United States
Environmental Protection
Agency

Office of Air Quality
Planning and Standards
Research Triangle Park NC 27711

EMB Report 78-NHF-2a
March 1979

Air

EPA

Ammonium Sulfate

Emission Test Report Occidental Chemical Company Houston, Texas

SOURCE EMISSIONS TEST REPORT

OCCIDENTAL CHEMICAL COMPANY
Houston, Texas

AMMONIUM SULFATE DRYER BAGHOUSE EXHAUST STACK

Barry L. Jackson
Supervisor
Air Testing

Peter J. Marks
Department Manager
Laboratory Services

for: ROY F. WESTON

RFW W.O. #0300-81-04
Contract No. 68-02-2816
Work Assignment No. 3

Prepared by:

ROY F. WESTON
ENVIRONMENTAL CONSULTANTS-DESIGNERS
Weston Way
West Chester, Pennsylvania 19380
(215) 692-3030

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

SUMMARY

The Emission Measurement Branch of the U.S. Environmental Protection Agency contracted Roy F. Weston, Inc. to conduct a source testing and analysis program at Occidental Chemical Company's Houston, Texas Ammonium Sulfate Plant.

The primary objective of the testing program was to quantify the particulate emissions to the atmosphere from the Ammonium Sulfate Dryer Baghouse Stack. This objective was achieved by performing a series of three particulate tests utilizing EPA Method 5[1] procedures at the baghouse exhaust stack location. In addition, visual determinations of plume opacities were made simultaneously with each particulate test at the source discharge point according to EPA Method 9[2] protocol.

The particulate matter emission results are summarized below:

Ammonium Sulfate Dryer Baghouse

Test No.	Test Location	Particulate Grains/DSCF	Concentration Pounds/Hour
1	Exhaust Stack	0.016	0.16
2	Exhaust Stack	0.023	0.23
3	Exhaust Stack	0.026	0.25

No visible emissions were observed emanating from the baghouse exhaust stack during the test program by the certified observer.

Detailed summaries of test data and test results are presented in Tables 1 and 2 of this report, respectively.

[1] Code of Federal Regulations, Title 40, Part 60, Appendix A, "Standards of Performance for New Stationary Sources," August 18, 1977.

[2] Federal Register, Vol. 39, No. 219, November 12, 1974.

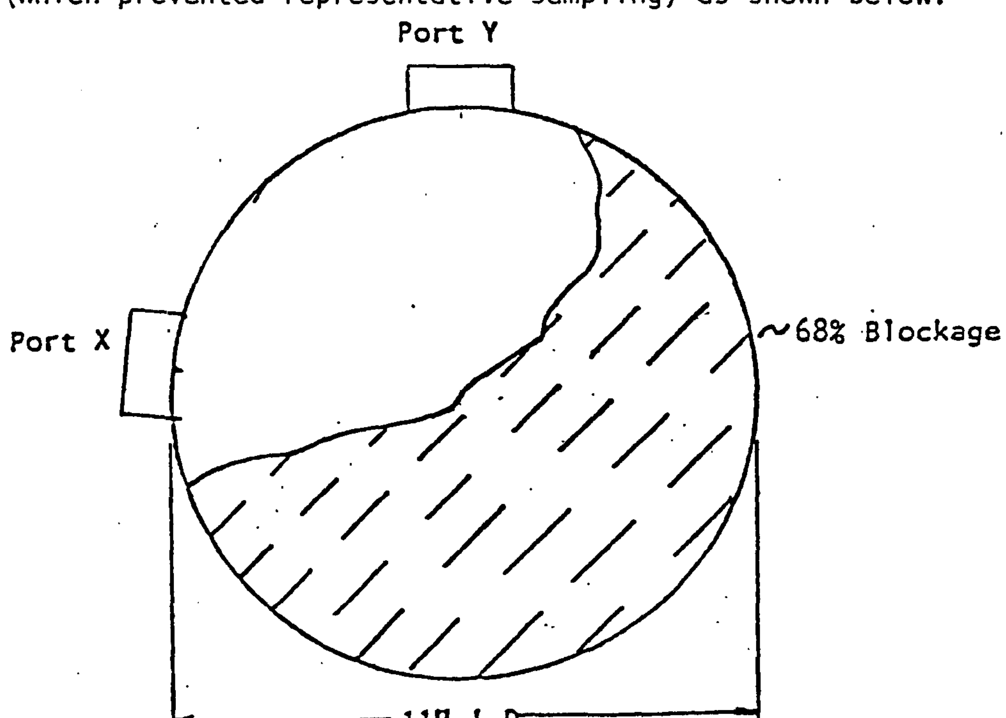
The Emission Measurement Branch of the U.S. Environmental Protection Agency contracted Roy F. Weston, Inc. to conduct a source testing and analysis program at Occidental Chemical Company's Houston, Texas Ammonium Sulfate Plant. The objective of the testing program was to measure various emission parameters from Oxychem's Ammonium Sulfate Dryer Baghouse.

The location tested, plus the number and types of tests performed at the site are listed below:

1. Ammonium Sulfate Dryer Baghouse Exhaust Stack.
   a. Three one-hour particulate tests by EPA Method 5.
   b. Three opacity tests by EPA Method 9. Visual determinations of plume opacities were determined simultaneously with the particulate tests.

These tests were conducted on 26 October 1978 by Weston personnel. Tests performed previously at the exhaust stack indicated emissions greater than might be expected from a bag collector used in this application and were attributed to leaking bag(s).

The baghouse inlet duct location was not tested during this period since most of the internal area of the duct was filled with an irregular buildup of product solids (which prevented representative sampling) as shown below:



Baghouse Inlet
Duct Cross-Sectional View

A decision was made not to test the inlet duct since the entire unit would have been required to shut down to enable the duct to be cleaned.

Test data and test results of the outlet testing program are presented in Tables 1 and 2 of this report, respectively. Also, incorporated herein is a description of the test location, test equipment, test procedures, sample recovery, and analytical methods used during the test program. Raw test data, laboratory reports, sample calculations, equipment calibration data, baghouse details, and a list of project participants are provided in Appendices A through F, respectively.

Ammonium Sulfate Dryer

Anhydrous ammonia and sulfuric acid are combined to yield granular ammonium sulfate at a rate of 14 to 18 tons/hour. The heat of reaction causes the desired moisture loss in the dryer to produce the final product. The final product drops from the dryer and is then conveyed to storage. The moist hot air from the dryer, which contains ammonium sulfate fines, is drawn through a baghouse to effect additional product recovery while reducing particulate emissions.

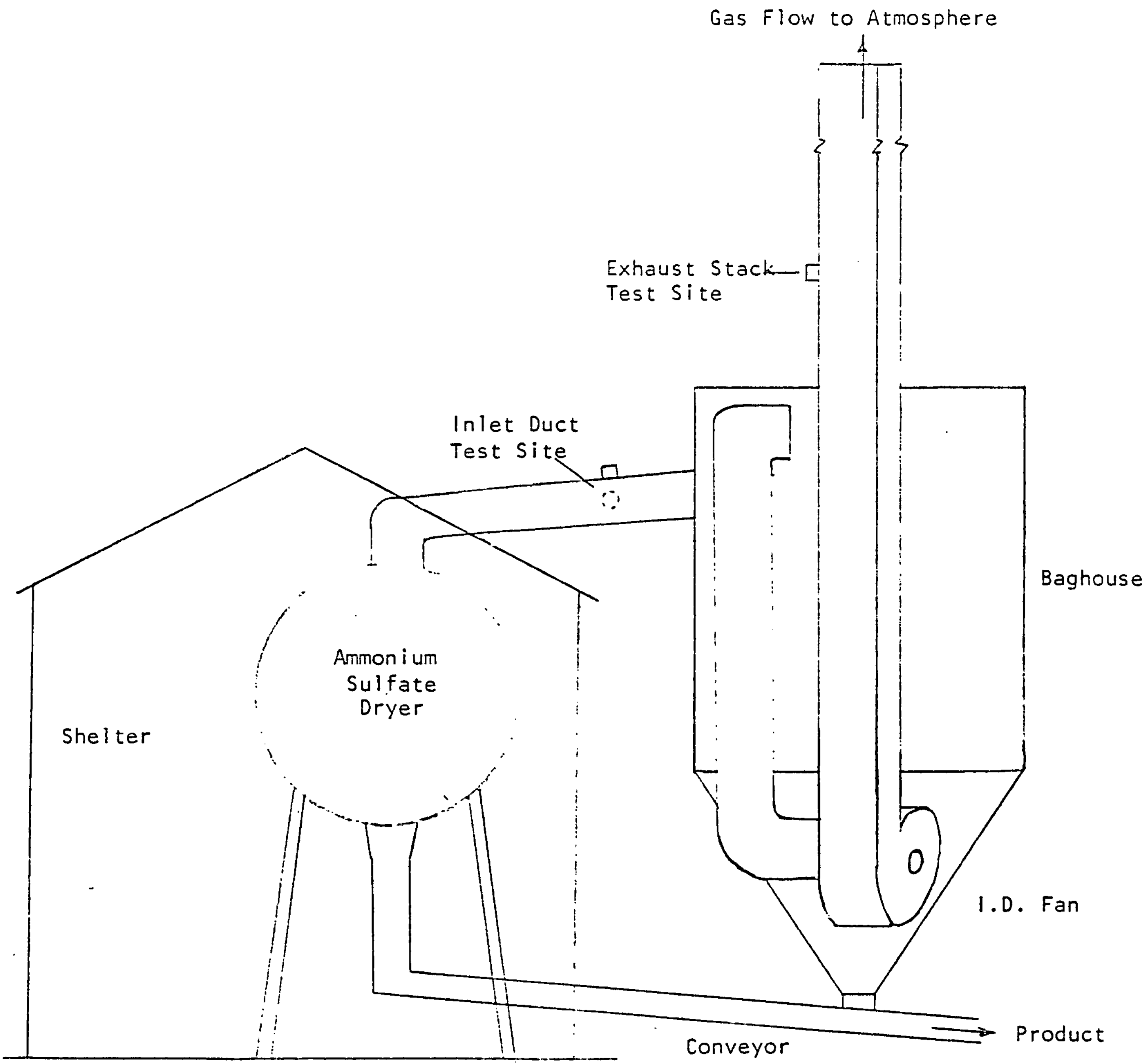
A schematic diagram of the Ammonium Sulfate Dryer and Baghouse is presented in Figure 1.

