73-GRN-3
SOURCE TEST REPORT
ON MEASUREMENT OF PARTICULATE EMISSIONS
FROM STOCKTON GRAIN ELEVATOR
SAN FRANCISCO, CALIFORNIA
FOR
ENVIRONMENTAL PROTECTION AGENCY
UNITED STATES GOVERNMENT
THOMAS E. WARD
PROJECT TEST OFFICER

environmental engineering, inc.

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SOURCE TEST REPORT

PLANT TESTED: Stockton Grain Elevators
San Francisco, California

TESTOR: Environmental Engineering, Inc.
2324 Southwest 34 Street
Gainesville, Florida 32601

CONTRACT NO: 68-02-0232 - Task Order No. 20

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INTRODUCTION

On January 10 and 11, 1973, particulate emission tests were conducted on the outlet of the baghouse servicing the tunnel belt conveyor at Stockton grain elevators located at Pier 90 San Francisco, California.

The baghouse is used to remove the dust caused by dumping grains onto the conveyor belt which transports the grain to storage and loading onto ships.

In order to test, it was first necessary to construct a stack extension to the baghouse outlet. This was done using a 20-inch I.D. galvanized sheet metal duct. Details are shown in Figure 1.

Five tests were conducted on the two days; tests 1, 2, and 3 on Wednesday the 11th, each test being 80 minutes in length; and tests 4 and 5 on Thursday the 12th, the 4th test being 80 minutes in length with the 5th and final test being 70 minutes duration due to plant shutdown.

SUMMARY OF RESULTS

A summary of the test results is included in Table 1. Of particular interest are the results of test No. 4. The emissions for this run were 30 times as much as the average emissions for runs 1, 2, 3, and 5, of 0.102 lbs/hour. It was noted that on washing the probe and nozzle during clean-up on this run, the acetone was very yellow. After evaporation of the acetone, a yellow, gummy residue remained. The Environmental Protection Agency project officer directed that this data not be included in averaging the test results.

Shortly after completion of the tests the dry gas meter used in measuring gas volumes was calibrated using a wet test meter. It was discovered that the meter was in error by approximately 28%. The results listed in Table 1 use the corrected gas volumes found by multiplying the difference between the final and initial meter readings by 1.283.

To prevent any misunderstanding, the initial and final meter readings together with the uncorrected and corrected gas volumes for each run are presented in Table 2.

The complete particulate emission calculations are included in Appendix A.

TABLE 1

SOURCE TEST DATA

TEST NO -
PLANT - STOCKTON GRAIN ELEVATORS *NO OF RUNS* - 5
SOURCE - TUNNEL BELT OUTLET *SAN FRANCISCO, CALIF.*
TYPE OF PLANT - GRAIN STORAGE
CONTROL EQUIPMENT - BAGHOUSE
POLLUTANTS SAMPLED - PARTICULATES

