alcohol and was separated from the second impinger by an unheated filter holder containing an unweighed 934 AH glass fiber filter. The second and third impinger each contained 100 ml of 3% hydrogen peroxide, and the fourth impinger contained 300 grams of dry silica gel. The first and third impingers were standard Greenburg-Smith types, the second and fourth were of a modified design. All impingers were maintained in an ice bath. A Nutech control console with a leakless vacuum pump, a calibrated dry gas meter, a calibrated orifice, and inclined manometers completed the sample train (see Figure 2).

Reagent grade isopropanol and hydrogen peroxide were used in the impinger train.

Flue gas velocity was measured with a calibrated "S" type pitot tube (provided with extensions) fastened alongside the sampling probe. Flue gas temperature was monitored with a calibrated direct readout pyrometer equipped with a chromel-alumel thermocouple positioned near the sampling nozzle. Impinger exit gas temperature was monitored with a calibrated direct readout pyrometer equipped with a chromel-alumel thermocouple positioned after the last impinger.

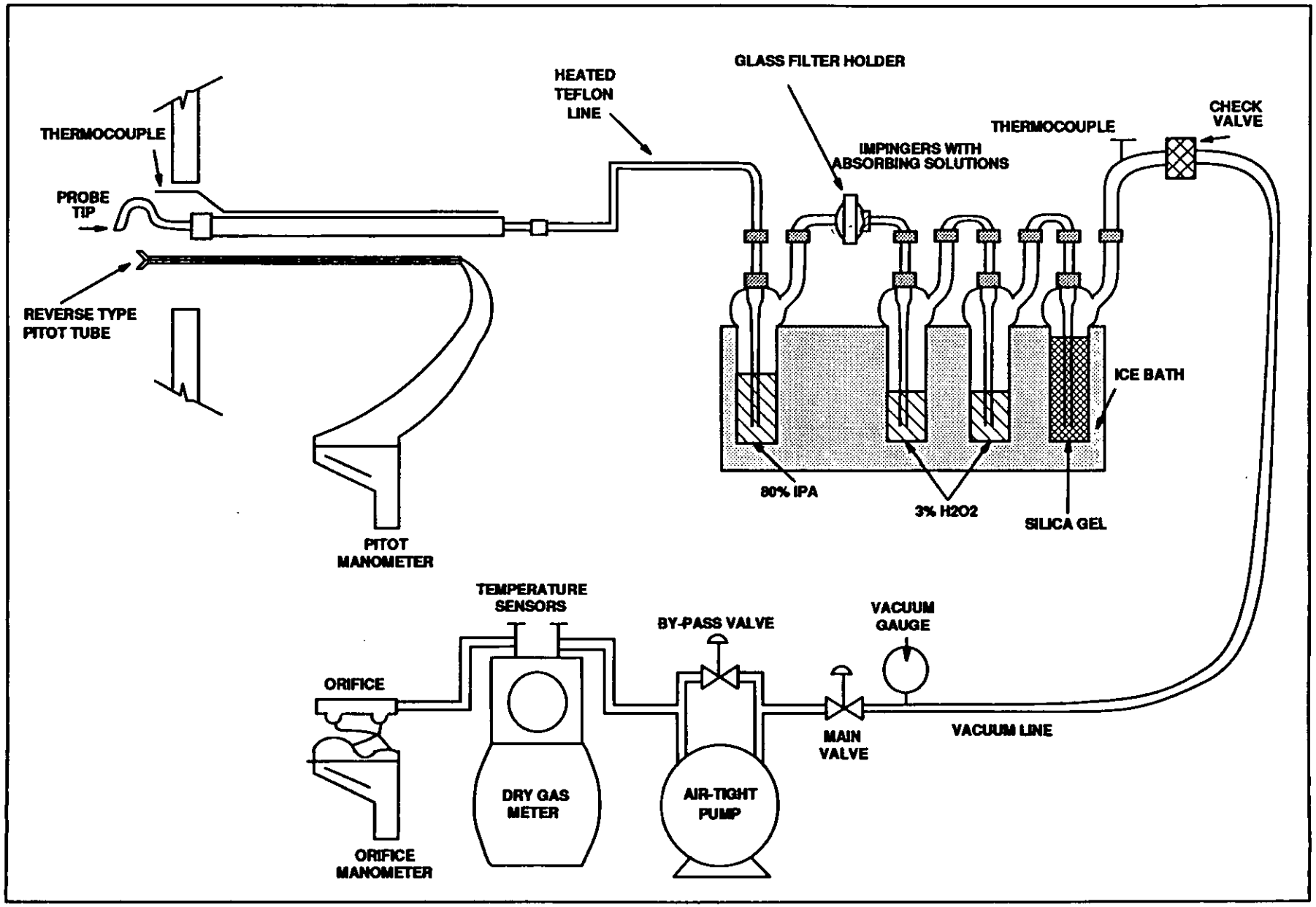


FIGURE 2
EPA METHOD 8
SULFUR OXIDES SAMPLING TRAIN

4.2 METHOD 6 - SULFUR DIOXIDE - STACK LOCATION

The sampling train utilized to perform the sulfur dioxide sampling was an EPA Method 6 train, modified with the use of large impingers as described below:

A calibrated stainless steel nozzle was attached to a heated (~250°F) borosilicate probe 6 feet in length. The probe was connected to the first of four impingers by means of a rigid borosilicate connector. The first impinger contained 200 ml of 80 percent isopropyl alcohol and was separated from the second impinger by an unheated filter holder containing an unweighed 934 AH glass fiber filter. The second and third impingers each contained 100 ml of 3% hydrogen peroxide, and the fourth impinger contained 300 grams of dry silica gel. The first and third impingers were standard Greenburg-Smith types, the second and fourth were of a modified design. All impingers were maintained in an ice bath. A Nutech control console with a leakless vacuum pump, a calibrated dry gas meter, a calibrated orifice, and inclined manometers completed the sample train (see Figure 3).

Impinger exit gas temperature was monitored with a calibrated direct readout pyrometer equipped with a chromel-alumel thermocouple positioned after the last impinger.

4.3 METHOD 6 - SULFUR DIOXIDE - CALIBRATION GAS CYLINDER

The sampling train utilized to perform the sulfur dioxide sampling of the CEM calibration gas cylinder was a EPA Method 6 train.

A calibrated 0-1 liter per minute range rotameter was placed between the cylinder valve and the first of four midget impingers. The first impinger contained 15 ml of 80 percent isopropyl alcohol. The second and third impingers each contained 15 ml of 3 percent hydrogen peroxide. All impingers were maintained in an ice bath. A calibrated dry test meter housed in a Nutech VOST control console followed the final impinger and was used to measure the sampled gas volume.

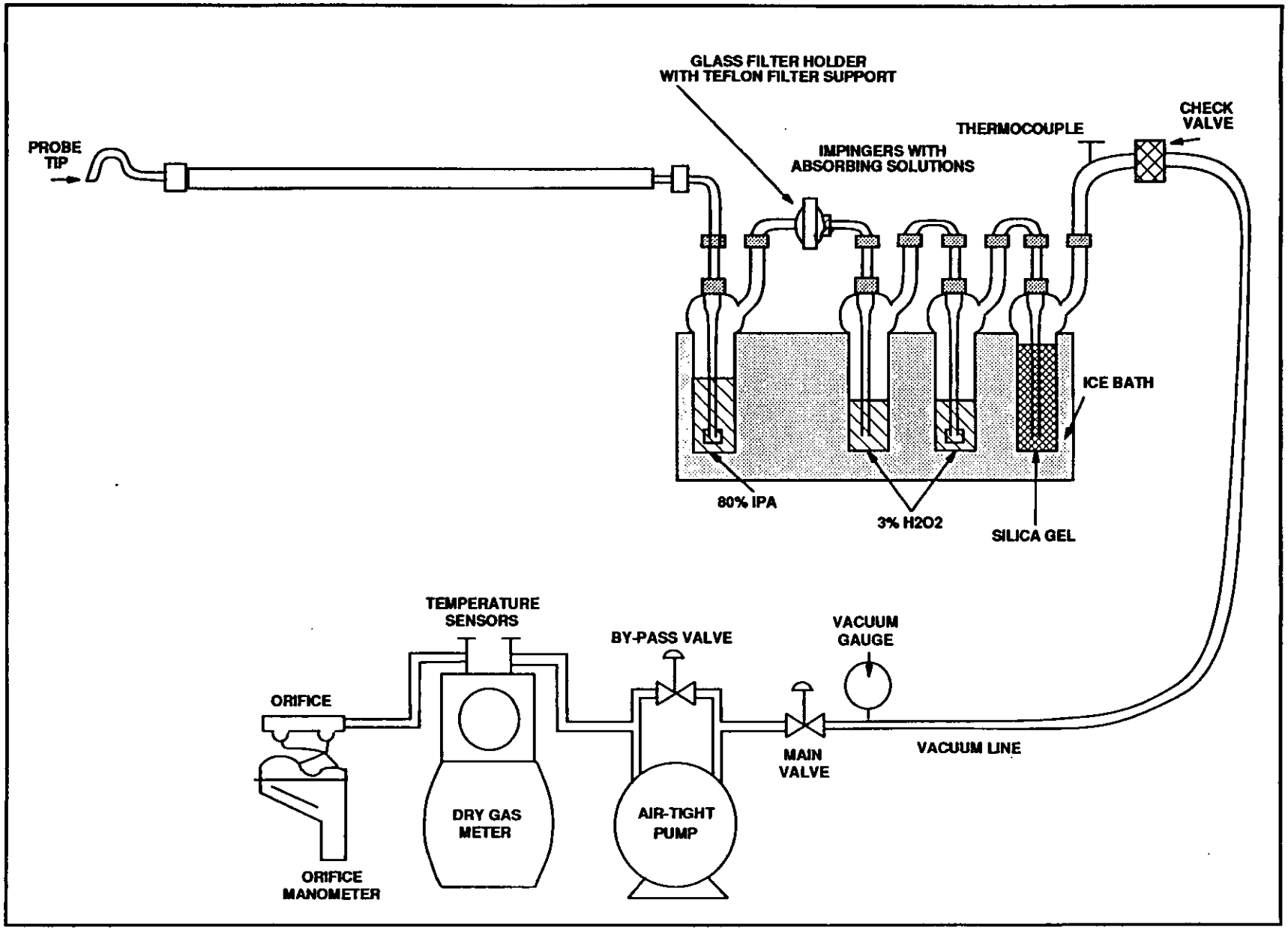


FIGURE 3

EPA METHOD 6 - SULFUR DIOXIDE SAMPLING TRAIN

EPA6-D12

SECTION 5
TEST PROCEDURES

5.1 PRELIMINARY TESTS - SULFURIC ACID STACK

Preliminary test data were obtained at the sulfuric acid stack. Stack geometry measurements were verified, and traverse point distances calculated. A preliminary velocity traverse was performed utilizing a calibrated "S"-type pitot tube and Dwyer inclined manometer to determine velocity profiles. Flue gas temperatures were observed with a calibrated direct readout pyrometer equipped with a chromel-alumel thermocouple. Water vapor content was estimated from previous stack test data.

A check for the presence or absence of cyclonic flow was conducted at the test location prior to formal testing. The cyclonic flow check proved to be negative ($\cong$ <10°) thus verifying the suitability of the test site for obtaining representative samples.

Preliminary test data was used for nozzle sizing and nomograph set-up for Method 8 isokinetic sampling procedures.

Calibration of probe nozzles, pitot tubes, metering systems and temperature gauges was performed as specified in Section 5 of EPA Method 5 test procedures (see Appendix D for calibration records).

5.2 FORMAL TESTS - SULFURIC ACID STACK

A series of three H_2SO_4/SO_2 EPA Method 8 test runs were conducted on the sulfuric acid stack location. An additional eight Method 6 test runs were conducted at the stack location for the purpose of determining the relative accuracy of the stack SO_2 CEM.

Test period length for each Method 8 acid mist/SO_2 test run was 72 minutes (24 total traverse points at 3 minutes each). Each Method 6 test run on the stack and cylinder was 20 minutes in length.

During the Method 8 H_2SO_4/SO_2 sampling, gas stream velocities were measured by inserting a calibrated "S"-type pitot tube into the gas stream adjacent to the sampling nozzle. The velocity pressure differential was observed immediately after positioning the nozzle at each traverse point, and the sampling rate was adjusted to maintain isokineticity. Flue gas temperature was monitored at each point with the pyrometer and thermocouple. Temperature measurements were made at the final impinger and at the inlet and outlet of the dry gas meter. Test data were recorded at each point during all test periods.

The Method 6 stack samples were obtained at a single point (midpoint) in the flue gas stream. A constant rate (< 0.5 cfm) sampling technique was employed to collect the twenty minute sample for each run. Temperature measurements were made at the final impinger and at the inlet and outlet of the dry gas meter.

A constant rate (1.0 liter per minute) sampling technique was used to sample the CEM calibration gas cylinder. During each 20 minute sample period rotameter readings were monitored along with dry gas meter pressures, volumes and temperatures.

Leak checks were performed on each apparatus according to method instructions, prior to and following each run. In addition, leak checks were conducted before and after each traverse change over during each Method 8 test run.

During each Method 8 test run, a constant rate integrated sampling technique was employed to collect flue gas samples at each traverse point for the molecular weight determination using an Orsat analyzer. The sampling train was operated for 5 minutes with the tedlar bag disconnected

to purge extraneous gases prior to each test. The Method 3 flue gas sample train was leak checked before and after each test run.

Following completion of all H_2SO_4/SO_2 test runs, the impingers were purged with cleaned ambient air for 15 minutes. The purge air was passed through a 3% H_20_2 solution prior to the test impingers, to remove any SO_2 present in the ambient air.

SECTION 6
ANALYTICAL PROCEDURES

6.1 SULFURIC ACID MIST/SULFUR DIOXIDE SAMPLE RECOVERY

At the conclusion of each test, the sampling train was dismantled, the openings sealed, and the components transported to the field laboratory.

A consistent procedure was employed for sample recovery:

1. The internal surfaces of the nozzle, probe, and probe to impinger flexible (Teflon) line were rinsed with 80% isopropyl alcohol while brushing and the rinses poured into a plastic container (sample type 1).

2. The contents of the first impinger were weighed to the nearest 0.1 gram and the value recorded. The liquid was added to the nozzle/probe wash (sample type 1) along with an 80% isopropyl alcohol rinse of the impinger, glass connectors and front-half of the unheated filter holder. The unheated glass fiber filter was added to the 80% isopropyl alcohol nozzle/probe wash, impinger contents and wash.

3. The total liquid in the second and third impingers was weighed to the nearest 0.1 gram and the value recorded. The liquid was placed in a plastic container along with a distilled water rinse of the impingers and connectors and back-half of the unheated filter holder (sample type 2).

4. The silica gel was removed from the last impinger and immediately weighed to the nearest 0.1 gram. The weight gain was recorded.

5. Blank samples of the 80% isopropyl alcohol and 3% hydrogen peroxide solutions were placed into plastic containers.

Each container was labeled to clearly identify its contents. The fluid level in each container was marked to determine whether or not leakage occurred during transport to WESTON laboratories. All samples were placed in a locked crate for shipment. Sulfur dioxide audit samples were supplied by DNREC. The audit results were reported and were within the acceptable range. The SO_2 audit results are provided in Appendix B.

6.1.1 Sulfur Dioxide Sample Recovery

For each M6 test the sample recovery procedure was the same and was performed in the following manner:

1. The internal surfaces of the nozzle, and probe were rinsed with 80% isopropyl alcohol while brushing and the rinses poured into a plastic container (sample type 1).

2. The contents of the first impinger were weighed to the nearest 0.1 gram and the value recorded. The liquid was added to the nozzle/probe wash (sample type 1) along with an 80% isopropyl alcohol rinse of the impinger, glass connectors and front-half of the unheated filter holder. The unheated filter was added to the 80% isopropyl alcohol nozzle/probe wash and impinger contents and wash.

3. The total liquid in the second and third impingers was weighed to the nearest 0.1 gram and the value recorded. The liquid was placed in a plastic container along with a distilled water rinse of the impingers and connectors (sample type 2).

4. The silica gel was removed from the last impinger and immediately weighed to the nearest 0.1 gram. The weight gain was recorded.

5. Blank samples of the 80% isopropyl alcohol and 3% hydrogen peroxide solutions were placed into plastic containers.

The recovery procedures utilized to collect the M6 cylinder test samples were identical to that described above except no isopropanol rinse of the probe, and filter holder was conducted and the impinger solutions were not weighed since sulfuric acid mist was not a target analyte and moisture was not a consideration in the cylinder gas audit.

Each container was labeled to clearly identify its contents. The fluid level in each container was marked to determine whether or not leakage occurred during transport to WESTON laboratories. All samples were placed in a locked crate for shipment.

6.2 SULFURIC ACID MIST/SULFUR DIOXIDE SAMPLE ANALYSIS

6.2.1 Sulfuric Acid Mist

Following a volume measurement a 100 ml aliquot of sample type 1 was pipetted into a 250 ml Erlenmeyer flask. Two to four drops of thorin indicator were added and the solution titrated to a pink end point with 0.01 N barium perchlorate. The titration was repeated on a second aliquot and the titrant volumes averaged. A reagent blank was analyzed in like fashion.

6.2.2 Sulfur Dioxide

Each SO_2 sample (sample Type 2) was analyzed as follows:

Following a volume measurement an aliquot was pipetted into a 250 ml Erlenmeyer flask and brought to a concentration of 80% isopropanol. Two to four drops of thorin indicator were added and the mixture was titrated to a pink end point with 0.01 N barium perchlorate. The titration was repeated on a second aliquot and on a reagent blank. The DNREC audit samples were analyzed in like fashion.

Prior to conduct of the titrations for both H_2SO_4 and SO_2, the barium perchlorate solution was standardized against a standard sulfuric acid solution.

SECTION 7
TEST RESULTS AND DISCUSSION

A summary of the sulfuric acid mist and sulfur dioxide test results is presented in Table 1. A summary of the CEM relative accuracy for SO_2 is presented in Table 2. Table 3 presents a summary of the analysis of the standard gas cylinder and Table 4 presents a summary of EPA Method 6 and 8 SO_2 test results. Detailed test data and test results summaries are included in Tables 5 through 9 of this section.

All test data and test results shown herein are believed to be representative of process emissions encountered during the survey period. A representative of DNREC was present during a portion of the test program. Sulfur dioxide audit samples were supplied by DNREC and analyzed by WESTON with the source test samples. The audit results were reported to DNREC and were within the acceptable range.

During all of the Method 8 compliance test periods, the measured sulfuric acid mist mass emission rate was below the DNREC allowable limit of 0.5 lb/ton of 100% H_2SO_4 processed. The average sulfuric acid mist mass rate measured during the three test runs was 0.15 lb/ton of 100% H_2SO_4 processed. The average sulfur dioxide concentration measured during the three Method 8 test runs was 106 parts per million by volume which was below the state allowable limit of 1,000 ppm/v. The SO_2 monitor relative accuracy for the eleven test runs was 15%.

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CLAYMONT, DELAWARE
TABLE 5
SUMMARY OF H_2SO_4/SO_2 TEST RESULTS

TEST DATA:			
Test run number	1	2	3
Test location	SULFURIC ACID STACK		
Test date	11-19-91	11-19-91	11-19-91
Test time period	0910-1042	1200-1322	1455-1618
SAMPLING DATA:			
Sampling duration, min.	72.0	72.0	72.0
Nozzle diameter, in.	0.245	0.235	0.235
Cross sectional nozzle area, sq.ft.	0.000327	0.000301	0.000301
Barometric pressure, in. Hg	30.27	30.25	30.25
Avg. orifice press. diff., in H_2O	2.11	1.97	2.07
Avg. dry gas meter temp., deg F	74	83	91
Avg. abs. dry gas meter temp., deg. R	534	543	551
Total liquid collected by train, ml	4.0	15.0	9.0
Std. vol. of H_2O vapor coll., cu.ft.	0.19	0.71	0.43
Dry gas meter calibration factor	1.004	1.004	1.004
Sample vol. at meter cond., dcf	54.833	53.791	55.757
Sample vol. at std. cond., dscf (1)	55.305	53.338	54.519
Percent of isokinetic sampling	98.1	100.7	100.4
GAS STREAM COMPOSITION DATA:			
CO_2, % by volume, dry basis	2.5	3.1	2.6
O_2, % by volume, dry basis	10.4	11.6	10.5
CO, % by volume, dry basis	0.0	0.0	0.0
N_2, % by volume, dry basis	87.1	85.3	86.9
Molecular wt. of dry gas, lb/lb mole	28.821	28.965	28.832
H_2O vapor in gas stream, prop. by vol.	0.003	0.013	0.008
Mole fraction of dry gas	0.997	0.987	0.992
Molecular wt. of wet gas, lb/lb mole	28.78	28.82	28.75
GAS STREAM VELOCITY AND VOLUMETRIC FLOW DATA:			
Static pressure, in. H_2O	0.37	0.43	0.40
Static pressure, in. Hg	0.027	0.032	0.029
Absolute pressure, in. Hg	30.297	30.282	30.279
Avg. temperature, deg. F	177	177	177
Avg. absolute temperature, deg.R	637	637	637
Pitot tube coefficient	0.84	0.84	0.84
Total number of traverse points	24	24	24
Avg. gas stream velocity, ft./sec.	47.65	49.20	50.15
Stack/duct cross sectional area, sq.ft.	19.63	19.63	19.63
Avg. gas stream volumetric flow, wacf/min.	56100	57900	59100
Avg. gas stream volumetric flow, dscf/min.	46900	47900	49200
SULFURIC ACID EMISSIONS:			
Average concentration, lb/dscf	2.03E-06	1.62E-06	3.65E-06
Average concentration, ppm/v	7.97	6.35	14.34
Average concentration, mg/cu.m	31.99	25.49	57.53
Mass emission rate, lbs/hr	5.72	4.65	10.77
SULFUR DIOXIDE EMISSIONS:			
Average concentration, lb/dscf	1.98E-05	1.75E-05	1.58E-05
Average concentration, ppm/v	118.78	104.97	94.78
Average concentration, mg/cu.m	311.20	275.02	248.33
Mass emission rate, lbs/hr	55.65	50.23	46.52
SOURCE OPERATIONS DATA: (2)			
100% H_2SO_4 processed, tons/hr	48.17	48.17	45.46

(1) Standard Conditions = 68 deg. F. (20 deg. C.) and 29.92 inches (760 mm) mercury, dry basis.
(2) Data provided to WESTON by General Chemical personnel