OCCIDENTAL CHEMICAL COMPANY

Houston, Texas

FIGURE 1

AMMONIUM SULFATE DRYER AND BAGHOUSE



DESCRIPTION OF TEST LOCATION

Ammonium Sulfate Dryer Baghouse Exhause Stack

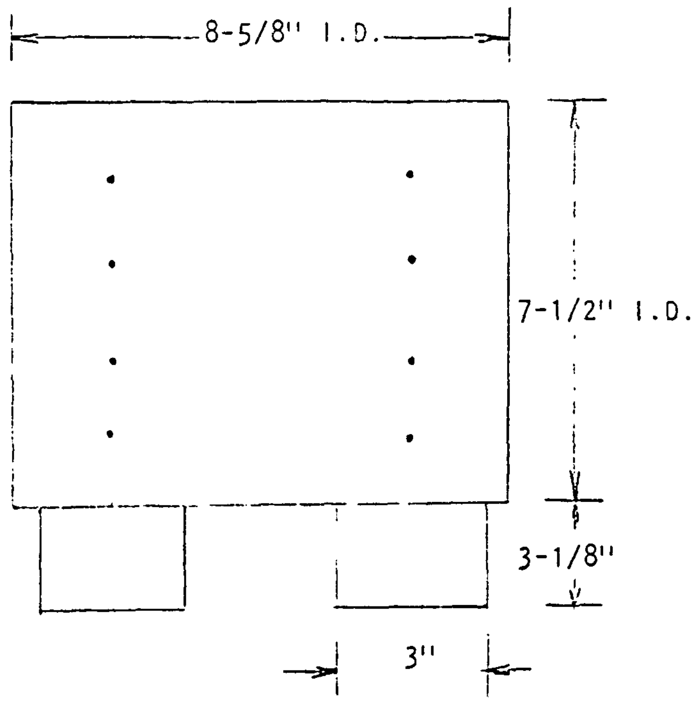
Two 3" I.D. test ports were placed on one side of the 7-1/2" x 8-5/8" rectangular exhaust stack serving the baghouse. The ports were located 15 diameters downstream and 10 diameters upstream from the nearest flow disturbances. Since the eight and two diameter criterion were met, a minimum of eight traverse points were required by EPA Method 1 regulations. Figure 2 illustrates duct geometry plus port and sampling point locations.

OCCIDENTAL CHEMICAL COMPANY

Houston, Texas

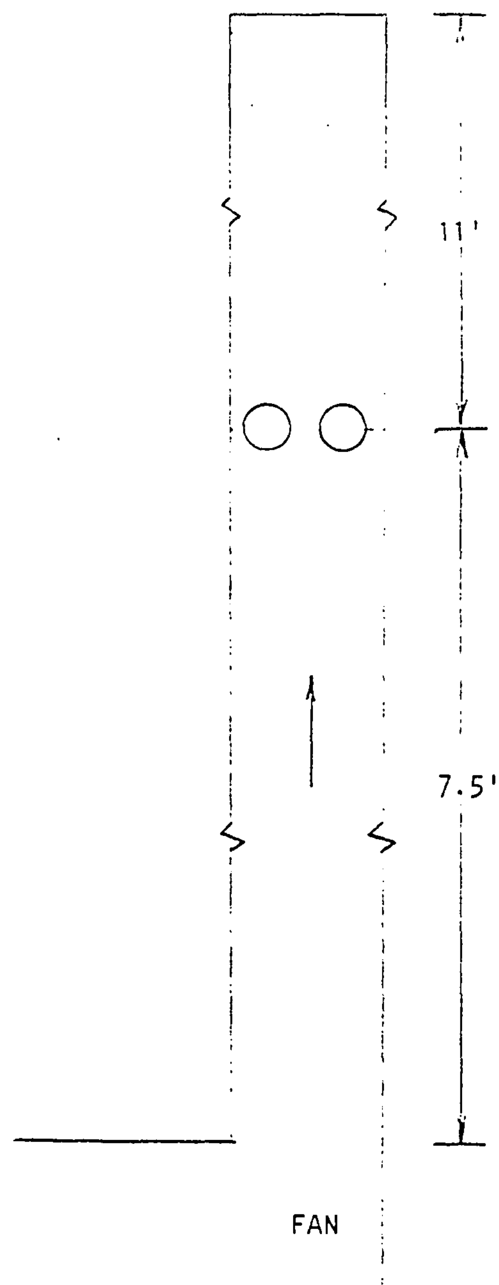
FIGURE 2

AMMONIUM SULFATE DRYER BAGHOUSE EXHAUST STACK



Duct Cross-Sectional View

Traverse Point Number	Distance From Inside Near Wall, Inches
1	1
2	2-3/4
3	4-5/8
4	6-1/2



METAL STACK

DESCRIPTION OF SAMPLING TRAIN

Particulate Sampling Train

The test train utilized for particulate sampling at the baghouse exhaust duct location was the standard EPA Method Five Train (see Figure 3).

A stainless steel nozzle was attached to a heated ($\sim$250°F) 3' borosilicate glass probe which was connected directly to a borosilicate filter holder containing a 4" Reeve Angel 900 AF glass fiber filter. The filter holder was maintained at approximately 250°F in a heated chamber, and was connected by a section of borosilicate tubing to the first of four Greenburg-Smith impingers which were included in the train to condense the moisture in the gas stream. Each of the first two impingers contained 100 ml of distilled water, the third was dry and the final impinger contained 200 grams of dry pre-weighed silica gel. The first, third, and fourth impingers were modified Greenburg-Smith type; the second was a standard Greenburg-Smith impinger. All impingers were maintained in a crushed ice bath. A RAC control console with vacuum pump, dry gas meter, a calibrated orifice, and inclined manometers completed the sampling train.

Flue gas temperature was measured by means of a Type K thermocouple which was connected to a direct readout pyrometer. The thermocouple sensor was positioned adjacent to the sampling nozzle.

Gas velocity was measured using a calibrated "S" type pitot tube provided with extensions and fastened alongside the sampling probe. Gas stream composition (carbon dioxide, oxygen, and carbon monoxide content) was determined utilizing Orsat apparatus to analyze stack gas samples. Gas stream composition proved to be ambient air since no combustion products were found in any of the stack gas effluent samples.