	1	2	3
1) *RUN NUMBER*	1	2	3
2) *DATE*	1/10/73	1/10/73	1/10/73
3) *TIME BEGAN*	9:05	11:15	2:05
4) *TIME END*	10:35	12:40	3:40
5) *BAROMETRIC PRESSURE, IN HG*	30.12	30.12	30.12
6) *METER ORIFICE PRESSURE DROP, IN HG*	2.04	9.08	9.69
7) *VOL DRY GAS, METER COND, CUBIC FEET*	129.555	130.521	137.153
8) *AVERAGE GAS METER TEMPERATURE, DEG F*	54.8	56.6	57.1
9) *VOL DRY GAS, S.T.P. , CUBIC FEET*	137.248	137.798	144.863
10) *TOTAL H2O COLLECTED, ML*	24.7	28.4	27.4
11) *VOL H2O VAPOR COLLECTED, S.T.P. , CU FT*	1.17	1.35	1.3
12) *STACK GAS MOISTURE, PERCENT VOLUME*	0.8	1	0.9
13) *ASSUMED STACK GAS MOISTURE, PCT VOL*	2	2	2
14) *PERCENT CO2*			
15) *PERCENT O2*			
16) *PERCENT CO*			
17) *PERCENT N2*			
18) *PERCENT EXCESS AIR*	NA	NA	NA
19) *MOLECULAR WEIGHT OF STACK GAS, DRY*	28.85	28.85	28.85
20) *MOLECULAR WEIGHT OF STACK GAS, STK COND*	28.76	28.75	28.75
21) *STACK GAS SPECIFIC GRAVITY*	0.99	0.99	0.99
22) *AVG SQUARE ROOT (VEL HEAD), IN H2O*	1.513	1.512	1.586
23) *AVERAGE STACK GAS TEMPERATURE, DEG F*	62	64	64
24) *AVG SQUARE ROOT (STK TEMP×VEL HEAD)*	34.569	34.61	36.302
25) *PITOT CORRECTION FACTOR*	0.83	0.83	0.83
26) *STACK PRESSURE, IN HG, ABSOLUTE*	30.12	30.12	30.12
27) *STACK GAS VEL, STACK COND, F.P.M.*	4995.9	5003	5246.7
28) *STACK AREA, SQ FEET*	2.18	2.18	2.18
29) *EFFECTIVE STACK AREA, SQUARE FEET*	2.18	2.18	2.18
30) *STACK GAS FLOW RATE, S.T.P. , SCFMD*	11038	10998	11543
31) *NET TIME OF TEST, MINUTES*	80	80	80
32) *SAMPLING NOZZLE DIAMETER, INCHES*	0.25	0.25	0.25
33) *PERCENT ISOKINETIC*	99.4	100.2	100.3
PARTICULATE EMISSIONS (LBS/HR)			
FRONT HALF SUBTOTAL	3.19×10^{-3}	4.22×10^{-3}	$2.11 \times 10^{-}$
BACK HALF SUBTOTAL	127.62×10^{-3}	139.31×10^{-3}	56.90×10
TOTALS	130.81×10^{-3}	143.53×10^{-3}	59.00×10
PARTICULATE EMISSIONS (LBS/TON PRODUCT)			
FRONT HALF SUBTOTAL	0.82×10^{-5}	1.08×10^{-5}	0.52×10^{-5}
BACK HALF SUBTOTAL	32.72×10^{-5}	35.72×10^{-5}	$14.05 \times 10^{-}$
TOTAL	33.54×10^{-5}	36.80×10^{-5}	$14.57 \times 10^{-}$

****S.T.P.↔ DRY, 70 DEGREES F, 29.92 INCHES MERCURY****

TABLE 1
(continued)
SOURCE TEST DATA

TEST NO -
PLANT - STOCKTON GRAIN ELEVATORS *NO OF RUNS* - 5
SOURCE - TUNNEL BELT OUTLET *SAN FRANCISCO, CALIF.*
TYPE OF PLANT - GRAIN STORAGE
CONTROL EQUIPMENT - BAGHOUSE
POLLUTANTS SAMPLED - PARTICULATES