GENERAL CHEMICAL
CLAYMONT, DELAWARE
TABLE 6
SUMMARY OF H2SO4/SO2 TEST RESULTS

TEST DATA:				
Test run number	4	5	6	7
Test location	SULFURIC ACID STACK			
Test date	11-20-91	11-20-91	11-20-91	11-20-91
Test time period	0800-0820	0900-0920	1005-1025	1100-1120
SAMPLING DATA:				
Sampling duration, min.	20.0	20.0	20.0	20.0
Barometric pressure, in. Hg	30.14	30.14	30.11	30.11
Avg. orifice press. diff., in H2O	0.76	0.75	0.75	0.75
Avg. dry gas meter temp., deg F	63	66	79	82
Avg. abs. dry gas meter temp., deg. R	523	526	539	542
Total liquid collected by train, ml	5.0	4.0	7.0	14.0
Std. vol. of H2O vapor coll., cu.ft.	0.24	0.19	0.33	0.66
Dry gas meter calibration factor	1.004	1.004	1.004	1.004
Sample vol. at meter cond., dcf	9.216	9.442	10.715	9.458
Sample vol. at std. cond., dscf (1)	9.421	9.593	10.628	9.320
SULFURIC ACID EMISSIONS:				
Average concentration, lb/dscf	2.42E-06	2.24E-06	2.52E-06	2.10E-06
Average concentration, ppm/v	9.51	8.81	9.91	8.27
Average concentration, mg/cu.m	38.13	35.32	39.75	33.16
SULFUR DIOXIDE EMISSIONS:				
Average concentration, lb/dscf	1.86E-05	1.84E-05	1.75E-05	1.94E-05
Average concentration, ppm/v	111.74	110.76	105.45	116.67
Average concentration, mg/cu.m	292.76	290.20	276.29	305.68

(1) Standard Conditions = 68 deg. F. (20 deg. C.) and 29.92 inches (760 mm) mercury, dry basis

GENERAL CHEMICAL
CLAYMONT, DELAWARE
TABLE 7
SUMMARY OF H2SO4/SO2 TEST RESULTS

TEST DATA:				
Test run number	8	9	10	11
Test location		SULFURIC ACID STACK		
Test date	11-20-91	11-20-91	11-20-91	11-20-91
Test time period	1200-1220	1302-1322	1415-1435	1505-1525
SAMPLING DATA:				
Sampling duration, min.	20.0	20.0	20.0	20.0
Barometric pressure, in. Hg	30.11	30.11	30.11	30.11
Avg. orifice press. diff., in H2O	0.75	0.75	0.75	0.75
Avg. dry gas meter temp., deg F	81	82	89	91
Avg. abs. dry gas meter temp., deg. R	541	542	549	551
Total liquid collected by train, ml	5.3	8.7	4.6	14.0
Std. vol. of H2O vapor coll., cu.ft.	0.25	0.41	0.22	0.66
Dry gas meter calibration factor	1.004	1.004	1.004	1.004
Sample vol. at meter cond., dcf	9.496	10.531	9.982	8.992
Sample vol. at std. cond., dscf (1)	9.371	10.378	9.714	8.724
SULFURIC ACID EMISSIONS:				
Average concentration, lb/dscf	3.65E-06	1.56E-06	5.15E-06	3.80E-06
Average concentration, ppm/v	14.33	6.12	20.22	14.93
Average concentration, mg/cu.m	57.47	24.56	81.11	59.91
SULFUR DIOXIDE EMISSIONS:				
Average concentration, lb/dscf	1.86E-05	2.02E-05	1.78E-05	2.06E-05
Average concentration, ppm/v	111.53	121.23	107.25	123.90
Average concentration, mg/cu.m	292.22	317.63	281.00	324.61

(1) Standard Conditions = 68 deg. F. (20 deg. C.) and
29.92 inches (760 mm) mercury, dry basis

GENERAL CHEMICAL
CLAYMONT, DELAWARE
TABLE 8
SUMMARY OF H2SO4/SO2 AUDIT TEST RESULTS

TEST DATA:						
Test run number	1	2	3	4	5	6
Test location	GAS CYLINDER CHECK			GAS CYLINDER CHECK		
Test date	11-18-91	11-18-91	11-18-91	11-18-91	11-18-91	11-18-91
Test time period	1230-1250	1255-1315	1320-1340	1345-1405	1410-1430	1435-1455
SAMPLING DATA:						
Sampling duration, min.	20.0	20.0	20.0	20.0	20.0	20.0
Barometric pressure, in. Hg	30.32	30.32	30.32	30.32	30.32	30.32
Avg. orifice press. diff., in H2O	0.75	0.75	0.75	0.75	0.75	0.75
Avg. dry gas meter temp., deg F	62	65	68	70	70	71
Avg. abs. dry gas meter temp., deg. R	522	525	528	530	530	531
Dry gas meter calibration factor	1.004	1.004	1.004	1.004	1.004	1.004
Sample vol. at meter cond., dl	19.545	19.860	19.790	19.830	20.080	19.900
Sample vol. at std. cond., dsl (1)	20.137	20.339	20.163	20.144	20.389	20.147
Sample vol. at std. cond., dscf (1)	0.711	0.718	0.712	0.711	0.720	0.711
SULFURIC ACID CONCENTRATIONS:						
Average concentration, lb/dscf	6.30E-08	5.06E-08	7.36E-08	3.55E-08	7.99E-08	4.47E-08
Average concentration, ppm/v	0.25	0.20	0.29	0.14	0.31	0.18
Average concentration, mg/cu.m	0.99	0.80	1.16	0.56	1.26	0.70
SULFUR DIOXIDE CONCENTRATIONS:						
Average concentration, lb/dscf	9.95E-05	1.06E-04	1.10E-04	1.06E-04	1.02E-04	1.03E-04
Average concentration, ppm/v	598.89	640.88	661.50	637.25	611.94	621.86
Average concentration, mg/cu.m	1569.12	1679.13	1733.14	1669.61	1603.30	1629.29

(1) Standard Conditions = 68 deg. F. (20 deg. C.) and 29.92 inches (760 mm) mercury, dry basis

APPENDIX A

RAW TEST DATA

GENERAL CHEMICAL
CLAYMONT, DELAWARE

Test Data			
Run number	1	2	3
Location	SULFURIC ACID STACK		
Date	11-19-91	11-19-91	11-19-91
Time period	0910-1042	1200-1322	1455-1618
Operator	JDO	JDO	JDO
Inputs For Calcs.			
Sq. rt. delta P	0.776520	0.801825	0.816640
Delta H	2.11380	1.96670	2.07300
Stack temp. (deg.F)	176.67	177.13	176.50
Meter temp. (deg.F)	74.25	82.88	90.67
Sample volume (act.)	54.833	53.791	55.757
Barometric press. (in.Hg)	30.27	30.25	30.25
Volume H2O imp. (ml)	-17.00	-5.00	-9.00
Weight chnge sil. gel (g)	21.00	20.00	18.00
% CO2	2.530	3.130	2.570
% O2	10.400	11.600	10.530
% CO	0.000	0.000	0.000
% N	87.070	85.270	86.900
Area of stack (sq.ft.)	19.63	19.63	19.63
Sample time (min.)	72	72	72
Static pressure (in.H2O)	0.370	0.430	0.400
Nozzle dia. (in.)	0.2450	0.2350	0.2350
Meter box cal.	1.0040	1.0040	1.0040
Cp of pitot tube	0.84	0.84	0.84
Laboratory Report Data			
Acid mist as H2SO4			
vol. of titrate, ml(cor)	21.15	15.15	43.33
nor. of titrate, g-eq/l	0.00992	0.00992	0.01000
vol. of sample, ml	495	531	425
vol. of aliquot, ml	100	100	100
dilution factor	1.0	1.0	1.0
Sulfur dioxide as SO2			
vol. of titrate, ml(cor)	82.70	78.20	69.70
nor. of titrate, g-eq/l	0.00998	0.00998	0.00998
vol. of sample, ml	375	338	350
vol. of aliquot, ml	20	20	20
dilution factor	1.0	1.0	1.0

GENERAL CHEMICAL
CLAYMONT, DELAWARE

Test Data

Run number	4	5	6	7
Location	SULFURIC ACID STACK			
Date	11-20-91	11-20-91	11-20-91	11-20-91
Time period	0800-0820	0900-0920	1005-1025	1100-1120
Operator	AW	AW	AW	AW

Inputs For Calcs.

Delta H	0.76000	0.75000	0.75000	0.75000
Meter temp. (deg.F)	63.13	66.38	78.63	82.13
Sample volume (act.)	9.216	9.442	10.715	9.458
Barometric press. (in.Hg)	30.14	30.14	30.11	30.11
Volume H2O imp. (ml)	-3.00	-17.00	0.00	1.00
Weight chnge sil. gel (g)	8.00	21.00	7.00	13.00
Sample time (min.)	20	20	20	20
Meter box cal.	1.0040	1.0040	1.0040	1.0040

Laboratory Report Data

Acid mist as H2SO4				
vol. of titrate, ml(cor)	5.70	5.45	7.03	6.15
nor. of titrate, g-eq/l	0.0100	0.0100	0.0100	0.0100
vol. of sample, ml	370	365	353	295
vol. of aliquot, ml	100	100	100	100
dilution factor	1.0	1.0	1.0	1.0
Sulfur dioxide as SO2				
vol. of titrate, ml(cor)	14.20	15.20	15.70	13.95
nor. of titrate, g-eq/l	0.00998	0.00998	0.00998	0.00998
vol. of sample, ml	350	330	337	368
vol. of aliquot, ml	20	20	20	20
dilution factor	1.0	1.0	1.0	1.0

GENERAL CHEMICAL
CLAYMONT, DELAWARE

Test Data

Run number	8	9	10	11
Location		SULFURIC ACID STACK		
Date	11-20-91	11-20-91	11-20-91	11-20-91
Time period	1200-1220	1302-1322	1415-1435	1505-1525
Operator	AW	AW	AW	AW

Inputs For Calcs.

Delta H	0.75000	0.75000	0.75000	0.75000
Meter temp. (deg.F)	81.38	82.13	89.00	90.63
Sample volume (act.)	9.496	10.531	9.982	8.992
Barometric press. (in.Hg)	30.11	30.11	30.11	30.11
Volume H2O imp. (ml)	-0.20	3.20	-1.40	6.50
Weight chnge sil. gel (g)	5.50	5.50	6.00	7.50
Sample time (min.)	20	20	20	20
Meter box cal.	1.0040	1.0040	1.0040	1.0040

Laboratory Report Data

Acid mist as H2SO4				
vol. of titrate, ml(cor)	10.40	5.25	15.95	9.03
nor. of titrate, g-eq/l	0.0100	0.0100	0.0100	0.0100
vol. of sample, ml	304	285	290	340
vol. of aliquot, ml	100	100	100	100
dilution factor	1.0	1.0	1.0	1.0
Sulfur dioxide as SO2				
vol. of titrate, ml(cor)	22.95	23.95	17.95	16.20
nor. of titrate, g-eq/l	0.00998	0.00998	0.00998	0.00998
vol. of sample, ml	215	248	274	315
vol. of aliquot, ml	20	20	20	20
dilution factor	1.0	1.0	1.0	1.0

GENERAL CHEMICAL
CLAYMONT, DELAWARE

Test Data						
Run number	1	2	3	4	5	6
Location	GAS CYLINDER CHECK			GAS CYLINDER CHECK		
Date	11-18-91	11-18-91	11-18-91	11-18-91	11-18-91	11-18-91
Time period	1230-1250	1255-1315	1320-1340	1345-1405	1410-1430	1435-1455
Operator	JDO	JDO	JDO	JDO	JDO	JDO
Inputs For Calcs.						
Sq. rt. delta P						
Delta H	0.750	0.750	0.750	0.750	0.750	0.750
Stack temp. (deg.F)						
Meter temp. (deg.F)	62.15	65.30	68.00	69.58	69.80	71.38
Sample volume (act.)	19.545	19.860	19.790	19.830	20.080	19.900
Barometric press. (in.Hg)	30.32	30.32	30.32	30.32	30.32	30.32
Volume H2O imp. (ml)						
Weight chnge sil. gel (g)						
% CO2						
% O2						
% CO						
% N						
Area of stack (sq.ft.)						
Sample time (min.)	20	20	20	20	20	20
Static pressure (in.H2O)						
Nozzle dia. (in.)						
Meter box cal.	1.004	1.004	1.004	1.004	1.004	1.004
Cp of pitot tube						
Laboratory Report Data						
Acid mist as H2SO4						
vol. of titrate, ml(cor)	0.55	0.450	0.675	0.325	0.675	0.350
nor. of titrate, g-eq/l	0.00992	0.00992	0.00992	0.00992	0.00992	0.00992
vol. of sample, ml	43	32	41	41	45	48
vol. of aliquot, ml	20	15	20	20	20	20
dilution factor	1.0	1.0	1.0	1.0	1.0	1.0
Sulfur dioxide as SO2						
vol. of titrate, ml(cor)	27.05	14.75	16.43	14.73	16.33	13.45
nor. of titrate, g-eq/l	0.00992	0.00992	0.00992	0.00992	0.00992	0.00992
vol. of sample, ml	56	74	68	73	64	78
vol. of aliquot, ml	15	10	10	10	10	10
dilution factor	1.0	1.0	1.0	1.0	1.0	1.0

FACILITY: Olin Chemical
TEST LOCATION: Hawley Creek
TEST RUN NO.: 1-23 M8, 6-11 M6 1-6 Cylinder Analy
TEST DATE: 11/18 - 11/20

ROY F. WESTON, INC.

EMISSION TEST DATA/REPORT
QA/QC CHECK LIST

	Initial Data Averages	Data Check 1	Data Check 2 (if req'd)	Data Completeness Check
Raw Test Data	JDO	✓✓ JDO		JDO
	Initial Lab Calculator	**Check 1**	**Check 2 (if req'd)**	**Data Completeness Check**
Laboratory Data	MK	JDO		
	Initial Calculator	**Check 1**	**Check 2 (if req'd)**	**Reasonableness Check**
Test Result Calculations	SL	JDO	JDO	
	Author	**Check 1**	**Check 2 (if req'd)**	**Completeness Reasonableness Check**
Test Data Tables	JDO	JDO		
	Author	**Check 1**	**Check 2 (if req'd)**	**Table of Contents, Figure, page number Check**
Report Body	JDO	JDO		
	Originator	**Check 1**	**Check 2 (if req'd)**	
Appendices Completeness	JDO			

Compilation Check: Page alignment and completeness

Draft Report _____
(if required)
Final Report _____

Date provided to Client: _____

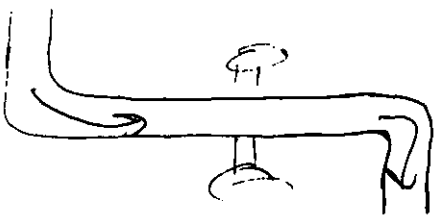
Final Report Review: PD BLJ
PM JDO
SM/DM _____

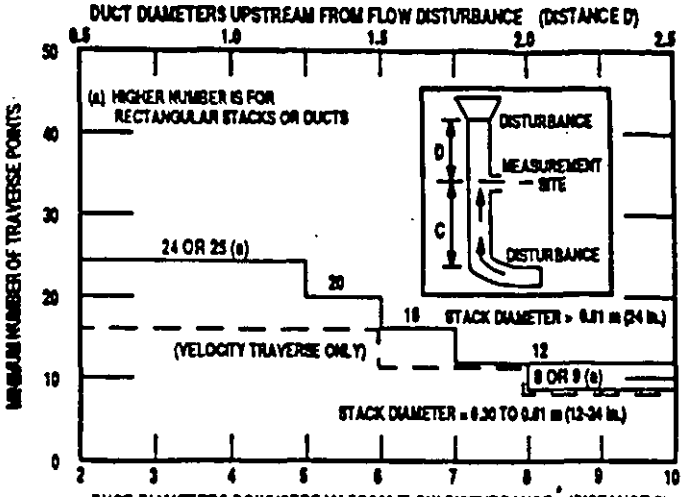
etdr10.24

WESTON.

TRAVERSE POINT LOCATION FOR CIRCULAR AND RECTANGULAR DUCTS

PLANT General Chem.
DATE 11/18/91
SAMPLING LOCATION Sulfric Acid stack
INSIDE OF FAR WALL TO
OUTSIDE OF PORT (DISTANCE A) 66"
INSIDE OF NEAR WALL TO
OUTSIDE OF PORT (DISTANCE B) 6"
STACK I.D. (DISTANCE A - DISTANCE B) 60
NEAREST UPSTREAM DISTURBANCE (C) 25'
NEAREST DOWNSTREAM DISTURBANCE (D) 10'
CALCULATOR JPD





RECTANGULAR DUCT EQUIVALENT DIAMETER DETERMINATION FOR THE MINIMUM NUMBER OF TRAVERSE POINTS $= \frac{2LW}{L+W}$

TRAVERSE POINT NUMBER	1 FRACTION OF STACK I.D.	2 STACK I.D.	3 PRODUCT OF COLUMNS 1 AND 2 (TO NEAREST 1/8 INCH)	4 DISTANCE B (PORT DEPTH)	5 TRAVERSE POINT LOCATION FROM OUTSIDE OF PORT (SUM OF COLUMNS 3 AND 4)
1	.021	60	1 1/4	6"	7 1/4
2	.067	↓	4	↓	10
3	.118	↓	7 1/8	↓	13 1/8
4	.177	↓	10 3/8	↓	16 5/8
5	.250	↓	15	↓	21
6	.356	↓	21 3/8	↓	27 3/8
7	.644	↓	38 3/8	↓	44 5/8
8	.750	↓	45	↓	51
9	.823	↓	49 3/8	↓	55 3/8
10	.882	↓	52 7/8	↓	58 7/8
11	.933	↓	56	↓	62
12	.979	↓	58 3/4	↓	64 3/4
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					

LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

	4	6	8	10	12	14	16	18	20	22	24
1	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3	75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4	93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5		85.4	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6		95.6	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
7			89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
8			96.8	85.4	75.0	63.4	37.5	28.6	25.0	21.9	19.4
9				91.8	82.3	73.1	62.5	38.2	30.6	26.3	23.0
10				97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11					93.3	85.4	78.0	70.4	61.2	39.3	32.3
12					97.9	90.1	83.1	76.4	69.4	60.7	39.8
13						94.3	87.5	81.2	75.0	68.5	60.2
14						98.2	91.5	85.4	79.6	73.8	67.7
15							95.1	88.1	83.5	78.2	72.8
16							98.4	92.5	87.1	82.0	77.0
17								95.6	90.3	85.4	80.6
18								98.6	93.3	88.4	83.9
19									96.1	91.3	86.6
20									98.7	94.0	89.5
21										96.5	92.1
22										98.9	94.5
23											96.8
24											98.9

LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS

	2	3	4	5	6	7	8	9	10	11	12
1	25.0	16.7	12.5	10.0	8.3	7.1	6.3	5.6	5.0	4.5	4.2
2	75.0	50.0	37.5	30.0	25.0	21.4	18.8	16.7	15.0	13.6	12.5
3		83.3	62.5	50.0	41.7	35.7	31.3	27.8	25.0	22.7	20.8
4			87.5	70.0	58.3	50.0	43.8	38.9	35.0	31.8	29.2
5				90.0	75.0	64.3	56.3	50.0	45.0	40.9	37.5
6					91.7	78.6	68.8	61.1	55.0	50.0	45.8
7						92.9	81.3	72.2	65.0	59.1	54.2
8							93.8	83.3	75.0	68.2	62.5
9								94.4	85.0	77.3	70.8
10									95.0	86.4	79.2
11										95.5	87.5
12											95.8

JEFF02-06

WESTON

GAS VELOCITY AND VOLUME DATA FORM

Company: General Chem.
Plant: Claymont, Del.
Location: Sulfic Acid Stack
Date: 11/18/91 Run No.: Peakim
Operators: Williams / Erndwein
Barometric Pressure, in. Hg: 30.32

Stack Diameter, in.:
Cross Sectional Area (AS), ft²:
Pitot Tube ID No.: P3 Cp:
Pitot Tube Leak Check:
Notes: Note the cyclonic check was performed independent of vel. traverse

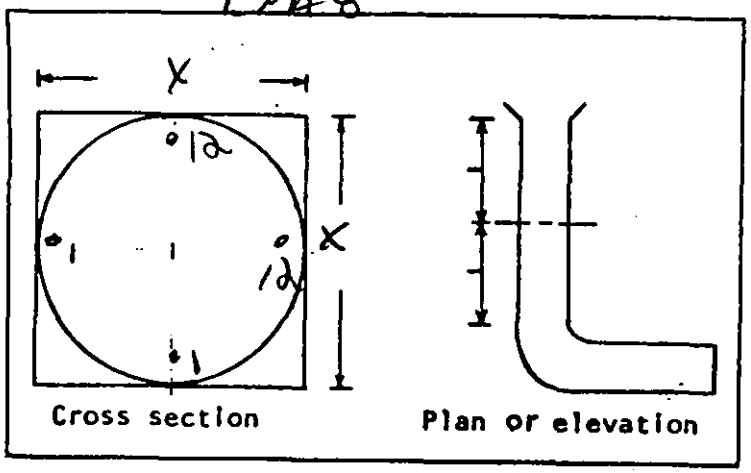
24-Hour Clock Time	Traverse Point Number	Velocity Head (Δp), in. H_2O	Stack Temperature (T_s), °F	Static Pressure (P_{static}), in. H_2O	Cyclonic Flow Determination: Δp at 0° Reference	Cyclonic Flow Determination: Angle (α) which yields a null Δp
11:32	X 1	.35	178		0.0	
	2	.48	180		0.0	
	3	.54	182		0.0	
	4	.55	182		0.0	
	5	.56	182	+ .33	0.0	
	6	.52	183		0.0	
	7	.52	183		0.02	3
	8	.54	183		0.0	
	9	.58	183		0.0	
	10	.59	183		0.0	
	11	.58	182		0.0	
	12	.54	182		0.0	
		.529166	197			
	Y 1	.29	181		0.0	
	2	.54	182		0.02	3
	3	.56	182		0.0	
	4	.55	182		0.0	
	5	.56	182		0.0	
	6	.54	182	+ .37	0.0	
	7	.56	182		0.0	
	8	.58	182		0.0	
	9	.63	182		0.0	
	10	.65	182		0.0	
	11	.59	182		0.0	
	12	.54	182		0.0	
		.549166	181			
		Avg. $\sqrt{\Delta p}$	Avg. T_s	Avg. P_{static}		Avg. α[a]

[a] Avg. α must be < 20° to be acceptable

EPA2-AT

BTT. TE LD I FQ

Plant General Chemical
City Claymont De
Location Hazox Stack
Operator O'Neill
Run No. DINE Date 11-19-91
Ambient temp., °F 57
Baro. press. (P_b), in. Hg. 30.27
Sample box no. #1
Meter box no. 11
Meter box ΔH@ 2.025
Meter box cal. (Y) 1.004
Probe length, ft. 6
Probe liner material PDR20
Probe heater setting 4D



Pitot tube identification no. P3
Pitot tube cal. factor (C_p) .840
Nozzle identification no. —
Avg. nozzle diameter (D_n), in. .245
Pyrometer identification no. #1
Thermocouple identification no. #1
Assumed moisture, % <1
Assumed temperature, °F. 181
Static pressure (P_{static}), in. H_2O +.37
C factor — Reference Δp —
Initial leak rate .006 cfm @ 15 in. Hg
Final leak rate .002 cfm @ 6 in. Hg
Filter no. N/A
Comments: Pitot LCF = good M3 = good
Pitot LCF = good M3 = good

Test point schematic b = 3.5

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, ft.^{3}	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
	0	0910			791.181						
X 1	3		.61	2.14	793.5	66	64	176	5	57	—
2	6		.63	2.2	796.5	68	65	178	5	50	—
3	9		.65	2.28	798.1	66	73	177	5	44	—
4	12		.65	2.28	800.3	66	74	179	5	45	—
5	15		.61	2.14	802.6	68	77	178	5	46	—
6	18		.61	2.14	805.6	68	77	178	5	48	
7	21		.59	2.07	807.6	68	77	177	5	50	—
8	24		.58	2.0	810.0	69	79	177	5	50	—
9	27		.57	2.0	812.0	70	80	177	5	52	—
10	30		.57	2.0	814.1	70	80	178	5	53	—
11	33		.57	2.0	816.2	71	80	177	5	55	—
12	36	0946	.57	2.0	818.963	71	89	177	5	56	—
				.015 at 7"							
				pre pitot	Y = .005 @ 15"						
	Total θ		Avg. $\sqrt{\Delta P}$	Avg. ΔH	Total V_m	Avg. T_m		Avg. T_s	Max. vac.	Max. temp.	Min. Max.