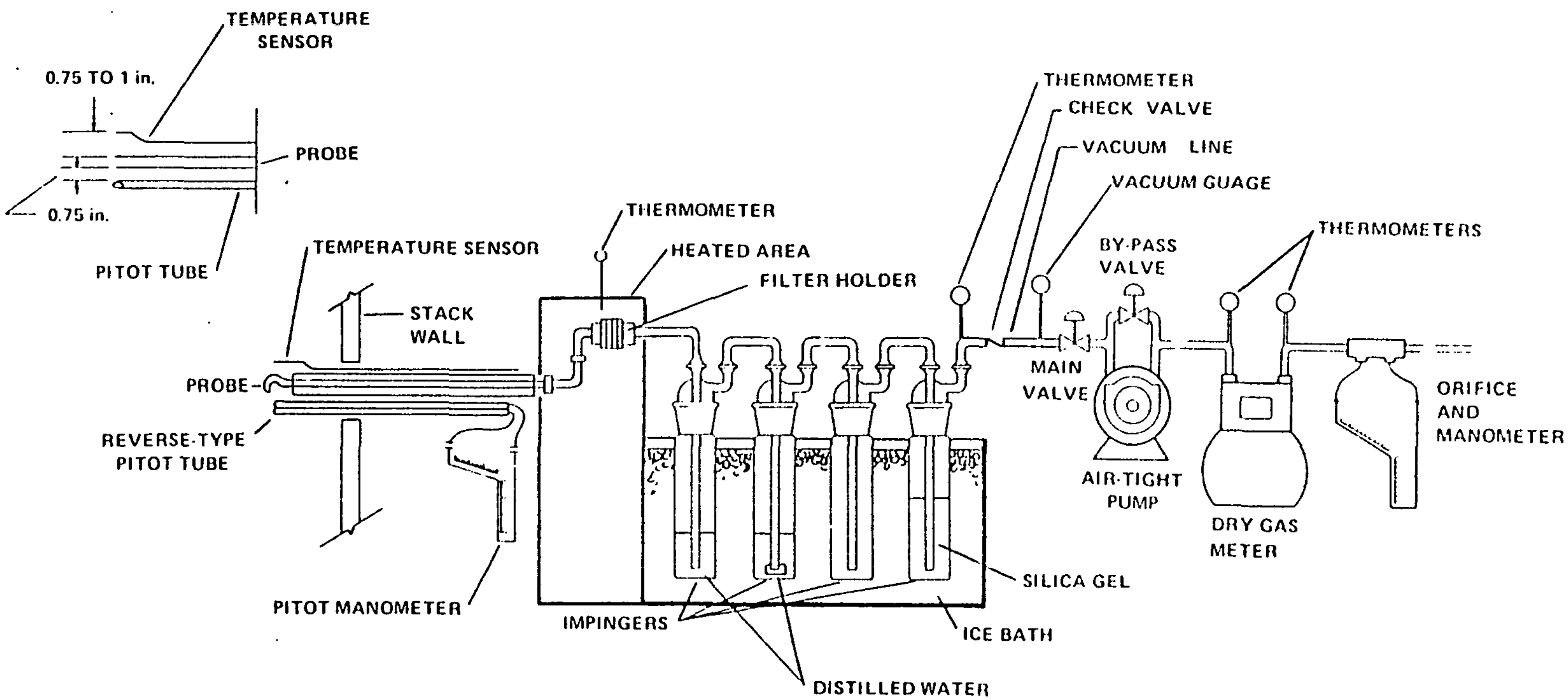


FIGURE 3 PARTICULATE SAMPLING TRAIN–EPA METHOD 5

BAGHOUSE EXHAUST STACK

TEST PROCEDURES

Preliminary Tests

Preliminary test data was obtained at the sampling location. Stack geometry measurements were recorded and sampling point distances calculated. A preliminary velocity traverse was performed utilizing a calibrated "S" type pitot tube and a Dwyer inclined manometer to determine velocity profiles. Stack gas temperatures were observed with a direct read-out pyrometer equipped with a chromel-alumel thermocouple. Gas stream composition and moisture content values were estimated from previous stack testing reports.

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

Calibration of the probe nozzles, pitot tubes, metering systems, probe heaters, temperature gauges and barometer were performed as specified in Section 5 of EPA Method 5 test procedures (see Appendix E for calibration data).

Ammonium Sulfate Dryer Baghouse Exhaust Stack

A series of three EPA Method 5 tests were performed at the Ammonium Sulfate Dryer Baghouse exhaust stack. Twelve points were traversed, six per port axis for five minutes each yielding a test period 60 minutes in length.

During particulate sampling, gas stream velocities were measured by inserting a calibrated "S" type pitot tube into the stream adjacent to the sampling nozzle. The velocity pressure differential was observed immediately after positioning the nozzle at each point, and sampling rates were adjusted to maintain isokinetic sampling. Stack gas temperatures were also monitored at each point with the pyrometer and thermocouple. Additional temperature measurements were made at the final impinger and at the inlet and outlet of the dry gas meter.

Test data was recorded every five minutes during all test periods. Table 1 presents a summary of test data for each of the three runs. Test result summarization appears on Table 2.

Visible emissions observations were recorded concurrently with each particulate test repetition by a certified observer according to EPA Method 9 procedures. See Table 2 for result summary.

Particulate Sample Recovery

At the conclusion of each test, the sampling train was dismantled, openings sealed, and the components transported to the field laboratory. Sample integrity was assured by maintaining chain of custody records which will be supplied upon request.

A consistent procedure was employed for sample recovery:

- The glass fiber filter(s) was removed from its holder with tweezers and placed in its original container (petri dish), along with any loose particulate and filter fragments (Sample 1).

- The probe and nozzle were separated and the internal particulate rinsed with distilled water into a borosilicate container while brusting a minimum of three times until no visible particles remained. Particulate adhering to the brush was rinsed with distilled water into the same container. The front half of the filter holder was rinsed with distilled water while brushing a minimum of three times. The rinses were combined (Sample 2) and the container sealed with a Teflon lined closure.

- The total liquid in impingers one, two and three was measured, the value recorded, and the liquid discarded.

- The silica gel was removed from the last impinger and immediately weighed.

- A distilled water sample was retained for blank analysis.

Particulate Analyses

The filters (Sample 1) and any loose fragments were desiccated for 24 hours and weighed to the nearest 0.1 milligram to a constant weight.

The distilled water wash samples (Sample 2) were evaporated at 105°C and ambient pressure in tared beakers, and desiccated to constant weight. All sample residue weights were adjusted by the water blank value.

The weight of the material collected on the glass fiber filter(s) plus the weight of the residue of the nozzle/probe/front-half filter holder washes represents the "total" EPA Method 5 catch. Complete laboratory results are presented in Appendix B of this report.

DISCUSSION OF TEST RESULTS

Particulate test data and test result summaries are presented in Tables 1 and 2 of this report.

No unusual process operating conditions were encountered during any of the test periods.

The amount of particulate matter discharged to the atmosphere from the baghouse was low ($\leq$ 0.026 grains/dscf and $\leq$ 0.25 pounds/hour). The certified observer further corroborated the particulate test findings since no visible emissions were recorded emanating from the stack during the test program.

OCCIDENTAL CHEMICAL COMPANY

Houston, Texas

TABLE I

AMMONIUM SULFATE DRYER BAGHOUSE EXHAUST STACK

Summary of Test Data

Test Data			
Test Number	1	2	3
Test Date	10-26-78	10-26-78	10-26-78
Test Period	0850 - 0953	1044 - 1146	1222 - 1325
Sampling Data			
Sampling Duration, minutes	60.0	60.0	60.0
Nozzle Diameter, inches	0.250	0.250	0.250
Barometric Pressure, inches mercury	29.91	29.91	29.91
Average Orifice Pressure Differential, inches water	2.54	2.77	2.74
Average Dry Gas Temperature at Meter, °F	96.	99.	98.
Sample Volume at Meter Conditions, cubic feet	54.43	54.15	54.08
Sample Volume at Standard Conditions, [1] cubic feet	50.55	50.09	50.04
Gas Stream Moisture Content			
Total Water Collected by Train, ml	84.	139.	113.5
Standard Volume of Water Collected, cubic feet	3.95	6.54	5.34
Moisture in Gas Stream, percent by volume	7.3	11.6	9.6
Mole Fraction of Dry Gas	0.927	0.884	0.904
Gas Stream Composition			
CO_2, percent by volume	0.0	0.0	0.0
O_2, percent by volume	20.9	20.9	20.9
CO, percent by volume	0.0	0.0	0.0
N_2, percent by volume	79.1	79.1	79.1
Molecular Weight of Wet Gas	28.17	27.70	27.91
Molecular Weight of Dry Gas	28.97	28.97	28.97
Gas Stream Velocity			
Static Pressure, inches water	4.2	4.2	4.1
Absolute Pressure, inches mercury	30.22	30.22	30.21
Average Temperature, °F	114.	114.	121.
Pitot Tube Calibration Coefficient	0.843	0.843	0.843
Total Number of Sampling Points	12.0	12.0	12.0
Velocity at Actual Conditions, feet/second	51.4	50.1	50.8
Gas Stream Volumetric Flow			
Stack Cross-Sectional Area, square feet	0.45	0.45	0.45
Volumetric Flow at Actual Conditions, cubic feet/minute	1,390.	1,380.	1,370.
Volumetric Flow at Standard Conditions, cubic feet/minute	1,200.	1,130.	1,140.
Percent Isokinetic	93.0	97.5	96.9
Process Operations Data			
Product Production Rate, Tons/hour	17.	17.	17.

[1] Standard Conditions = 68°F, 29.92 inches mercury, dry basis.

OCCIDENTAL CHEMICAL COMPANY

Houston, Texas

TABLE 2

AMMONIUM SULFATE DRYER BAGHOUSE EXHAUST STACK

Summary of Test Results

Test Data			
Test Number	1	2	3
Test Date	10-26-78	10-26-78	10-26-78
Test Time	0850 - 0953	1044 - 1146	1222 - 1325
Gas Flow			
Standard Cubic Feet/minute, dry	1,200.	1,130.	1,140.
Actual Cubic Feet/minute, wet	1,390.	1,380.	1,370.
Particulates			
Nozzle, Probe and Front Half Filter Holder Catch Fraction,g	0.0401	0.0569	0.0809
Filter Catch Fraction, g	0.0115	0.0187	0.0024
Total Particulates, g	0.0516	0.0756	0.0833
Particulate Emissions[1]			
Grains/dry standard cubic foot[2]	0.016	0.023	0.026
Pounds/hour	0.16	0.23	0.25
Visible Emissions			
≥ 5 percent opacity, minutes observed	0.	0.	0.
0 percent opacity, minutes observed	0.	0.	0.
No visible emission, minutes observed	60.	60.	60.