1)*RUN NUMBER*	4	5
2)*DATE*	1/11/73	1/11/73
3)*TIME BEGAN*	9:10	11:10
4)*TIME END*	10:35	12:25
5)*BAROMETRIC PRESSURE, IN HG*	30.12	30.12
6)*METER ORIFICE PRESSURE DROP, IN HG*	9.05	9.43
7)*VOL DRY GAS METER COND, CUBIC FEET*	130.557	115.384
8)*AVERAGE GAS METER TEMPERATURE, DEG F*	53.1	55.3
9)*VOL DRY GAS, S.T.P. , CUBIC FEET*	138.751	122.215
10)*TOTAL H2O COLLECTED, ML*	18.7	24.1
11)*VOL H2O VAPOR COLLECTED, S.T.P. , CU FT*	0.89	1.14
12)*STACK GAS MOISTURE, PERCENT VOLUME*	0.6	0.9
13)*ASSUMED STACK GAS MOISTURE, PCT VOL*	2	2
14)*PERCENT CO2*		
15)*PERCENT O2*		
16)*PERCENT CO*		
17)*PERCENT N2*		
18)*PERCENT EXCESS AIR*	NA	NA
19)*MOLECULAR WEIGHT OF STACK GAS, DRY*	28.85	28.85
20)*MOLECULAR WEIGHT OF STACK GAS, STK COND*	28.78	28.75
21)*STACK GAS SPECIFIC GRAVITY*	0.99	0.99
22)*AVG SQUARE ROOT (VEL HEAD), IN H2O*	1.514	1.547
23)*AVERAGE STACK GAS TEMPERATURE, DEG F*	62	62
24)*AVG SQUARE ROOT (STK TEMP×VEL HEAD)*	34.597	35.334
25)*PITOT CORRECTION FACTOR*	0.83	0.83
26)*STACK PRESSURE, IN HG, ABSOLUTE*	30.12	30.12
27)*STACK GAS VEL, STACK COND, F.P.M.*	4997.9	5107.2
28)*STACK AREA, SQ FEET*	2.18	2.18
29)*EFFECTIVE STACK AREA, SQUARE FEET*	2.18	2.18
30)*STACK GAS FLOW RATE, S.T.P. , SCFMD*	11066	11275
31)*NET TIME OF TEST, MINUTES*	80	70
32)*SAMPLING NOZZLE DIAMETER, INCHES*	0.25	0.25
33)*PERCENT ISOKINETIC*	100.2	99
PARTICULATE EMISSIONS (LBS/HR)		
FRONT HALF SUBTOTAL	3292.44×10^{-3}	12.20×10^{-3}
BACK HALF SUBTOTAL	13.71×10^{-3}	63.43×10^{-3}
TOTALS	3306.15×10^{-3}	75.63×10^{-3}
PARTICULATE EMISSIONS (LBS/TON PRODUCT)		
FRONT HALF SUBTOTAL	979.89×10^{-5}	3.33×10^{-5}
BACK HALF SUBTOTAL	4.08×10^{-5}	17.33×10^{-5}
TOTAL	983.97×10^{-5}	20.66×10^{-5}

S.T.P.↔ *DRY, 70 DEGREES F, 29.92 INCHES MERCURY*

TABLE 2

CORRECTED GAS VOLUMES

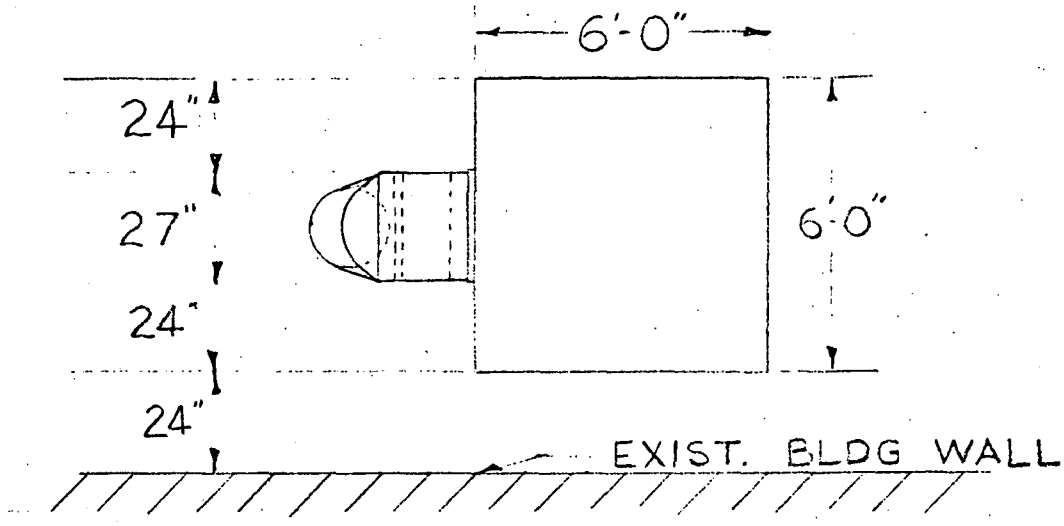
A.	TEST NO.	1	2	3	4	5
B.	FINAL GAS METER READING	272.643	378.431	485.332	587.091	677.053
C.	INITIAL GAS METER READING	171.665	276.700	378.432	485.332	587.120
*D.	UNCORRECTED GAS VOLUME COLLECTED (B - C)	100.978	101.731	106.900	101.759	89.933
*E.	CORRECTED GAS VOLUME (1.283 X D)	129.555	130.521	137.153	138.751	122.215