Comments:

EPA 8
General Chemical

11-18-91
Run 1

Sheet 2 of 2

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, $ft.^3$	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in. Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
	0	1006			818.743						
1	3		.66	2.31	819.1	72	74	177	5	47	—
2	6		.64	2.24	823.5	73	79	179	5	47	—
3	9		.62	2.17	825.7	72	79	177	5	47	—
4	12		.66	2.31	828.0	73	81	178	5	49	—
5	15		.64	2.24	831.3	73	81	177	5	52	—
6	18		.62	2.17	833.7	74	81	177	5	50	—
7	21		.62	2.17	834.7	74	80	177	5	48	—
8	24		.62	2.17	838.0	74	81	177	5	43	—
9	27		.58	~~1.8~~ 2.03	841.0	75	80	176	5	45	—
10	30		.62	2.17	842.4	79	71	176	5	50	—
11	33		.50	1.75	844.0	74	81	173	5	50	—
12	36	1042	.50	1.75	846.294	73	82	173	5	49	—
	Total θ 72	—	Avg. $\sqrt{\Delta P}$ ~~.768124~~	Avg. ΔH 2.1138	Total V_m 54.833	Avg. T_m 74.25		Avg. T_s ~~176.67~~	Max. vac 5	Max. temp. 57	Min. — Max. —

Purged 15 minutes

End L

27.551

97.5%
Acfm - 57000
46800

Comments: 177652 176.67

SOx SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant Gen Chemical Sample Date 11-19-91
Sample Location Hwy Stack Run Number ONE
Sample Recovery Person JPO Recovery Date 11-19-91
Filter Number(s) N/A

MOISTURE

Impingers	80% ISO		3% H_2O_2		Silica Gel			
Final volume (wt)	210	ml	222	ml	Final wt	321 g		g
Initial volume (wt)	257	ml	292	ml	Initial wt	300 g		g
Net volume (wt)	-47	ml	30	ml	Net wt	21 g		g

Total moisture +4 ml
Color of silica gel blue 30%
Description of impinger water all clear

RECOVERED SAMPLE

Blank Filter container number _____ Sealed _____
Filter container number _____ Sealed _____
Description of particulate on filter _____

80% ISO and Rinse container number GC-M8-1-ISO Liquid level marked? ✓
3% H_2O_2 and Rinse container number GC-M8-1-H_2O_2 Liquid level marked? ✓
80% ISO Blank container number GC-BLK-ISO Liquid level marked? ✓
3% H_2O_2 Blank container number GC-Blk-H_2O_2 Liquid level marked? ✓
Samples stored and locked 11-19-91 JPO
Remarks: _____

Date of laboratory custody 11-25-91
Laboratory personnel taking custody CL
Remarks: _____

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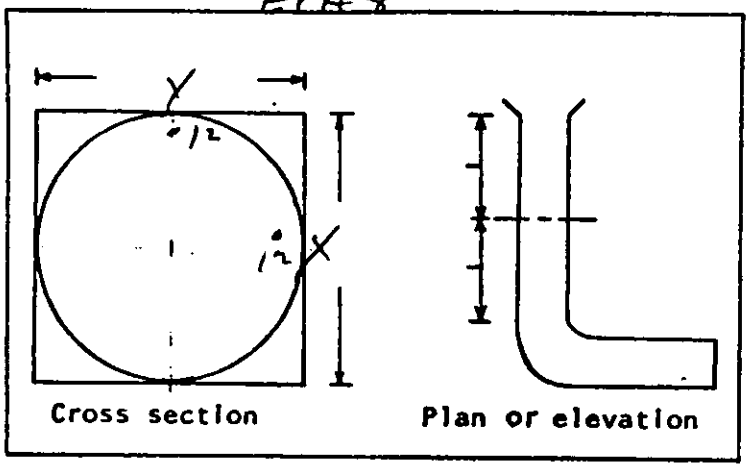
EKH8

Sheet 1 of 2

Plant General Chemical
City Claymont De
Location H2SO4 Stack
Operator O'Neill
Run No. TWO Date 11-19-91
Ambient temp., °F 60
Baro. press. (P_b), in. Hg. 30.25
Sample box no. #1
Meter box no. #11
Meter box ΔH@ 2.025
Meter box cal. (Y) 1.004
Probe length, ft. 6
Probe liner material Boro
Probe heater setting 40



Pitot tube identification no. P3
Pitot tube cal. factor (C_p) .840
Nozzle identification no. N21
Avg. nozzle diameter (D_n), in. .235
Pyrometer identification no. #11
Thermocouple identification no. #1
Assumed moisture, % <1
Assumed temperature, °F. 181
Static pressure (P_{static}), in. H_2O +.43
C factor — Reference Δp —
Initial leak rate .005 cfm @ 15 in. Hg
Final leak rate .007 cfm @ 8 in. Hg
Filter no. D7A
Comments: Pitot = good Ind = good
M3 = good Ind = good

Test point schematic 6 = 3.5

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, ft.^{3}	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
	0	1200			855.737						
Y 1	3		.66	1.98	857.4	76	78	177	6	52	—
2	6		.66	1.98	860.0	77	79	177	6	53	—
3	9		.70	2.1	863.9	78	83	177	7	50	—
4	12		.70	2.1	865.1	78	85	178	6.5	46	—
5	15		.66	1.98	867.3	79	87	177	6.5	46	—
6	18		.66	1.98	870.0	79	87	177	6.5	46	—
7	21		.65	1.95	872.0	79	87	177	6.5	47	—
8	24		.65	1.95	874.2	79	88	177	6.5	47	—
9	27		.66	1.98	876.9	79	88	178	6.5	47	—
10	30		.62	1.86	878.9	80	88	178	6	47	—
11	33		.60	1.86	880.1	80	88	178	6	46	—
12	36	1236	.60	1.86	882.652	80	88	178	6	48	—
				MID PT LC = .007 at 8" Hg							
	Total θ		Avg. √ΔP	Avg. ΔH	Total V_m	Avg. T_m		Avg. T_s	Max. vac	Max. temp.	Min. Max.

Comments:

Run 2 11-19-91 Gas Chemical M8 Sheet 2 of 2

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, $ft.^3$	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in. Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
	0	1246			882.726						
X 1	3		.66	2.05	885.0	80	82	175	6.5	59	—
2	6		.68	2.11	887.0	80	84	177	6.5	51	—
3	9		.68	2.11	889.6	80	86	177	6.5	49	—
4	12		.65	2.01	891.9	81	88	177	6.5	48	—
5	15		.65	2.01	894.0	81	88	178	6.5	50	—
6	18		.62	1.92	897.1	82	87	178	6.5	51	—
7	21		.62	1.92	899.1	89	81	178	6.5	52	—
8	24		.65	1.95	902.1	88	82	177	6.5	52	—
9	27		.65	2.02	904.1	77	82	178	6.5	48	—
10	30		.62	1.92	906.7	76	77	177	6.5	47	—
11	33		.58	1.80	908.0	88	78	177	6.5	54	—
12	36	1322	.58	1.80	909.602	87	78	176	6.5	53	—
			Start	point X	LC =	.006	and 8"				
					26.876						
	Total θ		~~785760~~ Avg. $\sqrt{\Delta P}$	Avg. ΔH	Total V_m	Avg. T_m		Avg. T_s	Max. vac.	Max. temp.	Min.
	72		801825	1.9667	53.791	82.875		177.13	6.5	57	Max.

Comments:

SOx SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant Gen Chemical Sample Date 11/19/91
Sample Location Hardy Stack Run Number TWO
Sample Recovery Person JDD Recovery Date 11/19/91
Filter Number(s) N/A

MOISTURE

Impingers	80% ISO		3% H_2O_2		Silica Gel		
Final volume (wt)	221	ml	319	ml	Final wt	320 g	— g
Initial volume (wt)	257	ml	288	ml	Initial wt	300 g	— g
Net volume (wt)	-36	ml	31	ml	Net wt	20 g	g

Total moisture + 15
Color of silica gel blue 30%
Description of impinger water all clear

RECOVERED SAMPLE

Blank Filter container number _____ Sealed _____
Filter container number _____ Sealed _____
Description of particulate on filter _____

80% ISO and Rinse container number GC-M8-2-ISO Liquid level marked? ✓
3% H_2O_2 and Rinse container number GC-M8-2-H_2O_2 Liquid level marked? ✓
80% ISO Blank container number _____ Liquid level marked? _____
3% H_2O_2 Blank container number _____ Liquid level marked? _____
Samples stored and locked 11-19-91 JDD
Remarks: _____

Date of laboratory custody 11-25-91
Laboratory personnel taking custody CL
Remarks: _____

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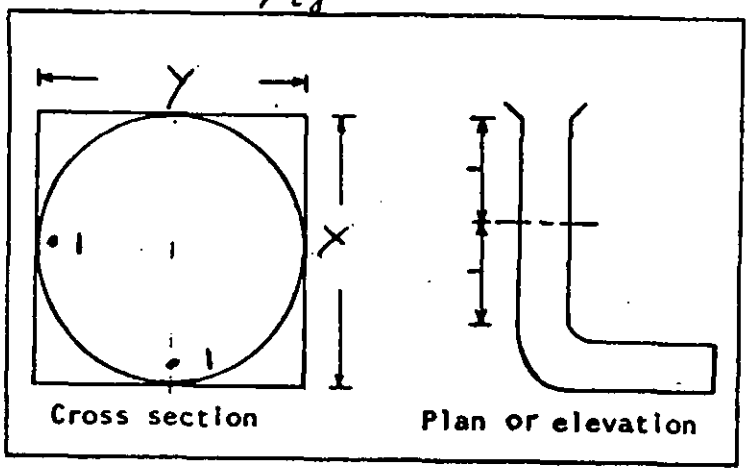
ATT. ATE LD FC

Mix

Page 1 of 2

Plant General Chemical
City Claymont De
Location Hardy Street
Operator O'Neill
Run No. 3 Date 11-19-91
Ambient temp., °F 60
Baro. press. (P_b), in. Hg. 30.25
Sample box no. #1
Meter box no. #11
Meter box ΔH@ 2.025
Meter box cal. (Y) 1.004
Probe length, ft. 6'
Probe liner material Pyrex
Probe heater setting 35



Test point schematic

Pitot tube identification no. P3
Pitot tube cal. factor (C_p) .840
Nozzle identification no. N21
Avg. nozzle diameter (D_n), in. .235
Pyrometer identification no. #11
Thermocouple identification no. #1
Assumed moisture, % <1
Assumed temperature, °F. 180
Static pressure (P_{static}), in. H_2O +.40
C factor — Reference Δp —
Initial leak rate .006 cfm @ 15 in. Hg
Final leak rate .009 cfm @ 7 in. Hg
Filter no. N/A
Comments: pitot LC = 5001 bad seal
M3 LC = 5014 bad seal

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, ft.^{3}	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
	0	1455			920.667						
X 1	3		.68	2.11	923.7	97	92	177	6	63	—
2	6		.68	2.11	926.6	91	87	177	6	45	—
3	9		.73	2.26	928.7	91	87	177	6	45	—
4	12		.72	2.23	931.0	92	87	178	6	45	—
5	15		.68	2.11	933.2	92	87	177	6	44	—
6	18		.68	2.11	935.6	93	85	177	6	47	—
7	21		.68	2.11	938.0	93	85	177	6	47	—
8	24		.68	2.11	940.5	95	88	178	6	49	—
9	27		.66	2.05	941.7	95	88	177	6	48	—
10	30		.60	1.86	943.9	95	88	175	6	48	—
11	33		.62	1.92	945.9	95	88	176	6	48	—
12	36	1531	.62	1.92	948.504	95	88	176	6	48	—
							Mix	pt LC = 0.006	cfm at	7"	
					27.837						
	Total θ		Avg. √ΔP	Avg. ΔH	Total V_m	Avg. T_m		Avg. T_s	Max. vac.	Max. temp.	Min. Max.

Comments:

Gen Chemical 11-19-81

Sheet 2 of 2

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, $ft.^3$	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
	0	1542			948.618						
Y 1	3		.68	2.11	951.2	87	89	175	5	62	—
2	6		.72	2.23	953.0	92	88	176	6	62	—
3	9		.72	2.23	954.8	93	88	176	6	46	—
4	12		.72	2.23	958.1	94	88	177	6.5	46	—
5	15		.70	2.17	960.7	94	89	177	6.5	47	
6	18		.66	2.05	963.4	96	88	177	6.5	47	—
7	21		.66	2.05	965.7	96	87	177	6.5	49	—
8	24		.66	2.05	968.0	96	89	176	6.5	49	—
9	27		.65	2.0	970.0	96	89	175	6.5	50	—
10	30		.62	1.92	972.2	90	89	175	6.5	49	—
11	33		.60	1.90	974.7	90	89	176	6.5	50	—
12	36	1618	.60	1.90	976.538	90	89	177	6.5	50	—
				Piped 15 min							
				Pre point Y	Leakrate = .005 at 8" Hg						
					27.920						
	Total θ 72	—	Avg. $\sqrt{\Delta P}$ .816398	Avg. ΔH 2.073	Total V_m 55.757	Avg. T_m 90.667		Avg. T_s 176.5	Max. vac.	Max. temp.	Min. Max.

Comments:

SOx SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant: Gen Chemical
Sample Date: 11-19-91
Sample Location: H_2SO_4 Stack
Run Number: Three
Sample Recovery Person: JPO
Recovery Date: 11-19-91
Filter Number(s): N/A

MOISTURE

Impingers	80% ISO		3% H_2O_2		Silica Gel		
Final volume (wt)	217	ml	321	ml	Final wt 370 g	— g	
Initial volume (wt)	257	ml	290	ml	Initial wt 300 g	— g	
Net volume (wt)	-40	ml	31	ml	Net wt 18 g	— g	

Total moisture: +9.0
Color of silica gel: blue 80%
Description of impinger water: all clear

RECOVERED SAMPLE

Blank Filter container number _____ Sealed _____
Filter container number _____ Sealed _____
Description of particulate on filter _____

80% ISO and Rinse container number: GC-M8-3-ISO Liquid level marked? ✓
3% H_2O_2 and Rinse container number: GC-M8-3-H_2O_2 Liquid level marked? ✓
80% ISO Blank container number _____ Liquid level marked? _____
3% H_2O_2 Blank container number _____ Liquid level marked? _____
Samples stored and locked: 11-19-91. JPO
Remarks: _____

Date of laboratory custody: 11-25-91
Laboratory personnel taking custody: C.L.
Remarks: _____

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GAS ANALYSIS DATA FORM

Plant General Chemical Sample location H_2SO_4 Stack

Date 11-18-91 Run no. 1-2-3 Operator OWeig

Sample type: single-point or multipoint; grab or integrated

Analytical method Orsat Comments leak test = good

Sample point	24-hour clock time	% CO2 Reading 1	% O2 Reading 2	% O2 Net[a]	% CO Reading 3	% CO Net[b]
1 - 1		2.5	13.0	10.5		0
1 - 2		2.6	12.9	10.3		0
1 - 3		2.5	12.9	10.4		0
	Ave	2.53		10.4		
2 - 1		3.2	14.8	11.6		0
2 - 2		3.1	14.7	11.6		0
2 - 3		3.1	14.7	11.6		0
	Ave	3.13		11.6		
3 - 1		2.6	13.0	10.4		0
3 - 2		2.6	13.2	10.6		0
3 - 3		2.5	13.2	10.6		0
	Ave	2.57		10.53		
Averages			----		----	

$\% N_2 = 100 - (\% CO_2 + \% O_2 + \% CO) =$

$MW_d = 0.440 (\% CO_2) + 0.320 (\% O_2) + 0.280 (\% N_2 + \% CO) =$

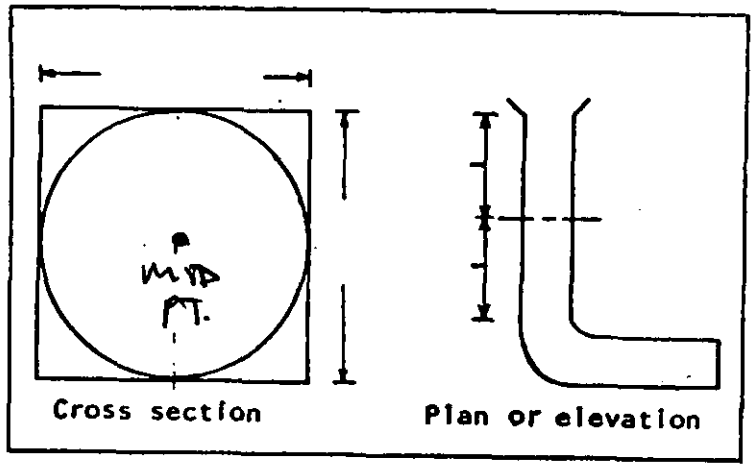
[a] Net % O_2 = Reading 2 - Reading 1

[b] Net % CO = Reading 3 - Reading 2

RTI. TE .D I FQ

Sheet 1 of 1

Plant Gen Chemical
City Claymont De
Location Hardy Stack
Operator Williams
Run No. 4 Date 11-20-91
Ambient temp., °F 60
Baro. press. (P_b), in. Hg. 30.14
Sample box no. #1
Meter box no. #11
Meter box ΔH@ 2.025
Meter box cal. (Y) 1.004
Probe length, ft. 6
Probe liner material Boro
Probe heater setting 30



Pitot tube identification no. —
Pitot tube cal. factor (C_p) —
Nozzle identification no. —
Avg. nozzle diameter (D_n), in. —
Pyrometer identification no. #11
Thermocouple identification no. —
Assumed moisture, % <1
Assumed temperature, °F. 180
Static pressure (P_{static}), in. H_2O —
C factor — Reference Δp —
Initial leak rate .016 cfm @ 15 in. Hg
Final leak rate .008 cfm @ 8 in. Hg
Filter no. N/A
Comments:

Test point schematic

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, ft.^{3}	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
	0	0800			983.483						
MID	5		~~0.7~~ —	0.73	985.7	62	57	—	3	57	—
POINT	10		—	0.76	988.0	65	60	—	3	52	—
	15		—	0.76	990.4	69	61	—	3	47	—
	20	0820	—	0.76	992.~~789~~ 699	68	63	—	3	48	—
					Purged 15 min			—			—
	Total θ 20	—	Avg. $\sqrt{\Delta P}$ —	Avg. ΔH 0.76	Total V_m 9.216	Avg. T_m 63.13		Avg. T_s —	Max. vac. 3	Max. temp. 57	Min. — Max. —

Comments:

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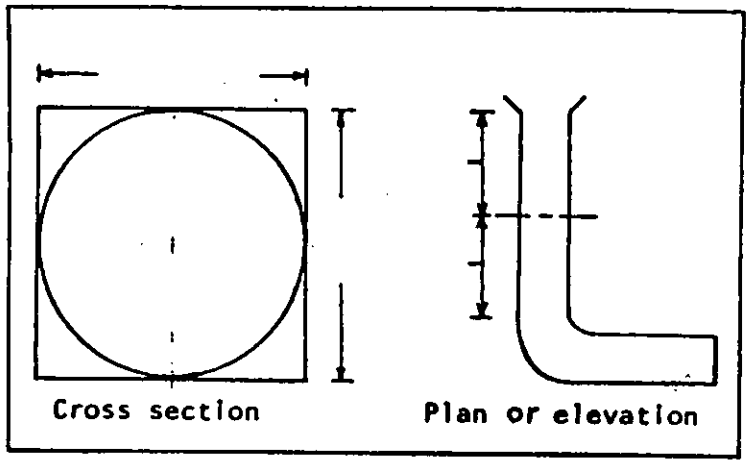
Sheet 1 of 1

Plant Gen Chemical
City Claymont De.
Location Hwy 13 Bush
Operator Williams
Run No. 5 Date 11-20-91
Ambient temp., °F
Baro. press. (P_b), in. Hg. 30.14
Sample box no. #1
Meter box no. #1
Meter box ΔH@ 2.025
Meter box cal. (Y) 1.004
Probe length, ft. 6'
Probe liner material Pyrex
Probe heater setting 30