---

[1]Based on Total Particulates captured by train.

[2]Standard Conditions = 68°F and 29.92 inches mercury.

APPENDIX A

RAW TEST DATA

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT: O[illegible] – [illegible]
DATE: [illegible]
SAMPLING LOCATION: [illegible]
INSIDE OF FAR WALL TO OUTSIDE OF PORT, (DISTANCE A): 10 5/8
INSIDE OF NEAR WALL TO OUTSIDE OF PORT, (DISTANCE B): 3 1/8"
STACK I.D., (DISTANCE A - DISTANCE B): [illegible] 1/2"
NEAREST UPSTREAM DISTURBANCE: 8' (10.5 dia)
NEAREST DOWNSTREAM DISTURBANCE: 11' (15 dia)
CALCULATOR: [illegible]

SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1 8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF PORT (SUM OF COLUMNS 4 & 5)
y, X-1		7 1/2 x 8 5/8	5/8	3 1/8	5 3/4
2			1 7/8	↓	5.0
3			3 1/8	↓	6 1/4
4			4 3/8	↓	7 1/2
5			5 5/8	↓	8 3/4
6			6 7/8	↓	10.0

PRELIMINARY VELOCITY TRAVERSE

PLANT: Oxiy Chemical - Houston
DATE: 10-25-78
LOCATION: [illegible]
STACK I.D.: 7½"
BAROMETRIC PRESSURE, in. Hg: ____
STACK GAUGE PRESSURE, in. H_2O: ____
OPERATORS: O'Neill / Celiano

SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
X 1	.30	137
2	.35	142
3	.40	145
4	.45	147
5	.53	150
6	.54	150
AVERAGE	.445	145.16

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
Y 1	.31	135
2	.37	140
3	.39	143
4	.42	145
5	.51	149
6	.54	149
AVERAGE		

NOMOGRAPH DATA

PLANT [illegible]

DATE 10-25-78

SAMPLING LOCATION outlet from B[illegible]

CONTROL BOX NO. 2253

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.81
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m\,avg.}$	90
PERCENT MOISTURE IN GAS STREAM BY VOLUME	B_{wo}	12
BAROMETRIC PRESSURE AT METER, in Hg	P_m	
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.073$ x STACK GAUGE PRESSURE in in. H_2O)	P_s	
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s / P_m	1.0
AVERAGE STACK TEMPERATURE, °F	$T_{s\,avg.}$	145.2
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.445
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.54
C FACTOR		0.90
CALCULATED NOZZLE DIAMETER, in.		
ACTUAL NOZZLE DIAMETER, in.		.250
REFERENCE Δp, in. H_2O		.56

PLANT Oxychem
DATE 10-26-78
SAMPLING LOCATION Baghouse Outlet
SAMPLE TYPE Particulate
RUN NUMBER O-1
OPERATOR Celicano
AMBIENT TEMPERATURE 70°
BAROMETRIC PRESSURE 29.91
STATIC PRESSURE, (P_s)
FILTER NUMBER (s) 24351-A O20-1F

PROBE LENGTH AND TYPE 4' [illegible]
NOZZLE I.D. .250
ASSUMED MOISTURE, % 1.2
SAMPLE BOX NUMBER 1
METER BOX NUMBER 2253
METER $\Delta H_@$ 1.84
C FACTOR .9
PITOT TUBE FACTOR .8
REFERENCE Δp 0.56
NOTE L-Cr = .001
L-CF = .00[illegible]

READ AND RECORD ALL DATA EVERY 5.0 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m_{in}}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m_{out}}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	0850	710.171									
X 1	5		714.200	.53	1.78	1.78	112	79	77	1	250 ± 25	60 ± 10
2	10		718.500	.72	2.40	2.40	120	91	80	1		
3	15		723.400	.87	2.90	2.90	118	1[illegible]	82	1		
4	20		728.500	.97	3.2	3.2	117	11[illegible]	84	1		
5	25		733.400	1.00	3.3	3.3	117	11[illegible]	86	1		
6	30		738.514	.97	3.2	3.2	116	117	88	1		
1	5	0926	742.300	.49	1.65	1.65	105	95	86	1		
Y 2	10		746.300	.57	1.88	1.88	113	111	89	1		
3	15		750.700	.73	2.43	2.43	114	112	90	1		
4	20		755.600	.78	2.62	2.62	113	111	90	1		
5	25		760.100	.81	2.70	2.70	112	110	90	1		
6	30		764.612	.73	2.43	2.43	108	109	90	1		
		0953	54.433	0.869	2.541		113.92	96.167				

PLANT Oxy Chem.
DATE 10-26-78
SAMPLING LOCATION Baghouse outlet
SAMPLE TYPE Part. [illegible]
RUN NUMBER 2
OPERATOR Celiano
AMBIENT TEMPERATURE 73°
BAROMETRIC PRESSURE
STATIC PRESSURE, (P_s)
FILTER NUMBER (s) 24352-A

PROBE LENGTH AND TYPE 4' [illegible]
NOZZLE I.D. .250
ASSUMED MOISTURE, % 7.5
SAMPLE BOX NUMBER 1
METER BOX NUMBER 2258
METER $\Delta H_@$ 1.81
C FACTOR 1.0
PITOT TUBE FACTOR
REFERENCE Δp .77
NOTE L.C.I. = .000 cfm
L.C.F. = .000 cfm

READ AND RECORD ALL DATA EVERY 5 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	1044	764.783									
Y-1	5		768.500	.42	1.61	1.61	117	81	81	1.5	250 ± 10	60 ± 10
2	10		773.100	.60	2.25	2.25	113	98	84	2		
3	15		777.800	.70	2.61	2.61	115	108	85	2.5		
4	20		782.380	.72	2.70	2.70	111	109	87	3		
5	25		787.400	.77	2.90	2.90	110	111	89	3.5		
6	30		791.452	.69	2.58	2.58	109	114	92	3.5		
		stop 1114										
X-1	5	1116 start	795.700	.55	2.10	2.10	111	100	91	3.5		
2	10		800.200	.74	2.78	2.78	112	112	93	3.5		
3	15		804.800	.82	3.05	3.05	111	116	94	4		
4	20		809.500	.91	3.4	3.4	113	115	95	4		
5	25		814.300	1.0	3.7	3.7	122	114	94	4.5		
6	30		818.932	.95	3.5	3.5	127	115	94	4		
			54.149	0.854	2.765		114.000	98.667				
		1146										

Oxy chem 10-26-78
Run 2

PLANT Oxy Chem.
DATE 10-26-78
SAMPLING LOCATION Baghouse outlet
SAMPLE TYPE Partic.
RUN NUMBER 3
OPERATOR Celiano
AMBIENT TEMPERATURE 75°
BAROMETRIC PRESSURE 29.91
STATIC PRESSURE, (P_s)
FILTER NUMBER (s) 24353-A

PROBE LENGTH AND TYPE 4' Py
NOZZLE I.D. .250
ASSUMED MOISTURE, % 5
SAMPLE BOX NUMBER 1
METER BOX NUMBER 2253
METER $\Delta H_@$ 1.81
C FACTOR 1.0
PITOT TUBE FACTOR
REFERENCE Δp .49
NOTE L.C.I = .000 cfm
L.C.F = .000 cfm

READ AND RECORD ALL DATA EVERY 5 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET $(T_{m\,in})$, °F	OUTLET $(T_{m\,out})$, °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0	1222	819.035									
X-1	5		823.200	.51	1.92	1.92	121	87	86	2	250±10	60±10
2	10		827.800	.72	2.71	2.71	121	102	88	2		
3	15		832.500	.81	3.02	3.02	120	105	88	2		
4	20		837.400	.90	3.30	3.30	122	109	89	2.5		
5	25	stop	842.400	.95	3.55	3.55	123	111	89	3.5		
6	30	1252	847.142	.97	3.63	3.63	124	112	90	4		
		start 1255										
Y-1	5		851.300	.46	1.75	1.75	117	98	89	2.5		
2	10		855.500	.58	2.20	2.20	124	106	90	3		
3	15		859.950	.66	2.50	2.50	121	107	90	3		
4	20		864.600	.72	2.71	2.71	121	112	91	3.5		
5	25		869.300	.76	2.90	2.90	122	118	92	3.5		
6	30		873.110	.72	2.71	2.71	120	120	94	3		
		end 1325										
			54.075									

Oxychem 10-26-78

SUMMARY
RECORD OF VISIBLE EMISSIONS

Type of Plant [illegible] Date [illegible]

Company Name [illegible] Hours of Observation [illegible]

Plant Address [illegible] Observer [illegible]

Type of Discharge (STACK) OTHER ____

Discharge Location [illegible]

Height of Point of Discharge [illegible]

Observer's Location:

Distance to Discharge Point [illegible]

Height of Observation Point 25'

Direction from Discharge Point ____

Background Description Solid gray of building

Weather: Clear Overcast (Partly Cloudy) Other ____ Sky Color ____

Wind Direction ____ Wind Velocity [illegible] mi/hr

Plume Description:

Detached: Yes No Not Visible

Color: Black White Other ____

Plume Dispersion Behavior: Looping Coning Fanning

Lofting Fumigating Other ____

Estimated Distance Plume Visible —

RECORD OF VISIBLE EMISSIONS

Company Name: Oxy Chem
Date: 10-26-78
Plant Address: Houston Tex
Observer: J. D. O'Neill
Stack Location: [illegible]
Observer's Location: [illegible]
Weather Conditions: 50% [illegible]
Temp. approx. 75°

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
	30					Run one
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
08	50	0	0	0	0	Start test 1 0850
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name [illegible]
Date [illegible]
Plant Address [illegible]
Observer [illegible]
Stack Location [illegible]
Observer's Location [illegible]
Weather Conditions

TIME						COMMENTS
HR	MIN	SECONDS 00	15	30	45	
[illegible]	00	[illegible]				
	01	[illegible]	[illegible]	[illegible]		
	02	[illegible]	[illegible]			
	03	[illegible]	[illegible]	[illegible]	[illegible]	
	04	[illegible]	[illegible]	[illegible]	[illegible]	
	05	[illegible]	[illegible]	[illegible]	[illegible]	
	06	[illegible]	[illegible]	[illegible]	[illegible]	
	07	[illegible]	[illegible]	[illegible]	[illegible]	
	08	[illegible]	[illegible]	[illegible]	[illegible]	
	09	[illegible]	[illegible]	[illegible]	[illegible]	
	10	[illegible]	[illegible]	[illegible]	[illegible]	
	11	[illegible]	[illegible]	[illegible]	[illegible]	
	12	[illegible]	[illegible]	[illegible]	[illegible]	
	13	[illegible]	[illegible]	[illegible]	[illegible]	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
09	19	0	0	0	0	
	20					End x port Test one.
	21					
	22					
	23					
	24					
09	25	0	0	0	0	Start y port Test one
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
09	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name: Oxy chem

Date: 10-26-78

Plant Address: Houston Texas

Observer: J O'Neill

Stack Location: [illegible]

Observer's Location: [illegible]

Weather Conditions:

HR	MIN	00	15	30	45	COMMENTS
[illegible]	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
09	54	0	0	0	0	End Test one
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name Oxy Chem.

Date 10-26-78

Plant Address Houston Texas

Observer J. O'Neill

Stack Location [illegible]

Observer's Location [illegible]

Weather Conditions

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS
	30					Run 3
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
10	44	0	0	0	0	[illegible] Start 1044
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name [illegible]　　Date [illegible]

Plant Address [illegible]　　Observer [illegible]

Stack Location [illegible]　　Observer's Location [illegible]

Weather Conditions

HR	MIN	SECONDS 00	15	30	45	COMMENTS
	00	[illegible]	[illegible]	[illegible]		
	01	[illegible]	[illegible]			
	02	[illegible]	0	[illegible]	[illegible]	
	03	[illegible]	[illegible]	[illegible]	[illegible]	
	04		[illegible]	[illegible]	[illegible]	
	05		[illegible]	[illegible]	[illegible]	
	06	[illegible]	[illegible]			
	07	[illegible]	[illegible]			
	08	[illegible]	[illegible]	[illegible]	[illegible]	
	09	0	0	[illegible]	[illegible]	
	10	0	0	0	0	
	11	0	0	0	[illegible]	
	12	0	0	[illegible]	[illegible]	
	13	0	0	0	[illegible]	
11	14	0	0	0	[illegible]	End Port Y
	15					
11	16	[illegible]	0	0	0	Start Port X
	17	[illegible]	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	[illegible]	[illegible]	
	25	[illegible]	0	[illegible]	[illegible]	
	26	0	[illegible]	[illegible]		
	27	0	0	[illegible]	[illegible]	
	28	0	0	0	0	
11	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Oxy Chem

Date 10-26-78

Plant Address Houston Texas

Observer J. O'Neill

Stack Location [illegible]

Observer's Location [illegible]

Weather Conditions

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
[illegible]	30	0	0	0	0	[illegible]
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
11	45	0	0	0	0	End Test Two
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name [illegible] Date [illegible]

Plant Address [illegible] Observer [illegible]

Stack Location [illegible] Observer's Location [illegible]

Weather Conditions

HR	MIN	00	15	30	45	COMMENTS
	00					
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
12	22	0	0	0	0	Start run 3 1222
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name: Oxy Chem
Date: [illegible]
Plant Address: Houston Texas
Observer: J. O'Neill
Stack Location: [illegible]
Observer's Location: [illegible]
Weather Conditions:

HR	MIN	00	15	30	45	COMMENTS
12	30	0	0	0	0	Run 3
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
12	51	0	0	0	0	
	52					
12	53	0	0	0	0	Start Port 4 Run 3
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Dow Chem

Date 10-26-78

Plant Address [illegible] Texas

Observer J. O'Neill

Stack Location [illegible]

Observer's Location NE of Stack

Weather Conditions

HR	MIN	00	15	30	45	COMMENTS
[illegible]	00	0	0	0	0	Run 3
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
13	22	0	0	0	0	End run 3
	23					
	24					
	25					
	26					
	27					
	28					
	29					

APPENDIX B

LABORATORY REPORTS

ANALYTICAL DATA

PLANT Oxy Chem

DATE 10-26-78

SAMPLING LOCATION [illegible]

SAMPLE TYPE [illegible]

RUN NUMBER [illegible]

SAMPLE BOX NUMBER 1

CLEAN UP MAN [illegible]

COMMENTS:

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER

CONTAINER OCO-1P 40.1 mg

FILTER NUMBER [illegible]

CONTAINER OCO-1F 11.5 mg

FRONT HALF SUBTOTAL 51.6 mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER

CONTAINER ______ ______ mg

ETHER-CHLOROFORM EXTRACTION ______ mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER

CONTAINER ______ ______ mg

BACK HALF SUBTOTAL ______ mg

TOTAL WEIGHT ______ mg

MOISTURE

IMPINGERS

FINAL VOLUME 272 ml

INITIAL VOLUME 200 ml

NET VOLUME 72 ml

72
12
84

SILICA GEL

FINAL WEIGHT 2[illegible] g ______ g

INITIAL WEIGHT [illegible] g ______ g

NET WEIGHT 12 g ______ g

SUBTOTAL ______ g

TOTAL MOISTURE 84

ANALYTICAL DATA

PLANT Occ Chem

DATE 10-26-78

SAMPLING LOCATION

SAMPLE TYPE

RUN NUMBER

SAMPLE BOX NUMBER 2755

CLEAN UP MAN

COMMENTS:

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER [illegible]-2F — 56.9 mg

FILTER NUMBER 21352-A — CONTAINER [illegible]-F — 18.7 mg

FRONT HALF SUBTOTAL 75.6 mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ____ ____ mg

ETHER-CHLOROFORM EXTRACTION ____ mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ____ ____ mg

BACK HALF SUBTOTAL ____ mg

TOTAL WEIGHT ____ mg

MOISTURE

IMPINGERS

FINAL VOLUME 325 ml

INITIAL VOLUME 200 ml

NET VOLUME 125 ml

125
14
139

SILICA GEL

FINAL WEIGHT 214 g ____ g

INITIAL WEIGHT 200 g ____ g

NET WEIGHT 14 g ____ g

SUBTOTAL ____ g

TOTAL MOISTURE 139

ANALYTICAL DATA

PLANT ______________________

DATE ______________________

SAMPLING LOCATION ______________________

SAMPLE TYPE ______________________

RUN NUMBER ______________________

SAMPLE BOX NUMBER ______________________

CLEAN UP MAN ______________________

COMMENTS:

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER ________ 80.9 mg

FILTER NUMBER 24353-A — CONTAINER ________ 2.4 mg

FRONT HALF SUBTOTAL 83.3 mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ________ ________ mg

ETHER-CHLOROFORM EXTRACTION ________ mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ________ ________ mg

BACK HALF SUBTOTAL ________ mg

TOTAL WEIGHT ________ mg

MOISTURE

IMPINGERS

FINAL VOLUME 301 ml
INITIAL VOLUME 200 ml
NET VOLUME 101 ml

101.0
12.5
113.5

SILICA GEL

FINAL WEIGHT 212.5 g ________ g
INITIAL WEIGHT 200 g ________ g
NET WEIGHT 12.5 g ________ g

SUBTOTAL ________ g

TOTAL MOISTURE 113.5 g

TITLE Oxy - Chemical, Houston, TEXAS Project No. ______ Book No. ______ 2

From Page No. O

Sample #	Beaker #	TSV ML	FINAL(1)	FINAL(2)	TARE(1)	TARE(2)	ΔWT.	-BLK. CORR.	Net wT. GMS.
OCO-1P	O-8	380	111.7637 ✓	111.7639	111.7209	111.7212	.0428	.0027	.0401
OCO-2P	13	365	103.0135 ✓	103.0135	102.9540	102.9543	.0595	.0026	.0569
OCO-3P	SU	365	98.8588 ✓	98.8590	98.7753	98.7755	.0835	.0026	.0809
Blank	Y86	250	111.6683 ✓	111.6688	111.6665	111.6669	.0018		