Test point schematic

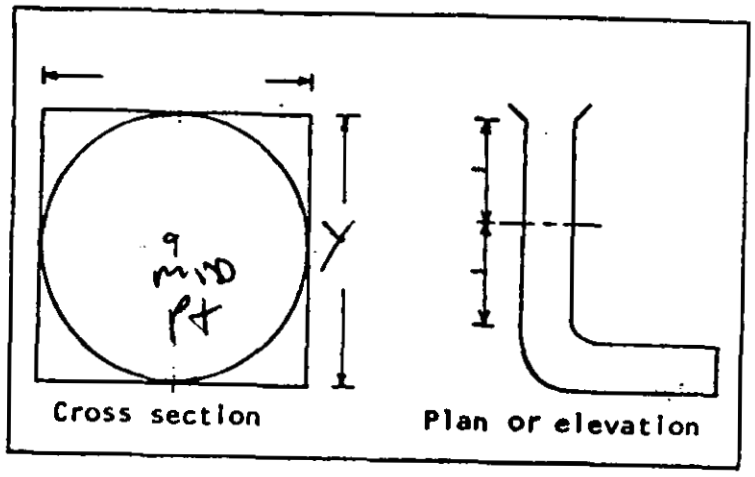
Pitot tube identification no. —
Pitot tube cal. factor (C_p) —
Nozzle identification no. —
Avg. nozzle diameter (D_n), in.
Pyrometer identification no. #11
Thermocouple identification no. —
Assumed moisture, % —
Assumed temperature, °F. —
Static pressure (P_{static}), in. H_2O —
C factor ____ Reference Δp
Initial leak rate .009 cfm @ 15 in. Hg
Final leak rate .005 cfm @ 7 in. Hg
Filter no. N/A
Comments:

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, ft.^{3}	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
	0	0960			993.722						
MIP POINT	5		—	0.75	996.1	61	62	—	3	59	—
	10		—	0.75	998.4	64	69	—	3	59	—
	15		—	0.75	1000.7	64	69	—	3	57	—
	20	0920	—	0.75	1003.164	71	71	—	3	58	—
					Purged 15 min						
	Total θ 20	—	Avg. $\sqrt{\Delta P}$ —	Avg. ΔH 0.75	Total V_m 9.442	Avg. T_m 66.38		Avg. T_s —	Max. vac. 3	Max. temp. 59	Min. — Max. —

Comments:

ARTI. ATE LD FC

Plant Gen Chemical
City Claymont De
Location Hanley Dock
Operator Williams
Run No. 6 Date 11-20-91
Ambient temp., °F 60
Baro. press. (P_b), in. Hg. 30.11
Sample box no. #1
Meter box no. #11
Meter box ΔH@ 2.025
Meter box cal. (Y) 1.004
Probe length, ft. 6'
Probe liner material Pyrex
Probe heater setting 30



Pitot tube identification no. —
Pitot tube cal. factor (C_p) —
Nozzle identification no. —
Avg. nozzle diameter (D_n), in. —
Pyrometer identification no. #1
Thermocouple identification no. —
Assumed moisture, % —
Assumed temperature, °F. —
Static pressure (P_{static}), in. H_2O —
C factor — Reference Δp —
Initial leak rate .009 cfm @ 15 in. Hg
Final leak rate .005 cfm @ 4 in. Hg
Filter no. N/A
Comments: —

Test point schematic

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, $ft.^3$	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
	0	1005			3.283						
MID	3		—	.75	6.4	77	74	—	2.5	64	—
Point	10		—	.75	9.1	82	78	—	2.5	51	—
	15		—	.75	11.7	83	77	—	2.5	51	—
	20	1025	—	.75	~~14.998~~ 13.998	80	78	—	2.5	52	—
				Purged	15 min						
	Total θ 20	—	Avg. $\sqrt{\Delta P}$ —	Avg. ΔH 0.75	Total V_m 10.715	Avg. T_m 78.63		Avg. T_s	Max. vac. 2.5	Max. temp. 64	Min. Max. —

Comments:

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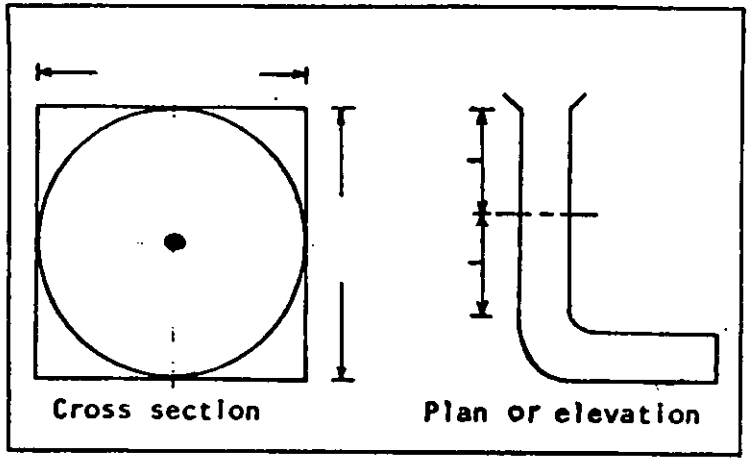
E 1 1

Plant Gen Chemical
City Claymont De
Location Hobby Shop
Operator William
Run No. 7 Date 11-20-91
Ambient temp., °F 60
Baro. press. (P_b), in. Hg. 30.11
Sample box no. #1
Meter box no. #11
Meter box ΔH@ 2.045
Meter box cal. (Y) 1.004
Probe length, ft. 6'
Probe liner material BORO
Probe heater setting 30



Test point schematic

Pitot tube identification no. —
Pitot tube cal. factor (C_p) —
Nozzle identification no. —
Avg. nozzle diameter (D_n), in. —
Pyrometer identification no. #11
Thermocouple identification no. —
Assumed moisture, % —
Assumed temperature, °F. —
Static pressure (P_{static}), in. H_2O —
C factor — Reference Δp —
Initial leak rate .007 cfm @ 15 in. Hg
Final leak rate .004 cfm @ 5 in. Hg
Filter no. N/A
Comments: —

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, $ft.^3$	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
	0	1100			14.438						
MID PT.	5		—	0.75	16.8	82	80	—	3	66	—
	10		—	0.75	19.1	83	80	—	3	60	—
	15		—	0.75	22.0	84	81	—	3	60	—
	20	1120	—	0.75	23.896	85	82	—	3	60	—
					Purged 15 min						
	Total θ 20	—	Avg. $\sqrt{\Delta P}$ —	Avg. ΔH 0.75	Total V_m 9.458	Avg. T_m 82.13		Avg. T_s	Max. vac 3	Max. temp. 66	Min. — Max. —

Comments:

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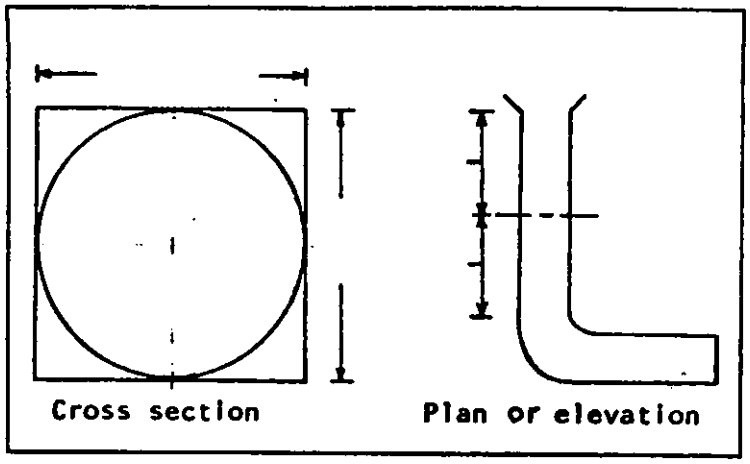
Sheet 1 of 1

Plant Gen Chemical
City Cincinnati Ohio
Location Hilsby Street
Operator Williams
Run No. 8 Date 11-20-91
Ambient temp., °F
Baro. press. (P_b), in. Hg. 30.11
Sample box no. #1
Meter box no. #11
Meter box ΔH@ 2.025
Meter box cal. (Y) 1.004
Probe length, ft. 6'
Probe liner material BORO
Probe heater setting 20



Test point schematic

Pitot tube identification no. —
Pitot tube cal. factor (C_p) —
Nozzle identification no. —
Avg. nozzle diameter (D_n), in. —
Pyrometer identification no. #11
Thermocouple identification no. —
Assumed moisture, % —
Assumed temperature, °F. —
Static pressure (P_{static}), in. H_2O —
C factor — Reference Δp —
Initial leak rate .006 cfm @ 15 in. Hg
Final leak rate .004 cfm @ 15 in. Hg
Filter no. N/A
Comments:

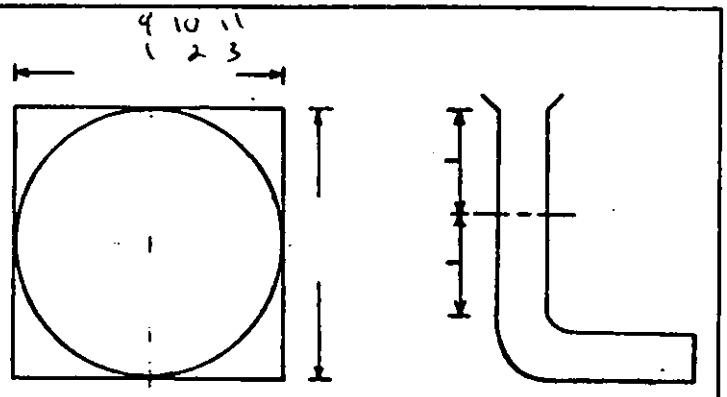
Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, ft.^{3}	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
	0	1200			24.006						
MIP Pt.	5		—	.75	26.3	80	81	—	3	67	—
	10		—	.75	28.7	80	81	—	3	64	
	15		—	.75	31.0	81	82	—	3	61	
	20	1220	—	.75	33.502	84	82	—	3	58	
					Purged 15 min						
	Total θ 20	—	Avg. $\sqrt{\Delta P}$ —	Avg. ΔH 0.75	Total V_m 9.496	Avg. T_m 81.38		Avg. T_s	Max. vac. 3	Max. temp. 67	Min. — Max. —

omments:

RTI. ITE ED I FQ

Sheet 1 of 1

Plant Gen Chemical
City Claymont De.
Location Henry Ishm
Operator Willm
Run No. 9 Date 11-20-91
Ambient temp., °F
Baro. press. (P_b), in. Hg. 30.11
Sample box no. #1
Meter box no. #11
Meter box ΔH@ 2.025
Meter box cal. (Y) 1.004
Probe length, ft. 6'
Probe liner material Moro
Probe heater setting 20



Pitot tube identification no. –
Pitot tube cal. factor (C_p) –
Nozzle identification no. –
Avg. nozzle diameter (D_n), in. –
Pyrometer identification no. #11
Thermocouple identification no. –
Assumed moisture, % <1
Assumed temperature, °F. 180
Static pressure (P_{static}), in. H_2O –
C factor – Reference Δp –
Initial leak rate .006 cfm @ 15 in. Hg
Final leak rate .008 cfm @ 15 in. Hg
Filter no. N/A
Comments: –

Test point schematic

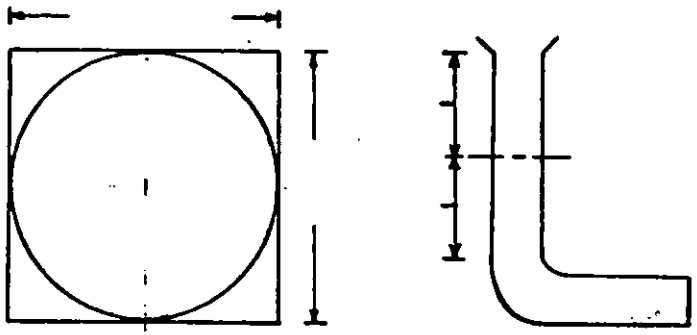
Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, ft.^{3}	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
	0	1302			34.588						
MM	5	1307	—	.75	38.0	79	80	—	4	64	—
Ar	10	1312	—	.75	40.3	86	83	—	4	62	—
	15	1317	—	.75	42.6	87	84	—	4	60	
	20	1322	—	.75	45.119	73	85	—	4	61	
					Purged 15 min						
	Total θ 20	—	Avg. $\sqrt{\Delta P}$ —	Avg. ΔH 0.75	Total V_m 10.531	Avg. T_m 82.125		Avg. T_s —	Max. vac. 4	Max. temp. 64	Min. — Max. —

Comments:

RTI. TE D I FQ

Sheet 1 of 1

Plant Dennal Chemical
City Clayment, Del
Location 14, Soil Stack
Operator TB/AW
Run No. 10 Date 11-20-91
Ambient temp., °F
Baro. press. (P_b), in. Hg. 30.11
Sample box no. #1
Meter box no. #11
Meter box ΔH@ 2.025
Meter box cal. (Y) 1.009
Probe length, ft. 6'
Probe liner material Boro
Probe heater setting 30



Test point schematic

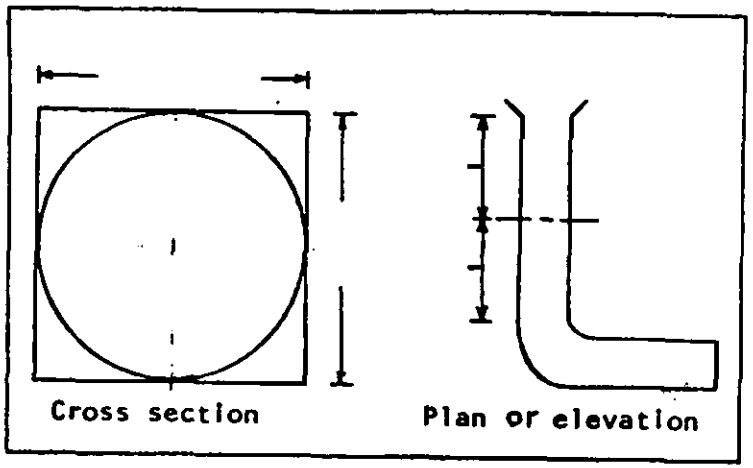
Pitot tube identification no. —
Pitot tube cal. factor (C_p) —
Nozzle identification no. —
Avg. nozzle diameter (D_n), in. —
Pyrometer identification no. #11
Thermocouple identification no.
Assumed moisture, % —
Assumed temperature, °F. —
Static pressure (P_{static}), in. H_2O
C factor — Reference Δp —
Initial leak rate .01 cfm @ 15 in. Hg
Final leak rate .01 cfm @ 15 in. Hg
Filter no. NA
Comments:

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, ft.^{3}	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
	~~1415~~ 0	1415			46.439						
MID PT	5	1420	—	.75	48.4	86	85	—	3	67	—
	10	1425	—	.75	50.8	88	87	—	3	59	
	15	1430	—	.75	53.4	92	89	—	3	54	
	20	1435	✓	.75	56.421	95	90	—	3	53	
	Total θ 20	—	Avg. $\sqrt{\Delta P}$ —	Avg. ΔH .75	Total V_m 9.982	Avg. T_m 89.1		Avg. T_s —	Max. vac. 3	Max. temp. 67	Min. — Max. —

Comments:

RTI. TE .0 I FQ

Plant: Formal Chemical
City: Elgin Ind.
Location: H_2SO_4 STACK
Operator: TB/AW
Run No. 11 Date 11-20-91
Ambient temp., °F
Baro. press. (P_b), in. Hg. 30.11
Sample box no. #1
Meter box no. #11
Meter box ΔH@ 2.025
Meter box cal. (Y) 1.004
Probe length, ft. 6'
Probe liner material Boro
Probe heater setting 30



Pitot tube identification no. —
Pitot tube cal. factor (C_p) —
Nozzle identification no. —
Avg. nozzle diameter (D_n), in. —
Pyrometer identification no. #11
Thermocouple identification no. —
Assumed moisture, % —
Assumed temperature, °F. —
Static pressure (P_{static}), in. H_2O —
C factor — Reference Δp —
Initial leak rate .010 cfm @ 15 in. Hg
Final leak rate .015 cfm @ 15 in. Hg
Filter no. NA
Comments: None

Test point schematic

Traverse point number	Sampling time, min.	24-hr. clock time	Velocity head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, $ft.^3$	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
	0	1505			56.827						
MPO PP	5	1510	—	0.75	58.7	90	89	—	4	61	—
	10	1515	—	0.75	61.8	90	90	—	4	54	
	15	1520	—	75	63.5	92	90	—	4	54	
	20	1525	—	75	65.819	94	90	—	4	54	
	Total θ 20	—	Avg. $\sqrt{\Delta P}$ —	Avg. ΔH 0.75	Total V_m 8.992	Avg. T_m 90.63		Avg. T_s —	Max. vac. 4	Max. temp. 61	Min. — Max. —

Comments:

SOx SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant: Gen Chem
Sample Date: 11-20-91
Sample Location: Hazy Stack
Run Number: FOUR
Sample Recovery Person: JDD
Recovery Date: 11-20-91
Filter Number(s): N/A

MOISTURE

Impingers	80% ISO		3% H_2O_2		Silica Gel			
Final volume (wt)	245	ml	304	ml	Final wt	309 g	—	g
Initial volume (wt)	261	ml	291	ml	Initial wt	300 g	—	g
Net volume (wt)	-16	ml	13	ml	Net wt	8 g		g

Total moisture: +5
Color of silica gel: blue 20%
Description of impinger water: all clear

RECOVERED SAMPLE

Blank Filter container number _____ Sealed _____
Filter container number _____ Sealed _____
Description of particulate on filter _____

80% ISO and Rinse container number: GC-M8-4-ISO Liquid level marked? ✓
3% H_2O_2 and Rinse container number: GC-M8-4-H_2O_2 Liquid level marked? ✓
80% ISO Blank container number _____ Liquid level marked? _____
3% H_2O_2 Blank container number _____ Liquid level marked? _____
Samples stored and locked: On JDD 11-20-91
Remarks: _____

Date of laboratory custody: 11-25-91
Laboratory personnel taking custody: C.L
Remarks: _____

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SOx SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant Gen Chemical Sample Date 11-20-91
Sample Location Hazardous Stack Run Number FIVE
Sample Recovery Person JDO Recovery Date 11-20-91
Filter Number(s) N/A

MOISTURE

Impingers	80% ISO		3% H_2O_2		Silica Gel			
Final volume (wt)	236	ml	296	ml	Final wt	321 g	—	g
Initial volume (wt)	259	ml	290	ml	Initial wt	300 g	—	g
Net volume (wt)	-23	ml	6	ml	Net wt	21 g	—	g

Total moisture +4
Color of silica gel blue 70%
Description of impinger water all clear

RECOVERED SAMPLE

Blank Filter container number _____ Sealed _____
Filter container number _____ Sealed _____
Description of particulate on filter _____

80% ISO and Rinse container number GC-M8-5-ISO Liquid level marked? ✓
3% H_2O_2 and Rinse container number GC-M8-5-H_2O_2 Liquid level marked? ✓
80% ISO Blank container number _____ Liquid level marked? _____
3% H_2O_2 Blank container number _____ Liquid level marked? _____
Samples stored and locked OK JDO 11-20-91
Remarks: _____

Date of laboratory custody 11-25-91
Laboratory personnel taking custody C.L
Remarks: _____

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SOx SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant Gen Chemical Sample Date 11/20/91
Sample Location Hwy 32 Run Number SOx
Sample Recovery Person JDD Recovery Date 11/20/91
Filter Number(s) N/A

MOISTURE

Impingers	80% ISO		3% H_2O_2		Silica Gel			
Final volume (wt)	245	ml	306	ml	Final wt	307 g	—	g
Initial volume (wt)	258	ml	293	ml	Initial wt	300 g	—	g
Net volume (wt)	-13	ml	+13	ml	Net wt	7 g	—	g

Total moisture +7
Color of silica gel blue 70%
Description of impinger water all clear

RECOVERED SAMPLE

Blank Filter container number _____ Sealed _____
Filter container number _____ Sealed _____
Description of particulate on filter _____

80% ISO and Rinse container number 6C-M8-6-ISO Liquid level marked? ✓
3% H_2O_2 and Rinse container number 6C-M8-6-H_2O_2 Liquid level marked? ✓
80% ISO Blank container number _____ Liquid level marked? _____
3% H_2O_2 Blank container number _____ Liquid level marked? _____
Samples stored and locked _____
Remarks: _____

Date of laboratory custody 11-25-91
Laboratory personnel taking custody C.L
Remarks: _____

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SOx SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant Gen Chemical Sample Date 11/20/91
Sample Location Hydy Stk Run Number Seven
Sample Recovery Person UPO Recovery Date 11/20/91
Filter Number(s) N/A

MOISTURE

Impingers	80% ISO	3% H_2O_2	Silica Gel		
Final volume (wt)	245.5 ml	304.5 ml	Final wt	g	— g
Initial volume (wt)	257 ml	292 ml	Initial wt	300 g	— g
Net volume (wt)	-11.5 ml	12.5 ml	Net wt	13 g	— g

Total moisture +14.
Color of silica gel blue 90%
Description of impinger water all clear

RECOVERED SAMPLE

Blank Filter container number _____ Sealed _____
Filter container number _____ Sealed _____
Description of particulate on filter _____

80% ISO and Rinse container number GC-M8-7-ISO Liquid level marked? ✓
3% H_2O_2 and Rinse container number GC-M8-7-H_2O_2 Liquid level marked? ✓
80% ISO Blank container number _____ Liquid level marked? _____
3% H_2O_2 Blank container number _____ Liquid level marked? _____
Samples stored and locked _____
Remarks: _____

Date of laboratory custody 11-25-91
Laboratory personnel taking custody C.L.
Remarks: _____

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SOx SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant Gen Chemical Sample Date 11-20-91
Sample Location H_2SO_4 Stack Run Number eight
Sample Recovery Person JDJ Recovery Date 11-20-91
Filter Number(s) N/A

MOISTURE

Impingers	80% ISO	3% H_2O_2	Silica Gel	
Final volume (wt)	251.6 ml	301.2 ml	Final wt ___ g	— g
Initial volume (wt)	261 ml	292 ml	Initial wt 300 g	— g
Net volume (wt)	-9.4 ml	9.2 ml	Net wt 5.5 g	— g

Total moisture +5.3
Color of silica gel blue 70%
Description of impinger water all clear

RECOVERED SAMPLE

Blank Filter container number ___ Sealed ___
Filter container number ___ Sealed ___
Description of particulate on filter ___

80% ISO and Rinse container number GC-M8-8-ISO Liquid level marked? ✓
3% H_2O_2 and Rinse container number GC-M8-8-H_2O_2 Liquid level marked? ✓
80% ISO Blank container number ___ Liquid level marked? ___
3% H_2O_2 Blank container number ___ Liquid level marked? ___
Samples stored and locked ___
Remarks: ___

Date of laboratory custody 11-25-91
Laboratory personnel taking custody C.L.
Remarks: ___