To Page No. ____

Witnessed & Understood by me.	Date	Invented by	Date
J.D.O.	11-3-78	Recorded by	

4" Glass Fiber
900 AF

TITLE ______ Project No. ______ Book No. ______ COPY

From Page No. ____

CLIENT/SAMPLE	FILTER #	FINAL 1	FINAL 2	FINAL 3	TARE 1	TARE 2	[illegible]
Oxy-chem Houston set (2)	24351-A	.3842	.3843	.3842	.3728	.3727	0.01
	24352-A	.4295	.4296	.4296	.4108	.4108	0.01
	24353-A	.4137	.4139	.4137	.4113	.4113	0.00
	24354-A				.4122	.4122	
	24355-A				.4132	.4132	
Anchor Hocking Balt. Md 11-1-78	24356-A	0.4992	0.49[illegible]		.4110	.4112	0.08[illegible]
	24357-A	0.4878	0.4879		.4114	.4114	0.07[illegible]
	24358-A	0.4801	0.4800		.4142	.4143	0.06[illegible]
	24359-A				.4109	.4109	
	24387				.4050	.4048	
	24388				.4023	.4023	
	24389				.4046	.4046	
	24390				.4052	.4054	
	24391				.4049	.4048	
	24392				.4043	.4043	
	24393				.4034	.4035	
	24394				.4048	.4047	
	24395				.4075	.4075	
	24396				.4051	.4050	
	24397				.3756	.3757	
	24398				.3764	.3762	
	24399				.3761	.3760	
	24400				.3782	.3781	
	24401				.3792	.3789	
	24402				.3801	.3798	
	24403				.3806	.3803	
	24404				.3812	.3811	
	24405				.3827	.3826	
	24406				.3820	.3821	
	24407				.3827	.3831	
	24408				.3838	.3840	
	24409				.3821	.3823	
	24410				.3801	.3803	
	24411				0.4297	0.4296	
	24412				0.4435	0.4434	
	24413				0.4398	0.4397	

To Page No. ____

Witnessed & Understood by me, [signature] Date 11-7-78 Invented by ______ Recorded by ______ Date ______

APPENDIX C

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS

Test Run 1 - Ammonium Sulfate Dryer Baghouse Exhaust Stack

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

$$V_{m(std)} = \frac{17.647 \times Y \times V_m \times \left(P_b + \frac{\Delta H}{13.6}\right)}{\left(T_m + 460\right)}$$

$$V_{m(std)} = \frac{17.647 \times 0.973 \times 54.43 \times \left(29.91 + \frac{2.54}{13.6}\right)}{96.2 + 460)} = 50.55$$

Where:

$V_{m(std)}$ = Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscf.

V_m = Volume of gas sample measured by the dry gas meter at meter conditions, dcf.

P_b = Barometric pressure, in. Hg.

ΔH = Average pressure drop across the orifice meter, in. H_2O.

T_m = Average dry gas meter temperature, °F.

17.647 = Factor that includes ratio of standard temperature (528°R) to standard pressure (29.92 in. Hg), °R/in. Hg.

Y = Dry gas meter calibration factor.

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

$$V_{w(std)} = (0.04707 \times V_{wc}) + 0.04715 \times W_{wsg}$$

$$V_{w(std)} = (0.04707 \times 72) + (0.04715 \times 12) = 3.95$$

Where:

$V_{w(std)}$ = Volume of water vapor in the gas sample corrected to standard conditions, scf.

V_{wc} = Volume of liquid condensed in impingers, ml.

W_{wsg} = 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) $(ft^3)/(lb\text{-}mole)(^oR)$] ; absolute temperature at standard conditions (528^oR), 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)$(ft^3)/(lb\text{-}mole)(^oR)$]. absolute temperature at standard conditions (528^oR), absolute pressure at standard conditions (29.92 in. Hg), and 453.6 g/lb, ft^3/g.

3. Moisture content.

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

$$B_{ws} = \frac{3.95}{3.95 + 50.55} = 0.073$$

Where:

B_{ws} = Proportion of water vapor, by volume, in the gas stream, dimensionless.

4. Mole fraction of dry gas.

$$M_d = 1 - B_{ws}$$

$$M_d = 1 - 0.073 = 0.927$$

Where:

M_d = Mole fraction of dry gas, dimensionless

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

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

MW_d = $(0.440 \times \quad) + (0.320 \times \quad) + [0.280 (\quad + \quad)]$

= 28.97 (Ambient air)

Where:

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

$\%CO_2$ = Percent carbon dixoide by volume, dry basis.

$\%O_2$ = Percent oxygen by volume, dry basis.

$\%N_2$ = 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.

MW_s = $(MW_d \times M_d) + [18 (1 - M_d)]$

MW_s = $(28.97 \times 0.927) + [18 (1 - 0.927)]$

= 28.17

Where:

MW_s = 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.

$$V_s = 85.49 \times C_p \times (\sqrt{\Delta p})_{avg.} \times \left[\frac{T_s\ (avg)}{P_s \times MW_s}\right]^{\frac{1}{2}}$$

$$v_s = 85.49 \times 0.843 \times 0.869 \times \left[\frac{(113.9 + 460)}{30.22 \times 28.17}\right]^{\frac{1}{2}}$$

$$= 51.4$$

Where:

v_s = Average gas stream velocity, ft/sec.

85.49 = Pitot tube constant, ft/sec $\times \left[\frac{(lb/lb\text{-}mole)(in. Hg)}{(^{o}R)\ (in.\ H_2O)}\right]^{\frac{1}{2}}$.

C_p = Pitot tube coefficient, dimensionless.

Δp = Velocity head of stack gas, in H_2O.

T_s = Absolute gas stream temperature, ^{o}R.

P_s = Absolute gas stack pressure, in. Hg.

8. Average gas stream dry volumetric flow rates, dscf/min.

$$Q_{s(std)} = \frac{1058.8 \times v_s \times A_s \times M_d \times P_s}{T_s}$$

$$Q_{s(std)} = \frac{1058.8 \times 51.4 \times 0.45 \times 28.97 \times 30.22}{(\quad + 460)}$$

$$= 1,200.$$

Where:

$Q_{s(std)}$ = Volumetric flow rate of dry stack gas, corrected to standard conditions, dscf/min.

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

1058.8 = Factor which includes standard temperature ($528^{o}R$), standard pressure (29.92 in. Hg), and 60 sec/min, $\frac{(^{o}R)\ (sec)}{(in.\ Hg)(min)}$.

9. Isokinetic variation calculated from intermediate values, percent.

$$I = \frac{17.316 \times T_s \times V_{m(std)}}{v_s \times \theta \times P_s \times M_d \times (D_n)^2}$$

$$I = \frac{17.316 \times 573.9 \times 50.55}{51.4 \times 60 \times 30.22 \times 0.927 \times (0.250)^2}$$

$$= 93.0$$

Where:

I = Percent of isokinetic sampling.

θ = Total sampling time, minutes.

D_n = Diameter of nozzle, inches.

17.316 = Factor which includes standard temperature (528^oR), standard pressure (29.92 in. Hg), the formula for calculating area of circle $\frac{\pi D^2}{4}$, conversion of square feet to square inches (144), conversion of seconds to minutes (60), and conversion to percent (100), $\frac{(in.\ Hg)\ (in^2)\ (min)}{(^oR)\ (ft^2)\ (sec)}$.

10. Particulate concentration, gr/dscf.

$$C_1 = 0.015432 \times \frac{M_t}{V_{m(std)}}$$

$$C_1 = 0.015432 \times \frac{51.6}{50.55} = 0.016$$

Where:

C_1 = Particulate concentration, gr/dscf.

M_t = Total weight of particulate caught by train, mg.

0.015432 = Conversion factor of gr/mg.

11. Particulate mass emission rate, lb/hr.

$$PMR_t = 0.0085714 \times C_1 \times Q_{s(std)}$$

$$= 0.0085714 \times 0.016 \times 1,196 = 0.16$$

Where:

PMR_t	=	Particulate mass emission rate, lb/hr.
0.0085714	=	Conversion factor relating minutes to hours (60), and grains to pounds (7,000), (lb) (min)/(gr) (hr).

APPENDIX D

EQUIPMENT CALIBRATION DATA

[illegible] = 28"
[illegible] .001[illegible]
[illegible]

Date [illegible] Box No. 2253

Barometric pressure, P_b = [illegible] in. Hg Dry gas meter No. ORIGINAL

Orifice manometer setting, ΔH, in. H_2O	Gas volume wet test meter V_w, ft^3	Gas volume dry gas meter V_d, ft^3	Temperature: Wet test Meter t_w, °F	Temperature: Dry gas meter Inlet t_{di}, °F	Temperature: Dry gas meter Outlet t_{do}, °F	Temperature: Dry gas meter Average t_d, °F	Time θ, min	γ	ΔH@
0.5	5.000	5.182	68 / 67	70 / 98	57 / 72	74.50	12.733	.980	1.783
1.0	5.0[illegible]	5.256	67 / 66	80 / 95	77 / 75	80.25	9.30	.974	1.880
2.0	~~10~~ [illegible]	5.237	66 / 77	82 / 102	74 / 7[illegible]	84.00	6.65	.981	1.911
2.5 ~~4.0~~	10.000	10.463	66 / 67	8[illegible] / 108	76 / 85	88.25	11.766	.989	1.857
1.5 ~~6.0~~	~~10~~ 4.995	5.355	67 / 66	92 / 103	81 / 83	89.75	7.583	.971	1.545
8.0	10								
						Average		.979	1.856

Calculations

ΔH	$\frac{\Delta H}{13.6}$	γ: $\frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$	ΔH@: $\frac{0.0317\ \Delta H}{P_b\ (t_d + 460)} \left[\frac{(t_w + 460)\ \theta}{V_w}\right]^2$
0.5	0.0368		
1.0	0.0737		
2.0	0.147		
4.0	0.294		
6.0	0.431		
8.0	0.588		

γ = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ± 0.01

ΔH@ = Orifice pressure differential that gives 0.75 cfm of air at 70° F and 29.92 inches of mercury, in. H_2O. Tolerance - ± 0.15

VAC.= 28" Hg

L.C.=.001 cfm

Date 10-30-78 Box No. 2253

Barometric pressure, P_b = 30.65 in. Hg Dry gas meter No. ORIGINAL

Orifice manometer setting, ΔH, in. H_2O	Gas volume wet test meter V_w, ft^3	Gas volume dry gas meter V_d, ft^3	Temperature: Wet test Meter t_w, °F	Temperature: Dry gas meter Inlet t_{di}, °F	Temperature: Dry gas meter Outlet t_{do}, °F	Temperature: Dry gas meter Average t_d, °F	Time θ, min	γ	$\Delta H_@$
0.5	5.001	5.165	65° 64	74 88	66 70	74.50	12.90	.9855	1.771
1.0	5.001	5.107	69 [illegible]	79 92	69 75	78.25	9.75	1.009	1.889
2.0	10.002	10.289	64 64	65 101	72 77	83.75	13.183	1.004	1.815
1.5 ~~4.0~~	~~10~~ 5.0[illegible]	5.225	67 67	88 103	76 78	85.50	7.630	.9926	1.818
1.5 ~~6.0~~	~~10~~ 5.[illegible]2	5.293	69 [illegible]	90 103	77 79	86.50	7.616	.9820	1.807
8.0	10								
						Average		.994	1.819

Calculations

ΔH	$\frac{\Delta H}{13.6}$	γ: $\frac{V_w P_b (t_d + 460)}{V_d\left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$	$\Delta H_@$: $\frac{0.0317\ \Delta H}{P_b (t_d + 460)}\left[\frac{(t_w + 460)\ \theta}{V_w}\right]^2$
0.5	0.0368		
1.0	0.0737		
2.0	0.147		
4.0	0.294		
6.0	0.431		
8.0	0.588		

γ = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ± 0.01

$\Delta H_@$ = Orifice pressure differential that gives 0.75 cfm of air at 70° F and 29.92 inches of mercury, in. H_2O. Tolerance - ± 0.15

BY BLJ DATE 6/2/77 **WESTON** ENVIRONMENTAL CONSULTANTS-DESIGNERS SHEET ______ OF ______

CHKD BY ______ DATE ______ W.O. NO. ______

PROJECT ______

SUBJECT Pitot Tube Calibration Factors

Pitot ID #	"A" Side 0.90	0.46	0.192	0.024	Avg.	"B" Side 0.90	0.46	0.192	0.024	Av.
E	.848	.832	.830	.844	.839	.848	.832	.839	.832	.838
G	.821	.821	.813	.820	.819	.825	.825	.828	.820	.825
H	.839	.840	.848	.844	.843	.843	.830	.837	.844	.839
I	.839	.841	.828	.832	.835	.830	.834	.828	.832	.831
J	.830	.836	.820	.820	.827	.834	.829	.820	.820	.826
=	.65	.330	.125			.65	.330	.125		
W	.848	.852	.851		.850	.846	.850	.849		.848
X	.856	.857	.861		.858	.858	.852	.854		.855
Y	.841	.848	.837		.842	.841	.846	.849		.845
Z	.856	.855	.859		.857	.841	.850	.849		.847

THE PENNSYLVANIA STATE UNIVERSITY
226 FENSKE LABORATORY
UNIVERSITY PARK, PENNSYLVANIA 16802

Center for Air Environment Studies

Area Code 814
865-1415

June 5, 1978

Mr. Jeffrey D. O'Neill
Roy F. Weston, Incorporated
Weston Way
West Chester, Pennsylvania 19380

Dear Mr. O'Neill:

Please be advised that you successfully completed the "Visible Emissions" course given June 1, 1978. You are certified to evaluate visible emissions since you met the standards described as Method 9 in the Federal Register of November 12, 1974. These standards are:

1) To maintain an average deviation of less than 7.5% for a set of 25 white smoke plumes and a set of 25 black smoke plumes.

2) To have no single reading of the 50 plumes to be in error by more than 15%.

Sincerely,

Robert Jennings Heinsohn

Robert Jennings Heinsohn
Professor of Mechanical Engineering
Project Director

RJH/cb

Enclosure

THE PENNSYLVANIA STATE UNIVERSITY

CONTINUING EDUCATION

THE PENNSYLVANIA STATE UNIVERSITY · 1855 ·

This certifies that

JEFFREY D. O'NEILL

has completed

VISIBLE EMISSIONS EVALUATION SEMINAR

Recertified: Date:

[signature] June '78

Certified Date:

Recertified: Date:

[signature]

PROJECT DIRECTOR OF VISIBLE EMISSIONS
TRAINING PROGRAM
CENTER FOR AIR ENVIRONMENT STUDIES

Floyd B. Fischer

VICE PRESIDENT FOR
CONTINUING EDUCATION

APPENDIX E

DETAILED BAGHOUSE INFORMATION

systematic way

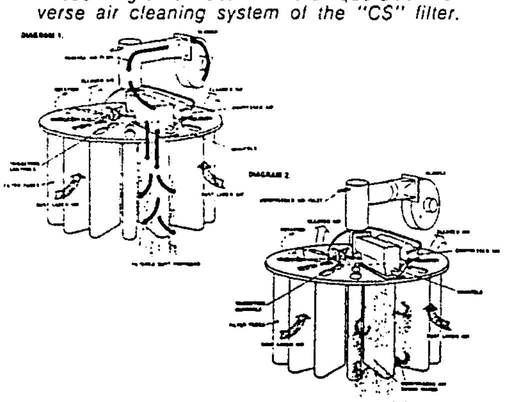
Efficient, low-maintenance filters for any air volume.

Carter-Day type "CS" filter

Exclusive combined shock design. Efficiency up to 99.99+%!

Designed to operate at higher air-to-cloth ratios on difficult applications. Requires only 80 PSIG of compressed air. Can be supplied with individual hoppers or trough type hoppers for multiple installations. For complete information, ask for Bulletin No. L-1126R2.

These diagrams illustrate the unique Dual Reverse air cleaning system of the "CS" filter.

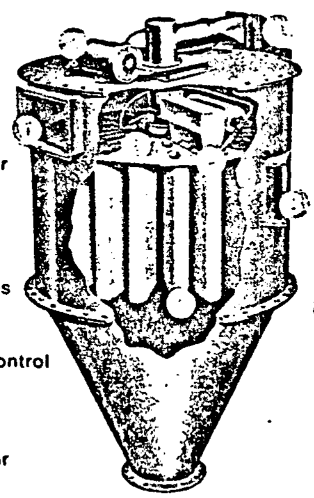


Carter-Day type "RJ" filter

Performance proven in hundreds of installations.

Versatile — handles air streams with light, medium or heavy material concentrations. Efficient—up to 99.99+%. Simple design. Automatic, continuous, low-cost operation. Can be supplied with individual hoppers or trough type hoppers for multiple installations. For complete information, ask for Bulletin No. G-464R.