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SOx SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant Gen Chemical Sample Date H 20-91
Sample Location Hanny Run Run Number N/NF
Sample Recovery Person JMO Recovery Date 11-20-91
Filter Number(s) N/A

MOISTURE

Impingers	80% ISO	3% H_2O_2	Silica Gel	
Final volume (wt)	246.7 ml	301.5 ml	Final wt ___ g	— g
Initial volume (wt)	254.5 ml	290.5 ml	Initial wt 300 g	— g
Net volume (wt)	-7.8 ml	11 ml	Net wt 5.5 g	— g

Total moisture + 8.7
Color of silica gel 70% blue
Description of impinger water all clear

RECOVERED SAMPLE

Blank Filter container number ___ Sealed ___
Filter container number ___ Sealed ___
Description of particulate on filter ___

80% ISO and Rinse container number GC-M8-9-ISO Liquid level marked? ✓
3% H_2O_2 and Rinse container number GC-M8-9-H_2O_2 Liquid level marked? ✓
80% ISO Blank container number ___ Liquid level marked? ___
3% H_2O_2 Blank container number ___ Liquid level marked? ___
Samples stored and locked ___
Remarks: ___

Date of laboratory custody 11-25-91
Laboratory personnel taking custody C.C.
Remarks: ___

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SOx SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant: Gen Chemical — Sample Date: 11-20-91
Sample Location: Hadley Stack — Run Number: 10
Sample Recovery Person: JPO — Recovery Date: 11-20-91
Filter Number(s): N/A

MOISTURE

Impingers	80% ISO	3% H_2O_2	Silica Gel	
Final volume (wt)	245.0 ml	298.0 ml	Final wt ___ g	— g
Initial volume (wt)	253.8 ml	290.6 ml	Initial wt 300 g	— g
Net volume (wt)	-8.8 ml	7.4 ml	Net wt 60 g	— g

Total moisture: +4.6
Color of silica gel: blue 60%
Description of impinger water: all clear

RECOVERED SAMPLE

Blank Filter container number ___ Sealed ___
Filter container number ___ Sealed ___
Description of particulate on filter ___

80% ISO and Rinse container number: GC-M8-10-ISO — Liquid level marked? ✓
3% H_2O_2 and Rinse container number: GC-M8-10-H_2O_2 — Liquid level marked? ✓
80% ISO Blank container number ___ Liquid level marked? ___
3% H_2O_2 Blank container number ___ Liquid level marked? ___
Samples stored and locked ___
Remarks: ___

Date of laboratory custody: 11-25-91
Laboratory personnel taking custody ___
Remarks: ___

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SOx SAMPLE RECOVERY AND INTEGRITY DATA FORM

Plant GEN CHEMICAL
Sample Date 11-20-91
Sample Location H_2SO_4 STACK
Run Number 11
Sample Recovery Person TB
Recovery Date 11-20-91
Filter Number(s) N/A

MOISTURE

Impingers	80% ISO		3% H_2O_2		Silica Gel		
Final volume (wt)	249.5	ml	306	ml	Final wt	g	g
Initial volume (wt)	256	ml	293	ml	Initial wt 300	g	g
Net volume (wt)	-6.5	ml	13	ml	Net wt 7.5	g	g

Total moisture + 14
Color of silica gel blue 60%
Description of impinger water all clear

RECOVERED SAMPLE

Blank Filter container number _____ Sealed _____
Filter container number _____ Sealed _____
Description of particulate on filter _____

80% ISO and Rinse container number GC-M-8-11-ISO Liquid level marked? ✓
3% H_2O_2 and Rinse container number GC-M8-11-H_2O_2 Liquid level marked? ✓
80% ISO Blank container number _____ Liquid level marked? _____
3% H_2O_2 Blank container number _____ Liquid level marked? _____
Samples stored and locked _____
Remarks: _____

Date of laboratory custody 11-25-91
Laboratory personnel taking custody C.L.
Remarks: _____

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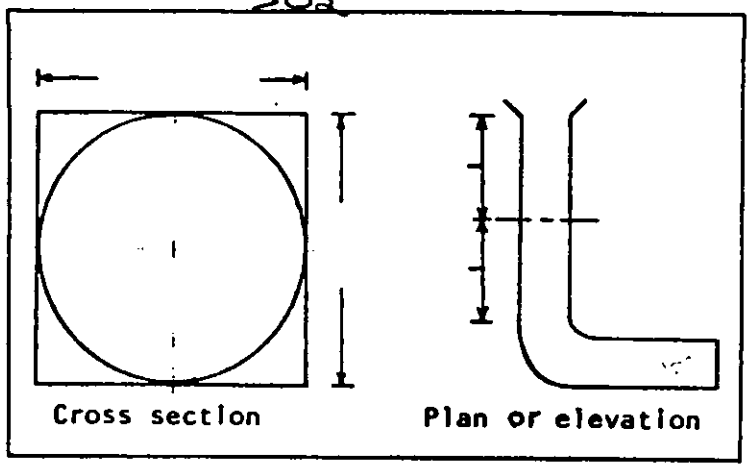
Fig 6 ~~METHODE~~ TE FIELD DATA FORM
SO_2

Plant General Chemical
City Claymont De
Location Cylinder 701.8
Operator O'Neill PPM
Run No. 1-2-3 Date 11-18-91
Ambient temp., °F 55
Baro. press. (P_b), in. Hg. 30.32
Sample box no. #1
Meter box no. #3
Meter box ΔH@ —
Meter box cal. (Y) 1.004
Probe length, ft. N/A
Probe liner material N/A
Probe heater setting —



Test point schematic

Pitot tube identification no. —
Pitot tube cal. factor (C_p) —
Nozzle identification no. —
Avg. nozzle diameter (D_n), in. —
Pyrometer identification no. —
Thermocouple identification no. —
Assumed moisture, % —
Assumed temperature, °F. —
Static pressure (P_{static}), in. H_2O —
C factor — Reference Δp —
Initial leak rate ____ cfm @ ____ in. Hg
Final leak rate ____ cfm @ ____ in. Hg
Filter no.
Comments: Initial LC = Roto 0 Sin
Final LC = Roto 0 Sin

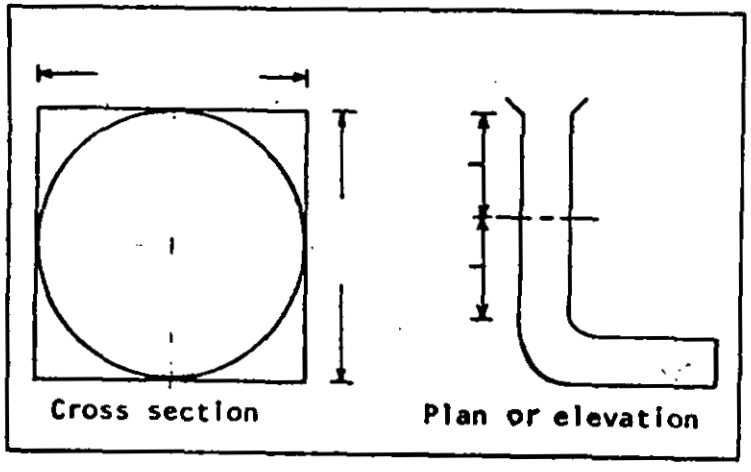
Traverse point number	Sampling time, min.	24-hr. clock time	Roto ~~Velocity~~ head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, ~~ft.³~~ liters	Dry gas meter temperature (T_m) Inlet ~~°F~~ °C	Dry gas meter temperature (T_m) Outlet ~~°F~~ °C	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
Run 1	0	1230			00.465						
	5		0.75	0.75	5.2	16	16	—	1	—	—
	10		0.75	0.75	10.0	17	17	—	1	—	—
	15		0.75	0.75	15.1	17	17	—	1	—	—
	20	1250	0.75	0.75	~~19.010~~ 20.	17	17	—	1	—	—
				0.75"	19.545"	16.75"		LCF=	good		
Run 2	0	1255			00.615						
	5		0.75	0.75	4.500	18	18	—	1	—	—
	10		0.75	0.75	10.55	18	18	—	1	—	—
	15		0.75	0.75	15.6	19	19	—	1	—	—
	20	1315	0.75	0.75	20.475	19	19	—	1	—	—
				0.75	19.860	18.50		LCF=	good		
	Total θ		Avg. $\sqrt{\Delta P}$	Avg. ΔH ~~0.75~~	Total V_m ~~39.405~~	Avg. T_m ~~17.625~~		Avg. T_s	Max. vac.	Max. temp.	Min. Max.

Comments:

Er. 6 RTI TE LED FQ

Sheet 2 of 3

Plant General Chemical
City Claymont De
Location Cylinder
Operator O.Dp.14
Run No. 3-4-5 Date 11/12/91
Ambient temp., °F 55
Baro. press. (P_b), in. Hg. 30.32
Sample box no. #1
Meter box no. #3
Meter box ΔH@
Meter box cal. (Y) 1.00Y
Probe length, ft. N/A
Probe liner material N/A
Probe heater setting N/A



Test point schematic

Pitot tube identification no. —
Pitot tube cal. factor (C_p) —
Nozzle identification no. —
Avg. nozzle diameter (D_n), in. —
Pyrometer identification no. —
Thermocouple identification no. —
Assumed moisture, % —
Assumed temperature, °F. —
Static pressure (P_{static}), in. H_2O —
C factor — Reference Δp —
Initial leak rate — cfm @ — in. Hg
Final leak rate — cfm @ — in. Hg
Filter no. —
Comments: —

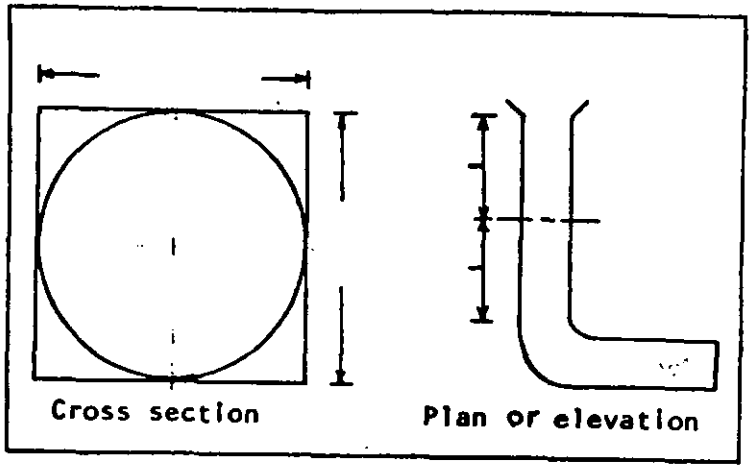
Run 3 LCZ = good

Traverse point number	Sampling time, min.	24-hr. clock time	Roto ~~Velocity~~ head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, ~~ft.³~~ liters	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
	0	1320			00.835						
Run 3	5		0.75	0.75	5.8	20	20	—	/	—	—
	10		0.75	0.75	10.1	20	20	—	/	—	—
	15		0.75	0.75	15.1	20	20	—	/	—	—
	20	1340	0.75	0.75	20.625	20	20	—	/	—	—
			0.75	0.75	19.790 =	20 =		Leak check final = good			
Run 4	0	1345			0.000			Leak check initial = good			
	5		0.75	0.75	9.800	20	21	—	/	—	—
	10		0.75	0.75	9.800	21	21	—	/	—	—
	15		0.75	0.75 und	15.800	21	21	—	/	—	—
	20	1405	0.75	0.75 und	20.830	21	21	—	/	—	—
			0.75	und	20.83	20.88 =		Leak check final = good			
Run 5	0	1410			0.000			Leak check initial =			
	5		0.75	0.75	4.8	21	21	—	/	—	—
	10		0.75	0.75	9.90	21	21	—	/	—	—
	15		0.75	0.75	15.2	21	21	—	/	—	—
	20	1430	0.75	0.75	20.080	21	21	—	/	—	—
	Total θ		Avg. $\sqrt{\Delta P}$ .75	Avg. ΔH .75	Total V_m 20.08	Avg. T_m 21		Avg. T_s	Max. vac.	Max. temp.	Min. Max.

Comments: Leak check final = good

Sheet 3 of 3

Plant General Chemical
City Claymont DE
Location Cylinder
Operator O'Neill
Run No. 6 Date 11/12/94
Ambient temp., °F 55
Baro. press. (P_b), in. Hg. 30.32
Sample box no. #1
Meter box no. #3 1030
Meter box ΔH@ —
Meter box cal. (Y) 1.004
Probe length, ft. N/A
Probe liner material N/A
Probe heater setting N/A



Pitot tube identification no. —
Pitot tube cal. factor (C_p) —
Nozzle identification no. —
Avg. nozzle diameter (D_n), in. —
Pyrometer identification no. —
Thermocouple identification no. —
Assumed moisture, % —
Assumed temperature, °F —
Static pressure (P_{static}), in. H_2O —
C factor ____ Reference Δp —
Initial leak rate ____ cfm @ — in. Hg
Final leak rate — cfm @ — in. Hg
Filter no. —
Comments: —

Test point schematic

Leak check Final:

Traverse point number	Sampling time, min.	24-hr. clock time	Rato ~~Velocity~~ head (ΔP), in. H_2O	Orifice meter pressure differential (ΔH), in. H_2O	Gas meter reading, ~~ft.³~~ liters	Dry gas meter temperature (T_m) Inlet °F.	Dry gas meter temperature (T_m) Outlet °F.	Source temperature (T_s), °F	Pump vacuum, in.Hg. gauge	Impinger exit gas temp., °F.	Filter box temp., °F.
Run 6	0	1435			0.000						
	5		0.75	0.75	5.05	21	22	—	1	—	—
	10		0.75	0.75	10.0	22	23	—	1	—	—
	15		0.75	0.75	15.0	21	22	—	1	—	—
	20		0.75	0.75	19.900	21	22	—	1	—	—
	Dur	1455	0.75	0.75	19.900	21.88	—	—	—	—	—
	Total θ		Avg. $\sqrt{\Delta P}$	Avg. ΔH	Total V_m	Avg. T_m		Avg. T_s	Max. vac.	Max. temp.	Min. Max.

Comments: Note: All M6 test data paged for 15 min following test completion.

APPENDIX B
LABORATORY REPORTS

WESTON
MANAGERS DESIGNERS/CONSULTANTS
WESTON WAY
WEST CHESTER, PA 19380
PHONE: 215-692-3030
TELEX: 83-5348

11 December 1991

State of Delaware
Department of Natural Resources
and Environmental Control
Division of Air and Waste Management
715 Gramthan Lane
New Castle, DE 19720

W.O. # 3840-02-02

Attention: **Mr. Charles S. Krick**
Environmental Engineer

Subject: **General Chemical Compliance Test Program**
Sulfur Dioxide Audit Results

Dear Charles:

The purpose of this letter is to document the results obtained by WESTON Analytics for the two (2) sulfur dioxide audit samples provided by you on 18 November 1991.

The audit identification number and associated measured concentrations are as follows:

Audit Vial ID Number	Measured Concentration mg/dscm
A01201	2,432.
A00108	797.

Please advise me as to the acceptability of these audit results.

Please contact me at (215) 430-7201 should you have any questions.

Very truly yours,

ROY F. WESTON, INC.

Jeffrey D. O'Neill
Senior Section Manager

JDO/mb
cc: Joseph Hardman - General Chemical

gc017a.ltr

Inter-Office Memorandum

WESTON MANAGERS DESIGNERS/CONSULTANTS

Auburn Operations

TO:

Jeff O'Neill

FROM: Catherine Lloyd

DATE: 4 December 1991

PROJECT: General Chemical

W.O. NO.: 3840-02-02

SUBJECT: Laboratory Results

ACTION:

RESULTS AND DISCUSSION:

Attached are the results for samples submitted to the laboratory for analysis on 23 November 1991.

ANALYTICAL METHODOLGY:

The analysis is performed following EPA Reference Method 8 for all except samples numbered GC-CA-1-H2O2 through -6-H2O2 (CF1777 - CF1782), which were analyzed following EPA Reference Method 6.

QUALITY ASSURANCE / QUALITY CONTROL:

Two EPA audit samples are run along with each set of samples and agreed to within five percent of their actual values.

M:\1502\.MEM

RFW 04-08-004/A-5/85

SULFUR DIOXIDE / SULFURIC ACID ANALYSIS DATA

CLIENT General Chemical

SOURCE Cylinder Audit

ANALYST [illegible]

WORK ORDER NO. 3840-02-02

MATRIX IPA

DATE 12/02/91

		SAMPLE ID: CF 1771		SAMPLE ID: CF 1772		SAMPLE ID: CF 1773		
		RUN # 1		RUN # 2		RUN # 3		
		TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	UNITS
V_{soln}		43		32		41		ml
V_a		20.0	20.0	20.0	10.0	20.0	20.0	ml
V_t	START	0.00	1.00	2.00	2.70	3.50	4.30	ml
	END	0.60	1.60	2.65	3.05	4.20	5.05	ml
	V_t	0.60	0.60	0.65	0.35	0.70	0.75	ml
V_{tb}		0.05	0.05	0.05	0.05	0.05	0.05	ml
$BaCl_2$ Normality		0.00992					0.00992	normal

NOTES:

SAMPLE VOLUMES WERE TOO SMALL TO ALLOW A 100 ml ALIQUOT TO BE TAKEN ON SAMPLE #'S CF 1771 - 1776

BARIUM CHLORIDE NORMALITY CALCULATION

Refer to Page : 15

		TRIAL 1	TRIAL 2	UNITS
V_{acid}				ml
N_{acid}				normal
V_{BaCl2}	START			ml
	END			ml
	V_{soln}			ml
N_{BaCl2}				normal

$$BaCl_2\ Normality = \frac{Volume_{acid} * Normality_{acid}}{BaCl_2\ Volume}$$

SULFUR DIOXIDE / SULFURIC ACID ANALYSIS DATA

CLIENT General Chemical

WORK ORDER NO. 3840-02-02

SOURCE Cylinder Audit

MATRIX IPA

ANALYST [illegible]

DATE 12/02/91

		SAMPLE ID: CF1774		SAMPLE ID: CF1775		SAMPLE ID: CF1776		
		RUN # 4		RUN # 5		RUN # 6		
		TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	UNITS
V_{soln}		41		45		48		ml
V_a		20.0	20.0	20.0	20.0	20.0	20.0	ml
V_t	START	5.00	5.50	6.00	6.70	7.60	7.90	ml
	END	5.40	5.85	6.70	7.45	7.90	8.30	ml
	V_t	0.40	0.35	0.70	0.75	0.40	0.40	ml
V_{tb}		0.05	0.05	0.05	0.05	0.05	0.05	ml
$BaCl_2$ Normality		0.00992					0.00992	normal

NOTES:

BARIUM CHLORIDE NORMALITY CALCULATION

Refer to Page : 15

		TRIAL 1	TRIAL 2	UNITS
V_{acid}				ml
N_{acid}				normal
V_{BaCl2}	START			ml
	END			ml
	V_{tcn}			ml
N_{BaCl2}				normal

$$BaCl_2\ Normality = \frac{Volume_{acid} * Normality_{acid}}{BaCl_2\ Volume}$$

SULFUR DIOXIDE / SULFURIC ACID ANALYSIS DATA

CLIENT General Chemical

WORK ORDER NO. 3840-02-02

SOURCE Cylinder Audit

MATRIX H_2O_2

ANALYST TP

DATE 12/02/91

		SAMPLE ID: CF1777		SAMPLE ID: CF1778		SAMPLE ID: CF1779		
		RUN # 1		RUN # 2		RUN # 3		
		TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	UNITS
V_{soln}		56		74		68		ml
V_a		20.0	10.0	10.0	10.0	10.0	10.0	ml
V_t	START	0.00	0.00	0.00	0.00	0.00	0.00	ml
	END	36.15	18.05	14.85	14.75	16.45	16.50	ml
	V_t	36.15	18.05	14.85	14.75	16.45	16.50	ml
V_{tb}		0.05	0.05	0.05	0.05	0.05	0.05	ml
$BaCl_2$ Normality		0.00992					0.00992	normal

NOTES:
INSTEAD OF MAKING A 1:2 DILUTION ON SAMPLES CF1777 - 1782, HALF THE ALIQUOT SIZE WAS USED.

BARIUM CHLORIDE NORMALITY CALCULATION

Refer to Page : 15

		TRIAL 1	TRIAL 2	UNITS
V_{acid}				ml
N_{acid}				normal
V_{BaCl2}	START			ml
	END			ml
	V_{BaCl2}			ml
N_{BaCl2}				normal

$$BaCl_2\ Normality = \frac{Volume_{acid} * Normality_{acid}}{BaCl_2\ Volume}$$

SULFUR DIOXIDE / SULFURIC ACID ANALYSIS DATA

CLIENT General Chemical

WORK ORDER NO. 3840-02-02

SOURCE Cylinder Audit

MATRIX H_2O_2

ANALYST [illegible]

DATE 12/02/91

		SAMPLE ID: CF1780		SAMPLE ID: CF1781		SAMPLE ID: CF1782		
		RUN # 4		RUN # 5		RUN # 6		
		TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	UNITS
V_{soln}		73		64		78		ml
V_a		10.0	10.0	10.0	10.0	10.0	10.0	ml
V_t	START	0.00	0.00	0.00	0.00	0.00	0.00	ml
	END	14.75	14.80	16.35	16.40	13.50	13.50	ml
	V_t	14.75	14.80	16.35	16.40	13.50	13.50	ml
V_{tb}		0.05	0.05	0.05	0.05	0.05	0.05	ml
$BaCl_2$ Normality		0.00992					0.00992	normal

NOTES:

BARIUM CHLORIDE NORMALITY CALCULATION

Refer to Page : 15

		TRIAL 1	TRIAL 2	UNITS
V_{acid}				ml
N_{acid}				normal
V_{BaCl2}	START			ml
	END			ml
	V_{BaCl2}			ml
N_{BaCl2}				normal

$$BaCl_2\ Normality = \frac{Volume_{acid} * Normality_{acid}}{BaCl_2\ Volume}$$

SULFUR DIOXIDE / SULFURIC ACID ANALYSIS DATA

CLIENT General Chemical

WORK ORDER NO. 3840-02-02

SOURCE

MATRIX IPA

ANALYST

DATE 12/03/91

		SAMPLE ID: CF1783		SAMPLE ID: CF1784		SAMPLE ID: CF1785		
		RUN # 1		RUN # 2		RUN # 3		
		TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	UNITS
V_{soln}		495		531		425		ml
V_a		100.0	100.0	100.0	100.0	100.0	100.0	ml
V_t	START	0.00	0.00	0.00	0.00	0.00	0.00	ml
	END	21.10	21.30	15.20	15.20	8.75	8.60	ml
	V_t	21.10	21.30	15.20	15.20	43.75 ~~8.75~~	43.00	ml
V_{tb}		0.05	0.05	0.05	0.05	0.05	0.05	ml
$BaCl_2$ Normality		0.00992 →		→	0.00992	0.010	0.010 ~~0.00992~~	normal

NOTES:
REFER TO PAGE 15 FOR $BaCl_2$ NORMALITIES FROM RUNS 1 & 2.
1:5 DILUTION

BARIUM CHLORIDE NORMALITY CALCULATION

Refer to Page :				
		TRIAL 1	TRIAL 2	UNITS
V_{acid}		10.0	10.0	ml
N_{acid}		0.010	0.010	normal
V_{BaCl2}	START	0.00	10.00	ml
	END	10.00	20.00	ml
	V_{acid}	10.00	10.00	ml
N_{BaCl2}		0.010	0.010	normal

$$BaCl_2\ Normality = \frac{Volume_{acid} * Normality_{acid}}{BaCl_2\ Volume}$$

SULFUR DIOXIDE / SULFURIC ACID ANALYSIS DATA

CLIENT General Chemical

WORK ORDER NO. 3840-02-02

SOURCE

MATRIX IPA

ANALYST

DATE 12/03/91

		SAMPLE ID: CF 1786		SAMPLE ID: CF 1787		SAMPLE ID: CF 1788		
		RUN # 4		RUN # 5		RUN # 6		
		TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	UNITS
V_{soln}		370		365		353		ml
V_a		100.0	100.0	100.0	100.0	100.0	100.0	ml
V_t	START	0.00	6.00	0.00	6.00	0.00	15.00	ml
	END	5.80	11.70	5.60	11.40	7.15	22.00	ml
	V_t	5.80	5.70	5.60	5.40	7.15	7.00	ml
V_{tb}		0.05	0.05	0.05	0.05	0.05	0.05	ml
$BaCl_2$ Normality		0.010	→			→	0.010	normal

NOTES:

BARIUM CHLORIDE NORMALITY CALCULATION

Refer to Page : 05

		TRIAL 1	TRIAL 2	UNITS
V_{acid}				ml
N_{acid}				normal
V_{BaCl2}	START			ml
	END			ml
	V_{tot}			ml
N_{BaCl2}				normal

$$BaCl_2\ Normality = \frac{Volume_{acid} \bullet Normality_{acid}}{BaCl_2\ Volume}$$

SULFUR DIOXIDE / SULFURIC ACID ANALYSIS DATA

CLIENT General Chemical

WORK ORDER NO. 3840-02-02

SOURCE

MATRIX IPA

ANALYST

DATE 12/03/91

		SAMPLE ID: CF1789		SAMPLE ID: CF1790		SAMPLE ID: CF1791		
		RUN # 7		RUN # 8		RUN # 9		
		TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	UNITS
V_{soln}		295		304		285		ml
V_a		100.0	100.0	100.0	100.0	100.0	100.0	ml
V_t	START	0.00	6.50	0.00	11.00	0.00	5.50	ml
	END	6.20	12.70	10.45	21.45	5.30	10.80	ml
	V_t	6.20	6.20	10.45	10.45	5.30	5.30	ml
V_{tb}		0.05	0.05	0.05	0.05	0.05	0.05	ml
$BaCl_2$ Normality		0.010					0.010	normal

NOTES:

BARIUM CHLORIDE NORMALITY CALCULATION

Refer to Page : 05

		TRIAL 1	TRIAL 2	UNITS
V_{acid}				ml
N_{acid}				normal
V_{BaCl2}	START			ml
	END			ml
	V_{BaCl2}			ml
N_{BaCl2}				normal

$$BaCl_2\ Normality = \frac{Volume_{acid} \bullet Normality_{acid}}{BaCl_2\ Volume}$$

SULFUR DIOXIDE / SULFURIC ACID ANALYSIS DATA

CLIENT General Chemical

WORK ORDER NO. 3840-02-02

SOURCE

MATRIX IPA

ANALYST

DATE 12/03/91

		SAMPLE ID: CF1792		SAMPLE ID: CF1793		SAMPLE ID:		
		RUN # 10		RUN # 11		RUN #		
		TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	UNITS
V_{soln}		290		340				ml
V_s		100.0	100.0	100.0	100.0			ml
V_t	START	0.00	0.00	0.00	9.50			ml
	END	15.90	16.10	9.10	18.55			ml
	V_t	15.90	16.10	9.10	9.05			ml
V_{tb}		0.05	0.05	0.05	0.05			ml
$BaCl_2$ Normality		0.010	→	→	0.010			normal

NOTES:

BARIUM CHLORIDE NORMALITY CALCULATION

Refer to Page : 05

		TRIAL 1	TRIAL 2	UNITS
V_{acid}				ml
N_{acid}				normal
V_{BaCl2}	START			ml
	END			ml
	V_{bco}			ml
N_{BaCl2}				normal

$$BaCl_2\ Normality = \frac{Volume_{acid} \bullet Normality_{acid}}{BaCl_2\ Volume}$$

SULFUR DIOXIDE / SULFURIC ACID ANALYSIS DATA

CLIENT General Chemical

SOURCE

ANALYST (F)

WORK ORDER NO. 3840-02-02

MATRIX H_2O_2

DATE 12/03/91

		SAMPLE ID: CF 1795		SAMPLE ID: CF 1796		SAMPLE ID: CF 1797		
		RUN # 1		RUN # 2		RUN # 3		
		TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	UNITS
V_{soln}		375		338		350		ml
V_a		20.0	20.0	20.0	20.0	20.0	20.0	ml
V_t	START	0.00	8.50	0.00	8.00	0.00	7.00	ml
	END	8.25	16.80	7.85	15.80	6.95	14.00	ml
	V_t *	82.50	83.00	78.50	78.00	69.50	70.00	ml
V_{tb}		0.05	0.05	0.05	0.05	0.05	0.05	ml
$BaCl_2$ Normality		0.00998	→	→	→	→	0.00998	normal

NOTES: (1:10 DILUTION) (1:10 DILUTION) (1:10 DILUTION)

* VALUE INCLUDES DILUTION FACTOR: (SAMPLES CF 1795 - 1805)

BARIUM CHLORIDE NORMALITY CALCULATION

Refer to Page : 16

		TRIAL 1	TRIAL 2	UNITS
V_{acid}				ml
N_{acid}				normal
V_{BaCl2}	START			ml
	END			ml
	V_{acid}			ml
N_{BaCl2}				normal

$$BaCl_2\ Normality = \frac{Volume_{acid} * Normality_{acid}}{BaCl_2\ Volume}$$

SULFUR DIOXIDE / SULFURIC ACID ANALYSIS DATA

CLIENT General Chemical

WORK ORDER NO. 3840-02-02

SOURCE

MATRIX H_2O_2

ANALYST

DATE 12/03/91

		SAMPLE ID: CF 1798		SAMPLE ID: CF 1799		SAMPLE ID: CF 1800		
		RUN # 4		RUN # 5		RUN # 6		
		TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	UNITS
V_{soln}		350		330		337		ml
V_a		20.0	20.0	20.0	20.0	20.0	20.0	ml
V_t	START	0.00	1.50	3.00	5.00	6.50	8.10	ml
	END	1.40	~~3.00~~ 2.95	4.55	6.50	8.05	9.70	ml
	V_t *	14.00	14.50	15.50	15.00	15.50	16.00	ml
V_{tb}		0.05	0.05	0.05	0.05	0.05	0.05	ml
$BaCl_2$ Normality		0.00998	→	→	→	→	0.00998	normal

NOTES: 1:10 DILUTION 1:10 DILUTION 1:10 DILUTION

BARIUM CHLORIDE NORMALITY CALCULATION

Refer to Page : 16

		TRIAL 1	TRIAL 2	UNITS
V_{acid}				ml
N_{acid}				normal
V_{BaCl2}	START			ml
	END			ml
	V_{BaCl2}			ml
N_{BaCl2}				normal

$$BaCl_2\ Normality = \frac{Volume_{acid} * Normality_{acid}}{BaCl_2\ Volume}$$

SULFUR DIOXIDE / SULFURIC ACID ANALYSIS DATA

CLIENT General Chemical

WORK ORDER NO. 3840-02-02

SOURCE

MATRIX H_2O_2

ANALYST

DATE 12/03/91

		SAMPLE ID: CF 1801		SAMPLE ID: CF 1802		SAMPLE ID: CF 1803		
		RUN # 7		RUN # 8		RUN # 9		
		TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	UNITS
V_{soln}		368		215		248		ml
V_a		20.0	20.0	20.0	20.0	20.0	20.0	ml
V_t	START	10.00	11.50	13.00	15.50	18.00	20.50	ml
	END	11.40	12.90	15.30	17.80	20.40	22.90	ml
	V_t *	14.00	14.00	23.00	23.00	24.00	24.00	ml
V_{tb}		0.05	0.05	0.05	0.05	0.05	0.05	ml
$BaCl_2$ Normality		0.00998					0.00998	normal

NOTES: 1:10 DILUTION 1:10 DILUTION 1:10 DILUTION

BARIUM CHLORIDE NORMALITY CALCULATION

Refer to Page : 16

		TRIAL 1	TRIAL 2	UNITS
V_{acid}				ml
N_{acid}				normal
V_{BaCl2}	START			ml
	END			ml
	V_{acid}			ml
N_{BaCl2}				normal

$$BaCl_2\ Normality = \frac{Volume_{acid} \bullet Normality_{acid}}{BaCl_2\ Volume}$$

SULFUR DIOXIDE / SULFURIC ACID ANALYSIS DATA

CLIENT General Chemical

WORK ORDER NO. 3B40-02-02

SOURCE

MATRIX H_2O_2

ANALYST

DATE 12/03/91

		SAMPLE ID: CF 1804		SAMPLE ID: CF 1805		SAMPLE ID:		
		RUN # 10		RUN # 11		RUN #		
		TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	UNITS
V_{soln}		274		315				ml
V_a		20.0	20.0	20.0	20.0			ml
V_t	START	0.00	2.00	4.00	6.00			ml
	END	1.80	3.80	5.65	~~7.50~~ 7.60			ml
	V_t *	18.00	18.00	16.50	16.00			ml
V_{tb}		0.05	0.05	0.05	0.05			ml
$BaCl_2$ Normality		0.00998	→	→	0.00998			normal

NOTES: 1:10 DILUTION 1:10 DILUTION

BARIUM CHLORIDE NORMALITY CALCULATION

Refer to Page : 16

		TRIAL 1	TRIAL 2	UNITS
V_{acid}				ml
N_{acid}				normal
V_{BaCl2}	START			ml
	END			ml
	V_{soln}			ml
N_{BaCl2}				normal

$$BaCl_2\ Normality = \frac{Volume_{acid} * Normality_{acid}}{BaCl_2\ Volume}$$

SULFUR DIOXIDE / SULFURIC ACID AUDIT DATA

CLIENT General Chemical

WORK ORDER NO. 3840-02-02

EPA AUDIT LOT # Compliance Audits

ANALYST TD

DATE 12/03/91

		AUDIT ID: A01201		AUDIT ID: A00108		AUDIT ID:		
		TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	UNITS
V_m (std)		0.021		0.021		0.021		dscm
V_{soln}		100		100		100		ml
V_a		20.0	20.0	20.0	20.0			ml
V_t	START	0.00	0.00	0.00	10.50			ml
	END	32.00	32.05	10.50	21.05			ml
	V_t	32.00	32.05	10.50	10.55			ml
V_{tb}		0.05	0.05	0.05	0.05			ml
$BaCl_2$ Normality		0.00998	0.00998	0.00998	0.00998			normal
CALCULATED CONC		2430.5	2434.3	795.0	798.8			mg/dscm
ACTUAL CONC								mg/dscm
RELATIVE ERROR								%

NOTES: SAMPLE ID CF1806 SAMPLE ID CF1807

BARIUM CHLORIDE NORMALITY CALCULATION

Refer to Page : 16

		TRIAL 1	TRIAL 2	UNITS
V_{acid}				ml
N_{acid}				normal
V_{BaCl2}	START			ml
	END			ml
	V_{BaCl2}			ml
N_{BaCl2}				normal

$$BaCl_2\ Normality = \frac{Volume_{acid} * Normality_{acid}}{BaCl_2\ Volume}$$

SULFUR DIOXIDE / SULFURIC ACID ANALYSIS DATA

CLIENT General Chemical

WORK ORDER NO. 3840-02-02

SOURCE 80% IPA // 3% H_2O_2 BLANKS

MATRIX 80% IPA // 3% H_2O_2

ANALYST [illegible]

DATE 12/02 // 12/03/91

		SAMPLE ID: CF1794		SAMPLE ID: CF1808		SAMPLE ID:		
		RUN # IPA BLANK		RUN # H_2O_2 BLANK		RUN #		
		TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	UNITS
V_{soln}		208		195				ml
V_a **		50.0	50.0	20.0	20.0			ml
V_t	START	9.00	9.10	8.00	8.10			ml
	END	9.05	9.15	8.05	8.15			ml
	V_t	0.05	0.05	0.05	0.05			ml
V_{tb}		N/A	N/A	N/A	N/A			ml
$BaCl_2$ Normality		0.00992	0.00992	0.00998	0.00998			normal

NOTES:

** A 50 ml ALIQUOT WAS USED ON THE IPA BLANK DUE TO A FAILED TITRATION. NOT ENOUGH SAMPLE REMAINED TO USE A FULL 100 ml.

BARIUM CHLORIDE NORMALITY CALCULATION

Refer to Page : 15/16

		TRIAL 1	TRIAL 2	UNITS
V_{acid}				ml
N_{acid}				normal
V_{BaCl2}	START			ml
	END			ml
	V_{BaCl2}			ml
N_{BaCl2}				normal

$$BaCl_2\ Normality = \frac{Volume_{acid} \bullet Normality_{acid}}{BaCl_2\ Volume}$$

SULFUR DIOXIDE / SULFURIC ACID AUDIT DATA

CLIENT General Chemical

WORK ORDER NO. 3840-02-02

EPA AUDIT LOT # 587 / 590

ANALYST [illegible]

DATE 12/02/91

		AUDIT ID: 2510		AUDIT ID: 4186		AUDIT ID:		
		TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	UNITS
V_m (std)		0.021		0.021		0.021		dscm
V_{soln}		100		100		100		ml
V_a		20.0	20.0	20.0	20.0			ml
V_t	START	0.00	8.10	0.00	0.00			ml
	END	8.05	16.15	15.50	15.70			ml
	V_t	8.05	8.05	15.50	15.70			ml
V_{tb}		0.05	0.05	0.05	0.05			ml
$BaCl_2$ Normality		0.00992			0.00992			normal
CALCULATED CONC		605.6	605.6	1169.5	1184.6			mg/dscm
ACTUAL CONC		617.7	617.7	1200	1200			mg/dscm
RELATIVE ERROR		-1.96	-1.96	-2.54	-1.28			%

NOTES:

BARIUM CHLORIDE NORMALITY CALCULATION

Refer to Page :

		TRIAL 1	TRIAL 2	UNITS
V_{acid}		10.0	10.0	ml
N_{acid}		0.010	0.010	normal
V_{BaCl2}	START	0.00	10.10	ml
	END	10.05	20.20	ml
	V_{BaCl2}	10.05	10.10	ml
N_{BaCl2}		0.00995	0.00990	normal

$$BaCl_2\ Normality = \frac{Volume_{acid} * Normality_{acid}}{BaCl_2\ Volume}$$

SULFUR DIOXIDE / SULFURIC ACID AUDIT DATA

CLIENT General Chemical

WORK ORDER NO. 3840-02-02

EPA AUDIT LOT # 587

ANALYST [illegible]

DATE 12/03/91

		AUDIT ID: 2510		AUDIT ID:		AUDIT ID:		
		TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	TRIAL 1	TRIAL 2	UNITS
V_m (std)		0.021		0.021		0.021		dscm
V_{soln}		100		100		100		ml
V_a		100.0	100.0					ml
V_t	START	0.00	8.10					ml
	END	8.05	16.20					ml
	V_t	8.05	8.10					ml
V_{tb}		0.05	0.05					ml
$BaCl_2$ Normality		0.00998	0.00998					normal
CALCULATED CONC		608.6	612.4					mg/dscm
ACTUAL CONC		617.7	617.7					mg/dscm
RELATIVE ERROR		-1.48	-0.86					%

NOTES:
A NEW BATCH OF $BaCl_2$ WAS USED FOR REMAINING SAMPLES. THIS IS THE NORMALIZATION AND VERIFICATION OF THE NORMALITY USING AN AUDIT.

BARIUM CHLORIDE NORMALITY CALCULATION

Refer to Page :

		TRIAL 1	TRIAL 2	UNITS
V_{acid}		10.0	10.0	ml
N_{acid}		0.010	0.010	normal
V_{BaCl2}	START	0.00	10.10	ml
	END	10.05	20.10	ml
	V_{BaCl2}	10.05	10.00	ml
N_{BaCl2}		0.00995	0.010	normal

$$BaCl_2\ Normality = \frac{Volume_{acid} * Normality_{acid}}{BaCl_2\ Volume}$$

WO# 3840-02-02 CA = Cylinder Adit lot 3

Custody Transfer Record/Lab Work Request

WESTON

WESTON Analytics Use Only

Client: General Chemical
Work Order: ~~2379-01-03~~
Date Rec'd.: 11-22-91 Date Due: STD.
RFW Contact: J. O'Neill
Client Contact/Phone:

Refrigerator#										
#/Type Container										
Volume										
Preservative										
ANALYSES REQUESTED →				H_2O_2 EPA 16	3 per	SO_2 EPA 6				
WA Use Only Lab ID	Client ID/Description	Matrix	Date Collected							
CF1771	GC-CA-1-ISO		11-18-91	X						
1772	GC-CA-2-ISO			X						
1773	GC-CA-3-ISO			X						
1774	GC-CA-4-ISO			X						
1775	GC-CA-5-ISO			X						
1776	GC-CA-6-ISO			X						
1777	GC-CA-1-H_2O_2					X				
1778	GC-CA-2-H_2O_2					X				
1779	GC-CA-3-H_2O_2					X				
1780	GC-CA-4-H_2O_2					X				
1781	GC-CA-5-H_2O_2					X				
CF1782	GC-CA-6-H_2O_2					X				

Matrix:
S - Soil, SE - Sediment, SO - Solid
W - Water, O - Oil, A - Air, WI - Wipe
DS - Drum Solids, DL - Drum Liquids, F - Fish, L - EP/TCLP Leachate, X - Other

Special Instructions: NOTE: ALL SAMPLE VOLUMES MUST BE MEASURED

Item/Reason	Relinquished by	Received by	Date	Time	Item/Reason	Relinquished by	Received by	Date	Time
Analysis	J. O'Neill	[illegible]	11/25	0800					

WESTON Analytics Use Only

Samples Were:
1 Shipped or Hand-Delivered
NOTES:

2 Ambient or Chilled
NOTES:

3 Received Broken/Leaking (Improperly Sealed)
Y (N)
NOTES:

4 Properly Preserved unknown
Y N
NOTES:

5 Received Within Holding Times
(Y) N
NOTES:

COC Tape Was:
1 Present on Outer Package (Y) N
2 Unbroken on Outer Package (Y) N
3 Present on Sample Y (N)
4 Unbroken on Sample Y N n/A
NOTES:

COC Record Was:
1 Present Upon Receipt of Samples (Y) N

Discrepancies Between Sample Labels and COC Record? (Y) (N)
NOTES: No ~~GEOGRAPHIC~~

RFW 21-21-001/A-12/88

WO# 3840-02-02

o 01 3

Custody Transfer Record/Lab Work Request

WESTON

WESTON Analytics Use Only

Client: Gen Chemical
Work Order: ~~2375-01-03~~
Date Rec'd.: 11-22-91 Date Due: STD
RFW Contact: J. O'Neill
Client Contact/Phone:

Refrigerator#										
#/Type Container										
Volume										
Preservative										
ANALYSES REQUESTED			H_2SO_4 EPA 8							

WA Use Only Lab ID	Client ID/Description	Matrix	Date Collected								
CF 1783	GC-M8-1-ISO		11-19-91			X					
1784	GC-M8-2-ISO		↓			X					
1785	GC-M8-3-ISO		↓			X					
1786	GC-M8-4-ISO		11-20-91			X					
1787	GC-M8-5-ISO		↓			X					
1788	GC-M8-6-ISO		↓			X					
1789	GC-M8-7-ISO		↓			X					
1790	GC-M8-8-ISO		↓			X					
1791	GC-M8-9-ISO		↓			X					
1792	GC-M8-10-ISO		↓			X					
1793	GC-M8-11-ISO		↓			X					
CF 1794	GC-BLK-ISO		11-19-91			X					

Matrix:
S - Soil, SE - Sediment, SO - Solid
W - Water, O - Oil, A - Air, WI - Wipe
DS - Drum Solids, DL - Drum Liquids, F - Fish, L - EP/TCLP Leachate
X - Other

Special Instructions: NOTE: ALL SAMPLE VOLUMES MUST BE MEASURED

Item/Reason	Relinquished by	Received by	Date	Time	Item/Reason	Relinquished by	Received by	Date	Time
~~DIO~~ Analysis	J. O'Neill	[illegible]	11/25/91	0800					

WESTON Analytics Use Only

Samples Were:
1 Shipped or Hand-Delivered
NOTES:

2 Ambient or Chilled
NOTES:

3 Received Broken/Leaking (Improperly Sealed)
Y (N)
NOTES:

4 Properly Preserved Y N
NOTES: unknown

5 Received Within Holding Times
(Y) N
NOTES:

COC Tape Was:
1 Present on Outer Package (Y) N
2 Unbroken on Outer Package (Y) N
3 Present on Sample Y (N)
4 Unbroken on Sample Y N
NOTES: N/A

COC Record Was:
1 Present Upon Receipt of Samples (Y) N

Discrepancies Between Sample Labels and COC Record? Y (N)
NOTES:

RFW 21-21-001/A-12/88

WO# 3840-02-02

SJ+ 3

Custody Transfer Record/Lab Work Request

WESTON

WESTON Analytics Use Only

Client: General Chemical
Work Order: ~~2375-01-03~~
Date Rec'd.: 11-22-91 Date Due: JTD
RFW Contact: J. O'Neill
Client Contact/Phone:

Refrigerator#										
#/Type Container										
Volume										
Preservative										
ANALYSES REQUESTED →				SO_2 EPA 3						