- Pressure Blower
- Reverse Air Manifold
- Air Inlet
- Filter Tubes
- Pressure Release Control
- Air Outlet
- Drive Motor



CAPACITY TABLE — DAY "RJ" FILTERS

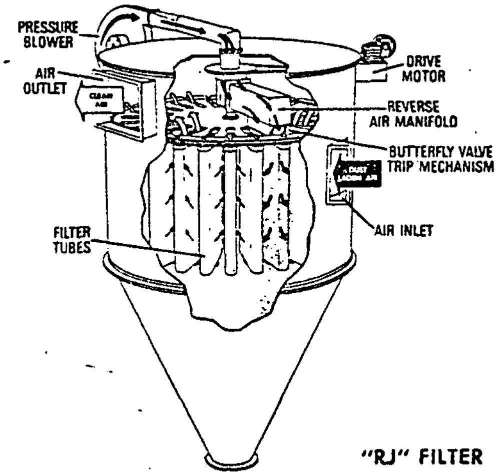
Filter No.	Cloth Area Sq. Ft.	Cubic Feet of Air/Min. (CFM) Air to Media Ratio 5	10	15	20	No. Sleeves	Sleeve Lgth.	Blower No.	Blower H.P.	Drive H.P.
12RJ26	57.5	285	570	855	1140	12	26	3A1	1	¼
12RJ36	83.5	418	835	1252	1670	12	36	3A3	1½	¼
12RJ48	105	525	1050	1575	2100	12	48	3A3	2	¼
12RJ60	131	655	1310	1965	2620	12	60	3A6	2	¼
18RJ36	125	625	1250	1875	2500	18	36	3A3	1½	¼
18RJ48	165	825	1650	2475	3300	18	48	3A3	2	¼
18RJ60	208	1040	2080	3120	4160	18	60	3A6	3	¼
24RJ37	200	1000	2000	3000	4000	24	37	3A3	2	¼
24RJ48	255	1300	2600	3900	5200	24	48	3A6	2	¼
24RJ60	320	1600	3200	4800	6400	24	60	3A6	3	¼
24RJ72	385	1925	3850	5775	7700	24	72	4A	5	¼
24RJ84	448	2240	4480	6720	8960	24	84	4A	7½	¼
72RJ37	600	3000	6000	9000	12000	72	36	4A	5	⅓
72RJ48	765	3825	7650	11475	15300	72	48	4A	7½	⅓
72RJ60	960	4800	9600	14400	19200	72	60	4A	7½	⅓
72RJ72	1155	5775	11550	17325	23100	72	72	4A	10	⅓
72RJ84	1340	6700	13400	20100	26800	72	84	4B	15	⅓
72RJ96	1530	7650	15300	22950	30600	72	96	4B	15	⅓

Multiple groupings can be furnished for greater capacities.

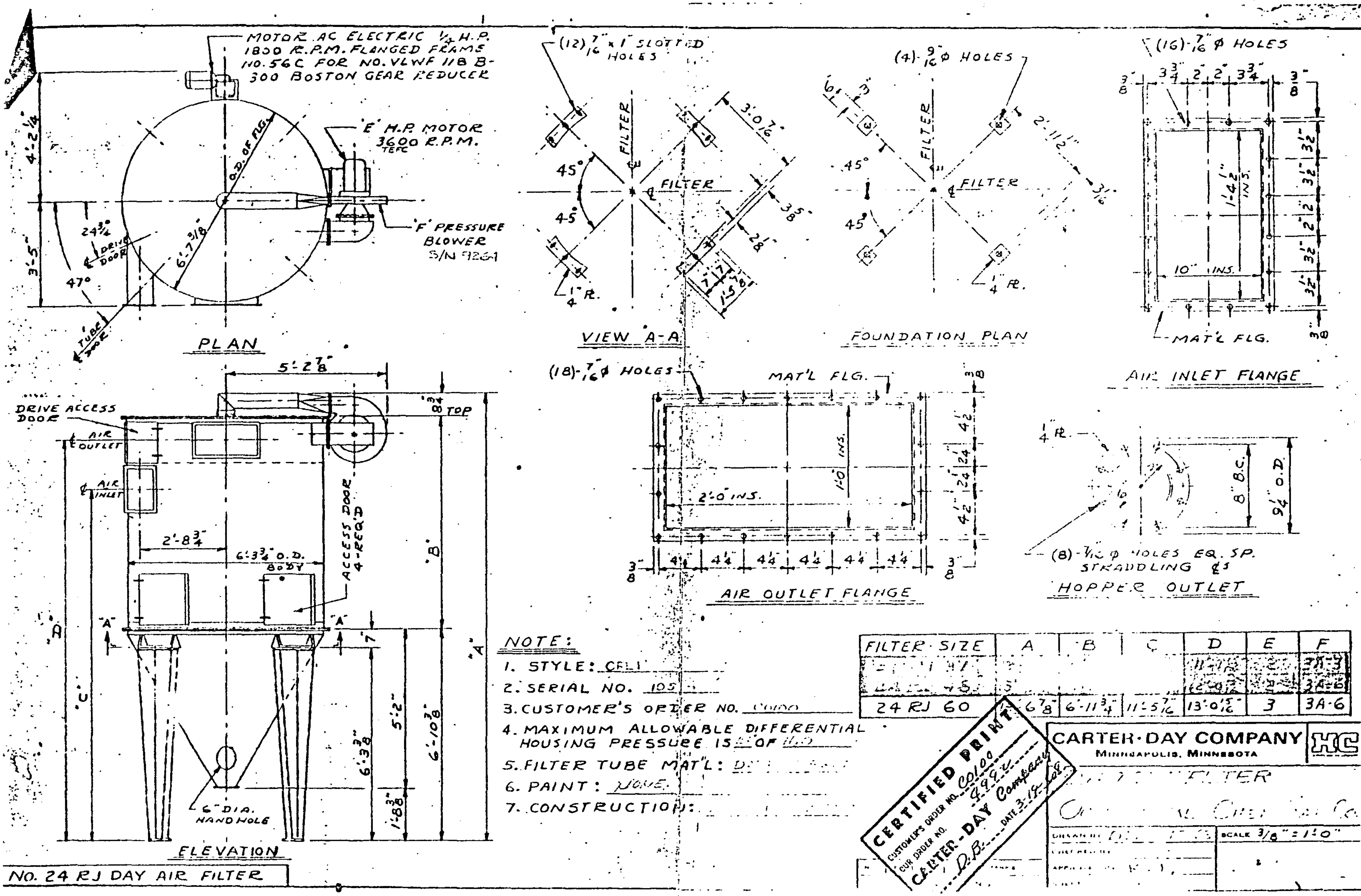
CAPACITY TABLE — DAY TYPE "CS" DUST FILTER

Filter No.	Cloth Area Sq. Ft.	Cubic Feet of Air/Min. (CFM) Air to Media Ratio 10	15	20	25	No. Sleeves	Sleeve Lgth.	Blower No.	Blower H.P.	Drive H.P.	SCFM* Comp. Air @ 80 PSIG
12CS26	57.5	575	865	1150	1440	12	26	3A1	1½	¼	4.1
12CS36	83.6	835	1250	1670	2080	12	36	3A1	1½	¼	4.1
12CS48	105	1050	1575	2100	2620	12	48	3A1	2	¼	4.1
12CS60	131	1310	1965	2620	3280	12	60	3A1	2	¼	4.1
18CS36	125	1250	1875	2500	3120	18	36	3A1	2	¼	5.6
18CS48	167	1670	2500	3340	4170	18	48	3A1	2	¼	5.6
18CS60	208	2080	3110	4160	5200	18	60	3A1	3	¼	5.6
24CS37	200	2000	3000	4000	5000	24	37	3A1	3	¼	6.6
24CS48	255	2550	3820	5100	6370	24	48	3A1	3	¼	6.6
24CS60	320	3200	4800	6400	8000	24	60	3A1	3	¼	6.6
24CS72	384	3840	5750	7680	9600	24	72	3A1	3	¼	6.6
24CS84	448	4480	6700	8960	11200	24	84	3A3	5	¼	6.6
72CS37	600	6000	9000	12000	15000	72	37	3A3	5	⅓	13.9
72CS48	765	7650	11500	15300	19100	72	48	3A3	5	⅓	13.9
72CS60	960	9600	14400	19200	24000	72	60	3A3	5	⅓	13.9
72CS72	1150	11500	17250	23000	28800	72	72	3A6	7½	⅓	13.9
72CS84	1340	13400	20100	26800	33500	72	84	3A6	7½	⅓	13.9
72CS96	1530	15300	23000	30600	38300	72	96	3A6	7½	⅓	13.9

***Compressed air consumption may be reduced through use of a timer, available when applicable at extra cost.**



"RJ" FILTER



NOTE:

1. STYLE: [illegible]
2. SERIAL NO. 105[illegible]
3. CUSTOMER'S ORDER NO. [illegible]
4. MAXIMUM ALLOWABLE DIFFERENTIAL HOUSING PRESSURE 15" OF [illegible]
5. FILTER TUBE MAT'L: [illegible]
6. PAINT: NONE
7. CONSTRUCTION: [illegible]

FILTER SIZE	A	B	C	D	E	F
[illegible]	[illegible]			[illegible]	[illegible]	3A-3
[illegible]	[illegible]			[illegible]	[illegible]	3A-6
24 RJ 60	[illegible]-6 7/8"	6'-11 3/4"	11'-5 7/16"	13'-0 15/16"	3	3A-6

CERTIFIED PRINT
CUSTOMER'S ORDER NO. C0100
CUR ORDER NO. 499V
CARTER-DAY Company
D.B. DATE 3-19-68

CARTER-DAY COMPANY
MINNEAPOLIS, MINNESOTA

[illegible] FILTER
[illegible] Chemical Co.

SCALE 3/8" = 1'-0"

APPENDIX F

PROJECT PARTICIPANTS

PROJECT PARTICIPANTS

The following Weston employees participated in this project:

Peter J. Marks Laboratory Manager	econENVIRONomics Division
Barry L. Jackson Supervisor, Air Testing	econENVIRONomics Division
Jeffrey D. O'Neill Project Scientist Assistant	econENVIRONomics Division
Gregory Celiano Assistant Project Scientist	econENVIRONomics Division
David D. Maloney Laboratory Technician	econENVIRONomics Division