WA Use Only Lab ID	Client ID/Description	Matrix	Date Collected								
CF 1795	GC - M8 - 1 - H_2O_2		11-19-91				X				
1796	GC - M8 - 2 - H_2O_2		↓				X				
1797	GC - M8 - 3 - H_2O_2		↓				X				
1798	GC - M8 - 4 - H_2O_2		11-20-91				X				
1799	GC - M8 - 5 - H_2O_2		↓				X				
1800	GC - M8 - 6 - H_2O_2		↓				X				
1801	GC - M8 - 7 - H_2O_2		↓				X				
1802	GC - M8 - 8 - H_2O_2		↓				X				
1803	GC - M8 - 9 - H_2O_2		↓				X				
1804	GC - M8 - 10 - H_2O_2		↓				X				
1805	GC - M8 - 11 - H_2O_2		↓				X				
1806	GC - SO_2 - Aud 17 - A01201		11-19-91				X				
1807	GC - SO_2 - Aud 17 - A00108		11-19-91				X				
CF 1808	GC - BLK - H_2O_2		11-19-91				X				

Matrix:
S - Soil, SE - Sediment, SO - Solid, W - Water, O - Oil, A - Air, WI - Wipe, DS - Drum Solids, DL - Drum Liquids, F - Fish, L - EP/TCLP Leachate, X - Other

Special Instructions: NOTE: ALL SAMPLE VOLUMES MUST BE MEASURED

Item/Reason	Relinquished by	Received by	Date	Time	Item/Reason	Relinquished by	Received by	Date	Time
Analysis	J O'Neill	[illegible]	11/25	0800					

WESTON Analytics Use Only

Samples Were:
1 Shipped or Hand-Delivered
NOTES:

2 Ambient or Chilled
NOTES:

3 Received Broken/Leaking (Improperly Sealed)
Y (N)
NOTES:

4 Properly Preserved Y N UNKNOWN
NOTES:

5 Received Within Holding Times
(Y) N
NOTES:

COC Tape Was:
1 Present on Outer Package (Y) N
2 Unbroken on Outer Package (Y) N
3 Present on Sample Y (N)
4 Unbroken on Sample Y N N/A
NOTES:

COC Record Was:
1 Present Upon Receipt of Samples (Y) N

Discrepancies Between Sample Labels and COC Record? (Y) N
NOTES: GE → GC

RFW 21-21-001/A-12/88

REPORT THE 2 AUDIT SAMPLE CONCENTRATIONS AS REQUIRED WITH AUDIT INSTRUCTIONS

APPENDIX C

PROCESS CONDITIONS AND SAMPLE CALCULATIONS

SAMPLE CALCULATIONS FOR MOISTURE, FLOW, AND DENSITY

Client:	GENERAL CHEMICAL	Plant:	CLAYMONT, DE
Test Run No.:	Run 1	Test Date:	11-19-91
Test Location:	SULFURIC ACID STACK	Test Period:	0910-1042

1. Volume of dry gas sampled at standard conditions (68 °F, 29.92 in. Hg), dscf.

$$Vm(std) = \frac{17.64 \times Y \times Vm \times \left(Pb + \frac{\Delta H}{13.6} \right)}{(Tm + 460)}$$

$$Vm(std) = \frac{17.64 \times 1.0040 \times 54.833 \times \left(30.27 + \frac{2.114}{13.6} \right)}{74.25 + 460} = 55.305$$

Where:

Vm(std)	=	Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscf.
Vm	=	Volume of gas sample measured by the dry gas meter at meter conditions, dcf.
Pb	=	Barometric Pressure, in Hg.
Δ H	=	Average pressure drop across the orifice meter, in H20.
Tm	=	Average dry gas meter temperature , °F.
Y	=	Dry gas meter calibration factor.
17.64	=	Factor that includes ratio of standard temperature (528 °R) to standard pressure (29.92 in. Hg), °R/in. Hg.
13.6	=	Specific gravity of mercury.

2. Volume of water vapor in the gas sample corrected to standard conditions, scf.

Vw(std) = (0.04707 x Vwc) + (0.04715 x Wwsg)

Vw(std) = (0.04707 x -17.0) + (0.04715 x 21.0) = 0.190

Where:

Vw(std) = Volume of water vapor in the gas sample corrected to standard conditions, scf.

Vwc = Volume of liquid condensed in impingers, ml.

Wwsg = Weight of water vapor collected in silica gel, g.

0.04707 = Factor which includes the density of water (0.002201 lb/ml), the molecular weight of water (18.0 lb/lb-mole), the ideal gas constant 21.85 (in. Hg) (ft^3)/lb-mole)(°R); absolute temperature at standard conditions (528 °R), absolute pressure at standard conditions (29.92 in. Hg), ft^3/ml.

0.04715 = Factor which includes the molecular weight of water (18.0 lb/lb-mole), the ideal gas constant 21.85 (in. Hg) (ft^3)/lb-mole)(°R); absolute temperature at standard conditions (528 °R), absolute pressure at standard conditions (29.92 in. Hg), and 453.6 g/lb, ft^3/g.

3. Moisture content

$$Bws = \frac{Vw(std)}{Vw(std) + Vm(std)}$$

$$Bws = \frac{0.190}{0.190 + 55.305} = 0.003$$

Where:

Bws = Proportion of water vapor, by volume, in the gas stream, dimensionless.

4. Mole fraction of dry gas.

Md = 1 - Bws

Md = 1 - 0.003 = 0.997

Where:

Md = Mole fraction of dry gas, dimensionless.

5. Dry molecular weight of gas stream, lb/lb-mole.

MWd = (0.440 x % CO2) + (0.320 x % O2) + (0.280 x (% N2 + % CO))

MWd = (0.440 x 2.53) + (0.320 x 10.40) + (0.280 x (87.07 + 0.00))

= 28.82

Where:

MWd = Dry molecular weight , lb/lb-mole.

% CO2 = Percent carbon dioxide by volume, dry basis.

% O2 = Percent oxygen by volume, dry basis.

% N2 = Percent nitrogen by volume, dry basis.

% CO = Percent carbon monoxide by volume, dry basis.

0.440 = Molecular weight of carbon dioxide, divided by 100.

0.320 = Molecular weight of oxygen, divided by 100.

0.280 = Molecular weight of nitrogen or carbon monoxide, divided by 100.

6. Actual molecular weight of gas stream (wet basis), lb/lb-mole.

$$MWs = (MWd \times Md) + (18 \times (1 - Md))$$

$$MWs = (28.82 \times 0.997) + 18\ (1 - 0.997)) = 28.78$$

Where:

MWs = Molecular weight of wet gas, lb/lb-mole.

18 = Molecular weight of water, lb/lb-mole.

7. Average velocity of gas stream at actual conditions, ft/sec.

$$Vs = 85.49 \times Cp \times ((\Delta p)^{1/2})avg \times \left(\frac{Ts\ (avg)}{Ps \times MWs}\right)^{1/2}$$

$$Vs = 85.49 \times 0.84 \times 0.776520 \times \left(\frac{637}{30.30 \times 28.78}\right)^{1/2} = 47.65$$

Where:

Vs = Average gas stream velocity, ft/sec.

85.49 = Pitot tube constant, ft/sec x $\frac{(lb/lb\text{-}mole)(in.\ Hg)^{1/2}}{(°R)(in\ H2O)}$

Cp = Pitot tube coefficient, dimensionless.

Ts = Absolute gas stream temperature, °R = Ts, °F + 460.

Ps = Absolute gas stack pressure, in. Hg. = Pb + $\frac{P(static)}{13.6}$

Δp = Velocity head of stack, in. H2O.

8. Average gas stream volumetric flowrate at actual conditions, wacf/hr.

$$Qs(act) = 3{,}600 \times Vs \times As$$

$$Qs(act) = 3{,}600 \times 47.65 \times 19.63$$

$$= 3366000$$

Where:

Qs(act) = Volumetric flowrate of wet stack gas at actual conditions, wacf/hr.

As = Cross-sectional area of stack, ft^2.

9. Average gas stream dry volumetric flowrate at standard conditions, dscf/hr.

$$Qs(std) = 17.64 \times Md \times \frac{Ps}{Ts} \times Qs(act)$$

$$Qs(std) = 17.64 \times 0.997 \times \frac{30.30}{637} \times 3367070$$

$$= 2814000$$

Where:

Qs(std) = Volumetric flowrate of dry stack gas at standard conditions, dscf/hr.

SAMPLE CALCULATIONS FOR
SULFUR DIOXIDES TEST (U.S.EPA METHOD 6)

Client:	GENERAL CHEMICAL	Plant:	CLAYMONT, DE
Test Run No.:	SULFURIC ACID STACK, Ru	Test Date:	11-19-91
Test Location:	SULFURIC ACID STACK	Test Period:	0910-1042

1. Sulfur dioxide concentration, lbs/dscf.

$$C1(SO2) = \frac{7.061 \times 10^{-5} \times (V(t) - V(tb)) \times N \times \frac{V(soln)}{V(a)} \times D}{Vm(std)}$$

$$C1(SO2) = \frac{7.061 \times 10^{-5} \times (82.70 - 0.00) \times 0.0100 \times \frac{375}{20} \times 1.00}{55.305}$$

$$= 1.98E-05$$

Where:

C1(SO2)	=	Sulfur dioxide concentration, lb/dscf.
V(t)	=	Volume of barium perchlorate titrate used for the sample, ml.
V(tb)	=	Volume of titrate used for the blank, ml.
N	=	Normality of barium perchlorate titrate, g-eg./l.
V(soln)	=	Total solution volume of SO2 sample (contents of first two impingers + washes), probe and front half wash & filter), ml.
V(a)	=	Volume of sample aliquot titrated, ml.
D	=	Dilution factor
7.061 x 10^-5	=	Conversion factor including number of grams per gram equivalent of sulfur dioxide (32.0 g/g - eg) 453.6 g/lb, and 1,000 ml/l. $\frac{(lb)(l)}{(g)(ml)}$
Vm(std)	=	Volume of sample gas pulled through the impinger, dscf.

5. Sulfuric acid Concentration, ppmdv.

$C2(H_2SO_4) = 3.996 \times 10^6 \times C1(H_2SO_4)$

$C2(H_2SO_4) = 3.996 \times 10^6 \times 0.000002030$

$= 8.1$

Where:

$C2(H_2SO_4)$ = Concentration of sulfuric acid in parts per million by volume (dry basis) (ppmdv).

3.996×10^6 = Conversion factor including number of 0.0353 cubic feet/ liter, 453.6 g/lb, 24.06 l/g-mole wt., 98.0 g/g-mole wt. and 10^6 ppm, $(ft^3)(ppm)/(lb)$.

6. Sulfuric acid mass emission rate, lbs/hr.

$PMR(H_2SO_4) = C1(H_2SO_4) \times Qs(std) \times 60$ min/hr

$PMR(H_2SO_4) = 2.03E\text{-}06 \times 46946 \times 60 = 5.718$

Where:

$PMR(H_2SO_4)$ = Sulfuric acid mass emission rate, lbs/hr.

WESTON

APPENDIX C

GENERAL CHEMICAL
CLAYMONT, DELAWARE

SOURCE COMPLIANCE TESTS - PRODUCTION RATES

COMPLIANCE TEST DATE	TEST RUN NUMBER	100% H_2SO_4 PROCESSED tons/day	100% H_2SO_4[1] PROCESSED tons/hr
11/19/91	One	1,156	48.17
11/19/91	Two	1,156	48.17
11/19/91	Three	1,091	45.46

[1] Data provided to WESTON by General Chemical personnel.

RELATIVE ACCURACY CALCULATION

sd = $$\left(\frac{\sum x^2 - (\sum x)^2/N}{n-1}\right)^{1/2}$$

sd = $$\left[\frac{1{,}990 - \frac{(120)^2}{11}}{10}\right]^{1/2} = 8.0$$

CC = $$T\ .975\ \frac{Sd}{\sqrt{N}} = 2.228\ \frac{8.3}{\sqrt{11}} = 6.0$$

RA = $$\frac{D + CC}{RM} \times 100 = \frac{11+6}{112} \times 100 = 15.0$$

Relative Accuracy of the SO2 Monitor

run#	RM ppm	M ppm	D	D squared
1	119	140	21	441
2	105	124	19	361
3	95	108	13	169
4	112	116	4	16
5	111	119	8	64
6	106	113	7	49
7	117	120	3	9
8	112	130	18	324
9	121	131	10	100
10	107	128	21	441
11	124	120	-4	16
sum	1229	1349	120	1990
average	112	123	11	181
		stdev	8	
		cc	6	
		rh	15	

12-12-91 02:11PM FROM GCC DVW ENVIR. DEPT. P07

calculations for stack testing on 19-20 November 1991

test1	
scfm N co	14990
scfm S co	17820
N% SO2 db	19
S% SO2 db	18.2
ave% SO2at conv.	12
ppmSO2	140
lb/hrH2SO4 mist	5.72
photos SO2 scfm	1712
#blowers	8
#converters	6

total gas flow at crossover	32810
ave gas strength at co.	18.57
air inleakage	17951
total gas flow at blwrs	50761
percent conversion	99.90
prod rate	1156
mist loading lbs/nt	0.12
mist loading gm/kg	0.06
unit volume	56249
gas to sack	46134
lbs of SO2 to atm lbs/hr	69.09

test 2	
scfm N co	14990
scfm S co	17820
N% SO2 db	19
S% SO2 db	18.2
ave% SO2at conv.	11.9
ppmSO2	124
lb/hrH2SO4 mist	4.65
photos SO2 scfm	1726
#blowers	8
#converters	6

total gas flow at crossover	32810
ave gas strength at co.	18.57
air inleakage	18378
total gas flow at blwrs	51188
percent conversion	99.91
prod rate	1156
mist loading lbs/nt	0.10
mist loading gm/kg	0.05
unit volume	56662
gas to sack	46556
lbs of SO2 to atm lbs/hr	61.75

test 3	
scfm N co	14990
scfm S co	17820
N% SO2 db	19
S% SO2 db	18.2
ave% SO2at conv.	11.7
ppmSO2	108
lb/hrH2SO4 mist	10.77
photos SO2 scfm	4585
#blowers	8
#converters	6

total gas flow at crossover	32810
ave gas strength at co.	18.57
air inleakage	18253
total gas flow at blwrs	52063
percent conversion	99.92
prod rate	1091
mist loading lbs/nt	0.24
mist loading gm/kg	0.12
unit volume	54678
gas to sack	45089
lbs of SO2 to atm lbs/hr	52.09

GENERAL CHEMICAL CORPORATION
DELAWARE VALLEY WORKS
CLAYMONT, DE 19703

SULFURIC ACID ANNUAL STACK TEST

RUN # 1 11/19/91

START TIME 910
END TIME 1042

Reading Number	TIME	% SO2 at Conv.	No. Blowers On Line	Photo's Operation Gas Flow (acfm) ABS	NH4-Hypo	Sulfite	Sulf-Tech	BME Vac " H2O	Diff. Press. " H2O	Exit Emission SO2 ppm	Absorber Acid % H2SO4	Temp. " F
1	910	11.8	8	Down	Down	1744	Down	3.5	4.5	156	98.70	180
2	925	11.8	8	Down	Down	1744	Down	3.6	4.5	145	98.67	180
3	940	12.1	8	Down	Down	1701	Down	3.7	4.5	142	98.75	180
4	955	12.1	8	Down	Down	1701	Down	3.6	4.5	140	98.70	180
5	1010	12.1	8	Down	Down	1701	Down	3.7	4.5	139	98.70	180
6	1025	12.1	8	Down	Down	1701	Down	3.8	4.5	135	98.62	180
7	1040	12.1	8	Down	Down	1701	Down	3.8	4.5	130	98.72	179
8	1042	12.1	8	Down	Down	1701	Down	3.8	4.5	135	98.70	180
9												
10	Average	12.0	8	Down	Down	1712	Down	3.7	4.5	140	98.70	180
11												
12												
13												
14												
15												

GENERAL CHEMICAL CORPORATION
DELAWARE VALLEY WORKS
CLAYMONT, DE 19703

SULFURIC ACID ANNUAL STACK TEST

RUN # 2 11/19/91

START TIME 1204
END TIME 1322

Reading Number	TIME	% SO2 at Conv.	No. Blowers On Line	Photo's Operation Gas Flow (scfm) ABS	NH4-Hypo	Sulfite	Sulf-Tech	BME Vac " H2O	Diff. Press. " H2O	Exit Emission SO2 ppm	Absorber Acid % H2SO4	Temp. ° F
1	1204	12.1	8	Down	Down	1701	Down	3.4	4.5	122	98.70	180
2	1219	12.1	8	Down	Down	1701	Down	3.6	4.5	125	98.73	180
3	1234	12.1	8	Down	Down	1701	Down	3.4	4.5	130	98.67	180
4	1249	12.1	8	Down	Down	1701	Down	3.5	4.4	122	98.70	179
5	1304	11.7	8	Down	Down	1759	Down	3.6	4.4	129	98.70	180
6	1319	11.7	8	Down	Down	1759	Down	3.0	4.3	122	98.67	180
7	1322	11.7	8	Down	Down	1759	Down	2.9	4.4	118	98.71	179
8												
9	Average	11.9	8	Down	Down	1726	Down	3.3	4.4	124	98.70	180
10												
11												
12												
13												
14												
15												

12-18-91 08:17 FROM GCC DWM ENVIR. DEPT. 811

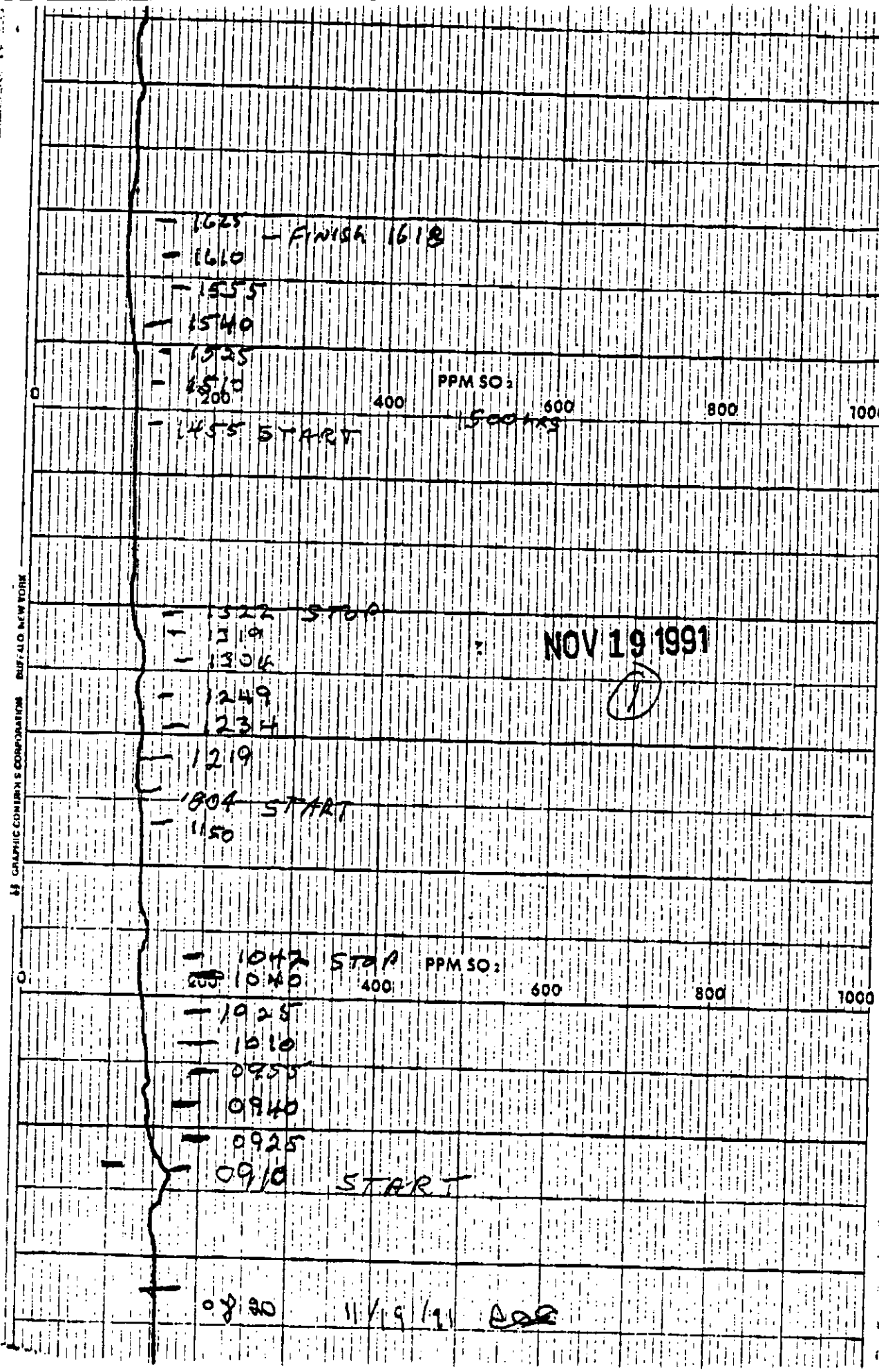
GENERAL CHEMICAL CORPORATION
DELAWARE VALLEY WORKS
CLAYMONT, DE 19703

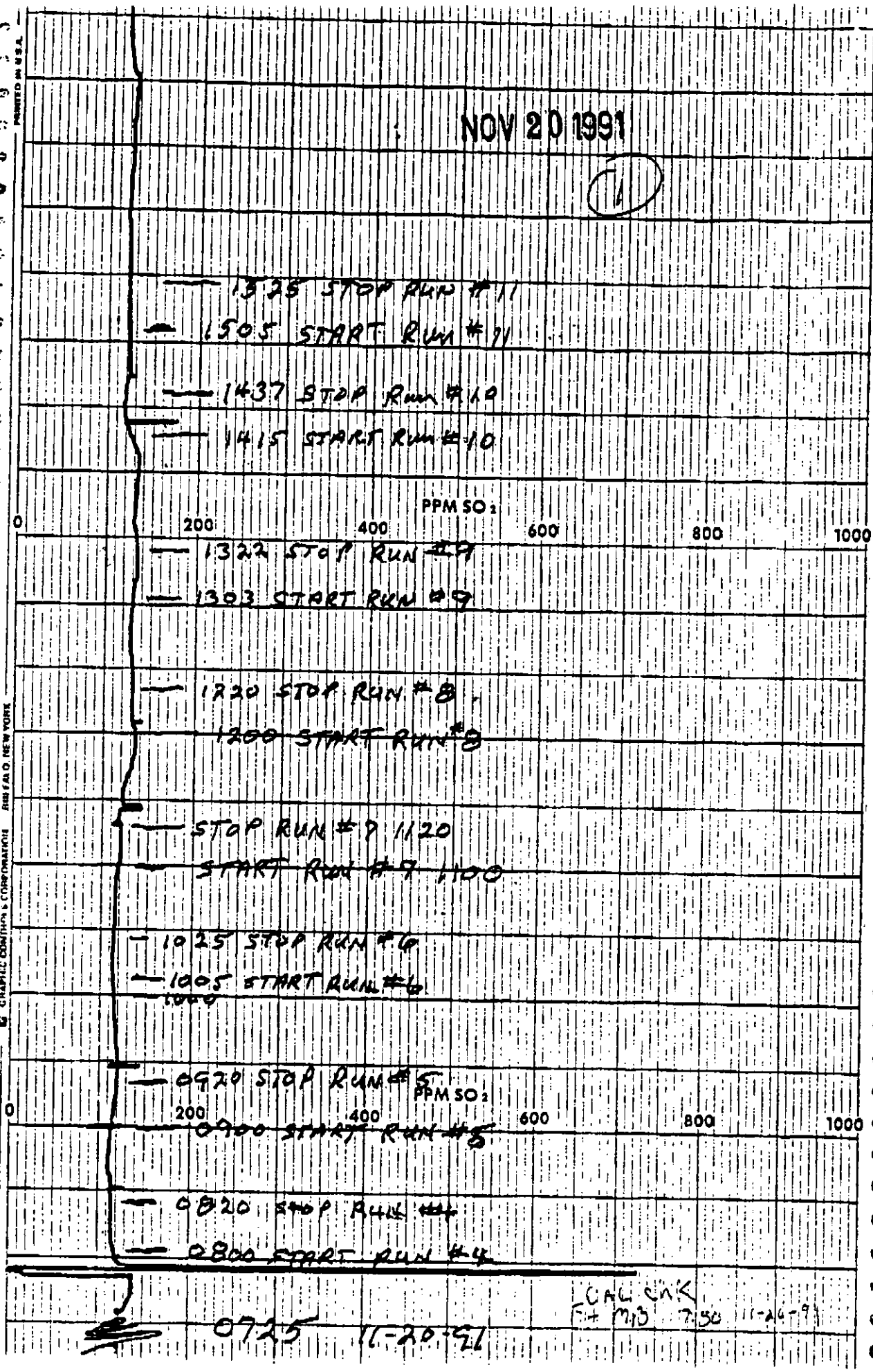
SULFURIC ACID ANNUAL STACK TEST

RUN # 3 11/19/91

START TIME 1455
END TIME 1618

Reading Number	TIME	% SO2 at Conv.	No. Blowers On Line	Photo's Operation Gas Flow (scfm) ABS	NH4-Hypo	Sulfite	Sulf-Tech	BME Vac " H2O	Diff. Press. " H2O	Exit Emission SO2 ppm	Absorber Acid % H2SO4	Temp. " F
1	1455	11.7	8	Down	2837	1759	Down	3.8	4.3	115	98.70	180
2	1510	11.7	8	Down	2837	1759	Down	3.9	4.3	115	98.70	180
3	1525	11.7	8	Down	2837	1759	Down	4.6	4.3	113	98.70	180
4	1540	11.7	8	Down	2837	1759	Down	4.7	4.3	109	98.69	179
5	1555	11.7	8	Down	2837	1759	Down	5.8	4.3	102	98.72	179
6	1610	11.7	8	Down	2837	1759	Down	6.2	4.3	100	98.70	178
7	1625	11.9	8	Down	2789	1729	Down	5.5	4.4	101	98.70	178
8												
9	Average	11.7	8	Down	2830	1755	Down	4.8	4.3	108	98.70	179
10												
11												
12												
13												
14												
15												


1625
1610 FINISH 1618
1555
1540
1525
1510
PPM SO2
0
200
400
600
800
1000
1455 START
1500 hrs
1322 STOP
1319
1304
NOV 19 1991
1249
1234
1219
1204 START
1150
1042 STOP
1040
1025
1010
0955
0940
0925
0910 START
0830 11/19/91
GRAPHIC CONTROLS CORPORATION BUFFALO NEW YORK



NOV 20 1991

11-18-91 02:21PM FROM GCC DVW ENVIR. DEPT p09

Test Designation: 50476 C/O 11-19-71 [illegible]

Date — Technician

Flue I.D. 50 Inches

A = 13.297 Ft.^{2} (Flue Area)

S.P. = -4.8 Inches W.C. ÷ 13.59 = -.35 Inches Hg

B.P. = 20.40 Inches Hg

T.P. = 20.05 Inches Hg

t = 85 °F + 459.67 = T = 544.67 °R

Fs = .85 (Pitot Tube Factor)

$\frac{1.213 \times 100}{30.05} = 4.04$

N	P	D	$\sqrt{D}$
1	1.3	.20	.447
2	4.1	.22	.469
3	7.3	.23	.480
4	11.3	.23	.480
5	17.1	.25	.500
6	32.9	.27	.520
7	38.7	.27	.520
8	42.7	.24	.490
9	45.9	.20	.447
10	48.7	.16	.400
11			
12			
13		AVG	.475
14			
15			
16			
17			
18			
19			
20			
Average			

Flue Gas Composition

Component	M.W.	vol. % DB	Mole Wt. Fraction		vol. % WB	Mole Wt. Fraction
SO_2	64.07			19.0	18.23	11.68
O_2	32.00			9.4	9.02	2.89
CO_2	44.01			6.4	6.14	2.70
N_2	28.02				62.57	17.53
SO_3	80.07					
H_2O	18.02				4.04	.73

Gas m.w. = Gas m.w. = 35.53

$$v = Fs \times \sqrt{2 \times 32.16 \times \frac{62.32 \times 359.05}{m.w.} \times \frac{D}{12} \times \frac{T}{491.67} \times \frac{29.92}{T.P.}}$$

$$v = Fs \times 85.43 \times \sqrt{D} \times \sqrt{\frac{T}{m.w. \times T.P.}}$$

$$v = .85 \times 85.43 \times .475 \times \sqrt{\frac{544.67}{35.53 \times 30.05}}$$

.714

510

1067.68

v = 24.64 FPS

V = v x 60 = 1478 FPM

Q = V x A = 19655 ACFM

$$Qs = Q \times \frac{491.67}{T} \times \frac{T.P.}{29.92}$$

$$Qs = \times \frac{491.67}{544.67} \times \frac{30.05}{29.92} = 17820 \text{ SCFM}$$

Average

DAE (1/4/79)

12-18-9 [illegible] FROM GCC DWW ENVIR. DEPT.

Flow Designation NORTH C10 11-19-91
Date Technician

Flue I.D. 50 Inches
A = 13.297 Ft.^{2} (Flue Area)

S.P. = -4.3 Inches W.C. ÷ 13.59 = -.32 Inches Hg
B.P. = 30.40 Inches Hg
T.P. = 30.08 Inches Hg
t = 75 °F + 459.67 =T= 534.67 °R
Fs = .85 (Pitot Tube Factor)

.875 x 100 = 2.91
30.08

N	P	D	$\sqrt{D}$
1	1.3	.16	.400
2	4.1	.19	.436
3	7.3	.19	.436
4	11.3	.195	.442
5	17.1	.195	.442
6	32.9	.14	.374
7	38.7	.13	.361
8	42.7	.13	.361
9	45.9	.13	.361
10	48.7	.10	.316
11			
12			
13		AVG	.393
14			
15			
16			
17			
18			
19			
20			
Average			

Flue Gas Composition

Component	M.W.	vol. % DB	Mole Wt. Fraction		vol. % WB	Mole Wt. Fraction
SO_2	64.07			18.2	12.67	11.32
O_2	32.00			9.0	8.74	2.80
CO_2	44.01			4.2	4.08	1.80
N_2	28.02				66.60	18.66
SO_3	80.07					
H_2O	18.02				2.91	.52
Gas m.w.=				Gas m.w.=		35.10

$$v = Fs \times \sqrt{2 \times 32.16 \times \frac{62.32}{m.w.} \times 359.05 \times \frac{D}{12} \times \frac{T}{491.67} \times \frac{29.92}{T.P.}}$$

$$v = Fs \times 85.43 \times \sqrt{D} \times \sqrt{\frac{T}{m.w. \times T.P.}}$$

$$v = .85 \times 85.43 \times .393 \times \sqrt{\frac{534.67}{35.10 \times 30.08}}$$

.712
506
1055.81

v = 20.32 FPS
V = v x 60 = 1219 FPM

Q = V x A = 16211 ACFM

$$Qs = Q \times \frac{491.67}{T} \times \frac{T.P.}{29.92}$$

$$Qs = \times \frac{491.67}{534.67} \times \frac{30.08}{29.92} = 14990 \text{ SCFM}$$

DAE (1/4/79)

12-18-91 02:01PM FROM GCC DWM ENVIR. DEPT. P14

APPENDIX D

EQUIPMENT CALIBRATION RECORDS

WESTON

Calibrator PM

POSTTEST DRY GAS METER CALIBRATION DATA FORM (VOST)

Date 11/25/91 Meter box number 3 Plant General chemical

Barometric pressure, P_b = 29.50 in. Hg Dry gas meter number N340453 Pretest Y 1.004

Setting		Gas Volume		Temperature							Y_i =
	Orifice Manometer	Wet test meter	Dry gas meter	Wet test meter	Dry gas meter						
Rotometer	(ΔH) in. H_2O	(V_w) liters	(V_d) liters	(t_w) °F	Inlet (td_i) °C	Outlet (td_o) °C	Average (t_d) °C/°F	Time (θ), min.	Vacuum Setting, in. Hg.	Y_i	$\frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
75	.75	10	57.30 47.13	61	20 20,21	—	20.5/68.5	10.55	1	.9955	
75	.75	10	67.47 57.30	61	21 22,22	—	21.6/71	10.7	1	1.000	
75	.75	10	77.71 67.47	61	23 23,24	—	23.3/74	10.7	1	.9990	
										Y = .9981	

If there is only one thermometer on the dry gas meter, record the temperature under td_o.

V_w = Gas volume passing through the wet test meter, liters.
V_d = Gas volume passing through the dry gas meter, liters.
t_w = Temperature of the gas in the wet test meter, °F.
td_i = Temperature of the inlet gas of the dry gas meter, °C.
td_o = Temperature of the outlet gas of the dry gas meter, °C.
t_d = Average temperature of the gas in the dry gas meter, $\frac{td_i + td_o}{2}$.
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.
°C/°F = (°C 9/5) + 32 = °F

No ✓

WESTON

Calibrator PM

LONG/PRE DRY GAS METER CALIBRATION DATA FORM (VOST)

Date 11/16/91 Meter box number 3 Plant ____

Barometric pressure, P_b = 29.51 in. Hg Dry gas meter number N340453 Comments ____

Setting			Gas Volume		Temperature							Y_i =
		Orifice Manometer	Wet test meter	Dry gas meter	Wet test meter	Dry gas meter						
Liters per minute	Rotometer	(Δ H) in. H_2O	(V_w) liters	(V_d) liters	(t_w) °F	Inlet (td_i) °C	Outlet (td_o) °C	Average (t_d) °C/°F	Time (θ), min.	Vacuum Setting in. Hg.	Y_i	$\frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
.5	41	.35	5	52.46 47.45	64.5	21 21,21	—	21/70	9.7	3	1.007	
.5	41	.35	5	57.47 52.46	64.5	21 21,21	—	21/70	9.6	3	1.007	
1.0	79	.8	~~10~~ 11	71.41 60.35	65	20 21,21	—	20.6/69	12.9	3	1.000	
1.0	79	.8	~~10~~ 13	84.44 71.44	65	20 21,21	—	20.6/69	12.9	3	1.005	
											Y = 1.004	

If there is only one thermometer on the dry gas meter, record the temperature under td_o.

V_w = Gas volume passing through the wet test meter, liters.

V_d = Gas volume passing through the dry gas meter, liters.

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

td_i = Temperature of the inlet gas of the dry gas meter, °C.

td_o = Temperature of the outlet gas of the dry gas meter, °C.

t_d = Average temperature of the gas in the dry gas meter, $\frac{td_i + td_o}{2}$.

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 four runs; tolerance = pretest Y ± 0.05Y.

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

WESTON

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

DATE 11/25/91
AMBIENT TEMPERATURE 64.5
CALIBRATION PM

POTENTIOMETER NUMBER Vost #3
BAROMETRIC PRESSURE 29.52
REFERENCE: THERMOCOUPLE SIMULATOR
(ACCURACY ± 1°F)

REFERENCE TEMPERATURE °C	°F	TEMPERATURE READING FROM THERMOCOUPLE CHANNEL INPUT NUMBER 1	2	3	4	5	AVERAGE TEMPERATURE READING ⊙	TEMPERATURE DIFFERENCE ⊙ (%)
0	32	0	0	0	0		0	0° – 0%
100	212	100	100	100	100		100	0° – 0%
500	932	500	500	500	500		500	0° – 0%
1000	1832	999	999	999	999		999	1°C – .07% 1.8F

COMMENTS

⊙ AVERAGE TEMPERATURE READING = MEAN OF THE TEMPERATURE READINGS FOR THE THERMOCOUPLE CHANNELS

⊙ THE CHANNEL READINGS MUST AGREE WITHIN ± 5°F OR 3°C

ACCEPTABLE TEMPERATURE DIFFERNCE ≤ 1.5 = $\left(\frac{(\text{REF TEMP}^{\circ}\text{F} + 460) - (\text{TEST TEMP}^{\circ}\text{F} + 460)}{(\text{REF TEMP}^{\circ}\text{F} + 460)}\right) \times 100$

POTCAL 4T

WESTON

LONG/PRE DRY GAS METER CALIBRATION DATA FORM

Calibrator PM

Date 11/06/91 Meter Box Number 11 Plant _____

Barometric pressure, P_b = 29.72, 29.71 in. Hg Dry Gas Meter Number 6837013 Comments _____

Setting	Gas volume		Temperatures						
Orifice manometer	Wet test meter	Dry gas meter	Wet test meter	Dry gas meter					
(Δ H) in. H_2O	(V_w) ft^3	(V_d) ft^3	(t_w) °F	Inlet (td_i) °F	Outlet (td_o) °F	Avg (t_d) °F	Time (θ), min	Y_i	ΔH @$_i$ in. H_2O
0.5	5	685.320 690.321	66	71,73,73	71,71,71	71.5	13.1	1.009	1.905
1.0	5	720.314 725.282	65	75,74,77	70,70,71	73	9.4	1.006	1.950
1.5	10	751.437 761.329	66	77,79,81	72,73,74	76	15.8	1.004	2.062
2.0	10	772.585 782.443	67	80,82,84	75,75,76	78.5	13.85	1.002	2.111
3.0	10	789.254 799.161	67	76,80,82	72,73,74	76	11.25	1.000	2.099
							Avg	Y 1.004	Δ H @ 2.025

If there is only one thermometer on the dry gas meter, record the temperature under td_o.

(ΔH) in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$	$\Delta H@i = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\Theta}{V_w}\right]^2$
0.5	0.0368	(5)(29.72)(71.5+460) / (4.999)(29.72+.0368)(66+460)	(.0317)(.5) / (29.72)(71.5+460) [(66+460)(13.1) / 5]²
1.0	0.0735	(5)(29.71)(73+460) / (5.032)(29.71+.0735)(65+460)	(.0317)(1.0) / (29.71)(73+460) [(65+460)(9.4) / 5]²
1.5	0.110	(10)(29.71)(76+460) / (10.108)(29.71+.110)(66+460)	(.0317)(1.5) / (29.71)(76+460) [(66+460)(15.8) / 10]²
2.0	0.147	(10)(29.71)(78.5+460) / (10.14)(29.71+.147)(67+460)	(.0317)(2.0) / (29.71)(78.5+460) [(67+460)(13.85) / 10]²
3.0	0.221	(10)(29.71)(76+460) / (10.093)(29.71+.221)(67+460)	(.0317)(3.0) / (29.71)(76+460) [(67+460)(11.25) / 10]²

WESTON

Calibrator PM

POSTTEST DRY GAS METER CALIBRATION DATA FORM

Date 11/25/91 Meter box number 11 Plant General Chemicals

Barometric pressure, P_b = 29.54 in. Hg Dry gas meter number 6837013 Pretest Y 1.004

Setting	Gas Volume		Temperature							Y_i =
Orifice Manometer	Wet test meter	Dry gas meter	Wet test meter	Dry gas meter						
(ΔH) in. H_2O	(V_w) ft^3	(V_d) ft^3	(t_w) °F	Inlet (td_i) °F	Outlet (td_o) °F	Average (t_d) °F	Time (θ), min.	Vacuum Setting, in. Hg.	Y_i	$\frac{V_w P_b (t_d + 460)}{V_d\left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
.75	10	82.322 / 72.188	70	75, 79, 81	71, 73, 74	75.5	21.6	4	.9950	
.75	10	72.515 / 62.323	70	77, 81, 83	76, 77, 79	79	21.7	4	.9959	
.75	10	102.707 / 92.515	70	82, 84, 85	79, 79, 80	81.5	21.7	4	1.000	
									Y = .9969	

If there is only one thermometer on the dry gas meter, record the temperature under td_o.

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.
td_i = Temperature of the inlet gas of the dry gas meter, °F.
td_o = Temperature of the outlet gas of the dry gas meter, °F.
t_d = Average temperature of the gas in the dry gas meter, $\frac{td_i + td_o}{2}$.

$$\Delta H @_1 = \frac{0.0317 \Delta H}{P_b (t_d + 460)} \left[\frac{(t_d + 460)\theta}{V_w} \right]^2$$

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.

Long calibration required? Yes _____ No ✓

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STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

DATE 11/25/91
AMBIENT TEMPERATURE 72
CALIBRATION PM

POTENTIOMETER NUMBER 2040 # 11
BAROMETRIC PRESSURE 29.34
REFERENCE: THERMOCOUPLE SIMULATOR
(ACCURACY ± 1°F)

REFERENCE TEMPERATURE °C	°F	TEMPERATURE READING FROM THERMOCOUPLE CHANNEL INPUT NUMBER 1	2	3	4	5	AVERAGE TEMPERATURE READING ⊙	TEMPERATURE DIFFERENCE ⊙ (%)
0	32	32	32	32	32	32	32	0° - 0%
100	212	212	212	212	212	212	212	0° - 0%
500	932	932	932	932	932	932	932	0° - 0%
1000	1832	1826	1826	1826	1826	1826	1826	6° - .26%

COMMENTS

⊙ AVERAGE TEMPERATURE READING = MEAN OF THE TEMPERATURE READINGS FOR THE THERMOCOUPLE CHANNELS

⊙ THE CHANNEL READINGS MUST AGREE WITHIN ± 5°F OR 3°C

ACCEPTABLE TEMPERATURE DIFFERNCE ≤ 1.5 = $\left(\frac{(\text{REF TEMP}^{\circ}\text{F} + 460) - (\text{TEST TEMP}^{\circ}\text{F} + 460)}{(\text{REF TEMP}^{\circ}\text{F} + 460)}\right) \times 100$

POTCAL-4T

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TYPE S PITOT TUBE INSPECTION DATA FORM

Pitot P3

Pitot tube assembly level? ✓ Yes _____ No

Pitot tube openings damaged? _____ Yes (explain below) ✓ No

α_1 = 2 ° (<10°), α_2 = 1 ° (<10°), β_1 = 1 ° (<5°), β_2 = 2 ° (< 5°)

Y = 1 °, Θ = 1 °, A = .874 cm (in.)

z = A sin γ = .015 cm (in.); < 0.32 cm (< ⅛ in.),

w = A sin Θ = .015 cm (in.); <.08 cm (<1/32 in.)

P_A .437 cm (in.) P_b .437 cm (in.) D_t = .374 cm (in.)

Comments: Inspected 4/24/91 Andre Williams

Calibration required? _____ Yes ✓ No

type-s.frm

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STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date: 1-8-91 Thermocouple Number: NUTECH VOST 3

Ambient Temperature: 65 °F Barometric Pressure: 30.68 in. Hg

Calibrator: KH Reference: Mercury-in-glass ✓

Other:

Reference Point Number	Source[a] (Specify)	Reference Thermometer Temperature, °F	Thermocouple Potentiometer Temperature, °F	Temperature Difference[b] %
	HOT OIL	412	211°C / 412	0
	AMBIENT	65	18°C / 64	.19
	ICE BATH	32	0°C / 32	0

[a]Type of calibration system used.

[b] $\left[\frac{(\text{ref temp, °F} + 459.67) - (\text{test thermom temp, °F} + 459.67)}{\text{ref temp, °F} + 459.67}\right] 100 \leq 1.5\%$

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STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date: 1-7-91 Thermocouple Number: NUTECH 11

Ambient Temperature: 65 °F Barometric Pressure: 30.45 in. Hg

Calibrator: KY Reference: Mercury-in-glass ✓

Other:

Reference Point Number	Source[a] (Specify)	Reference Thermometer Temperature, °F	Thermocouple Potentiometer Temperature, °F	Temperature Difference[b] %
	HOT OIL	400	401	.12
	AMBIENT	64	64	0
	ICE BATH	32	34	.41

[a]Type of calibration system used.

[b] $\left[\frac{(\text{ref temp, °F} + 459.67) - (\text{test thermom temp, °F} + 459.67)}{\text{ref temp, °F} + 459.67}\right] 100 \leq 1.5\%$

NOZZLE CALIBRATION DATA FORM

Date 11-19-91 Calibrated by JDO

Nozzle identification number	Nozzle diameter, inches[a]			ΔD,[b]	D_{avg}[c]
	D_1	D_2	D_3		
Na 1	.245 .235	.244 .234	.245 .235	.001 .001	.245 .235

Where:

[a] $D_{1,2,3}$ = three different nozzle diamters, inches; each diameter must be measured to nearest 0.001 in.

[b] ΔD = maximum difference between any two diameters, inches. ΔD must be $\leq$ 0.004 in.

[c] D_{avg} = nozzle diameter = average of D_1, D_2 and D_3.

APPENDIX E

LIST OF WESTON PARTICIPANTS

PROJECT PARTICIPANTS

The following WESTON employees participated in this project:

Barry L. Jackson Project Director	econENVIRONomics Division
Jeffrey D. O'Neill Senior Section Manager	econENVIRONomics Division
Paul M. Meeter Technical Manager	econENVIRONomics Division
Tom Bernstiel Project Scientist	econENVIRONomics Division
Andre Williams Project Technician	econENVIRONomics Division
Cathy Lloyd Laboratory Supervisor	WESTON Analytics - Auburn