* At meter conditions

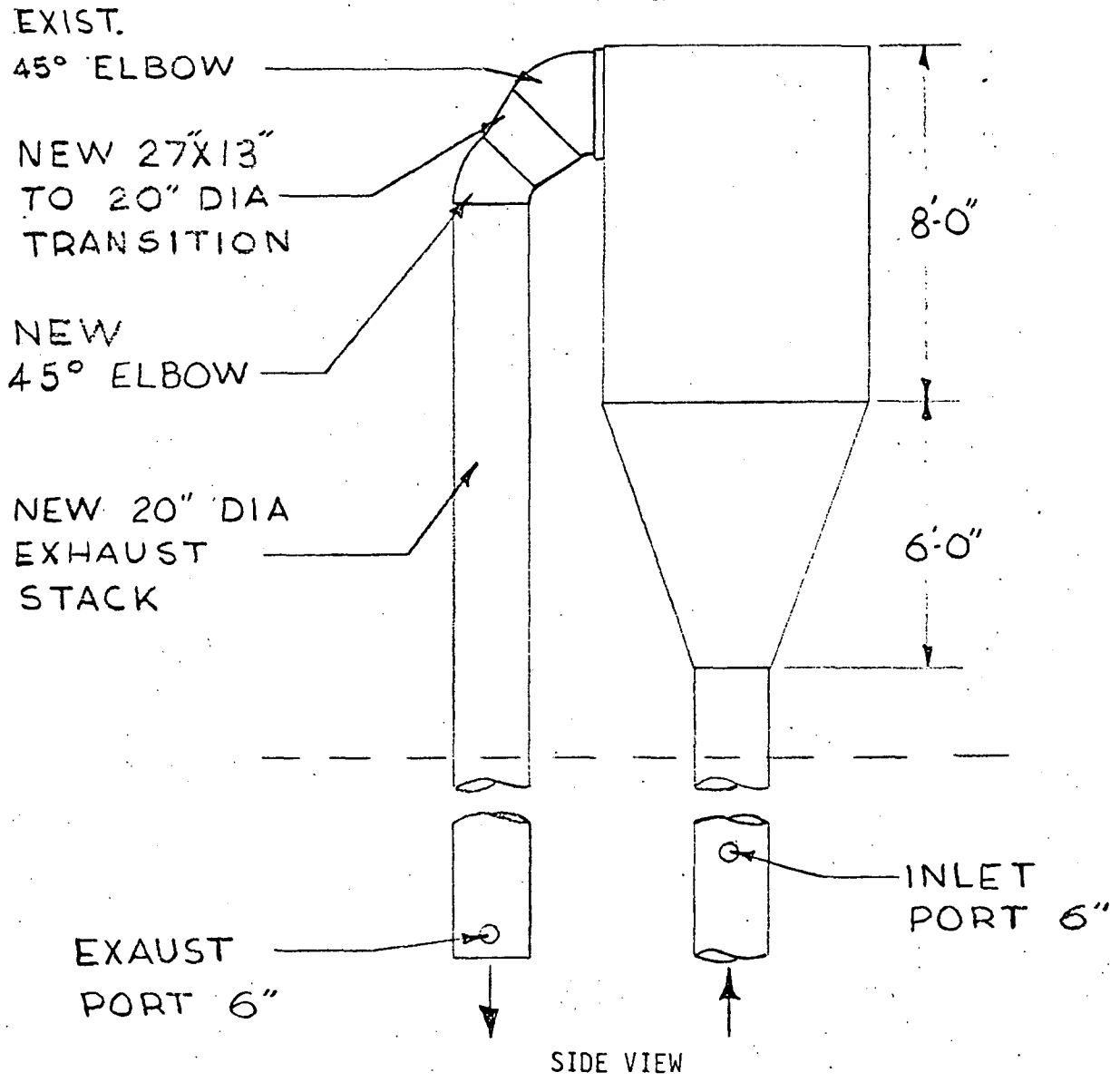
LOCATION OF SAMPLING POINTS

Sampling points were selected using the guidelines presented in Method No. 1 of the Federal Register (Volume 36, Number 247, December 23, 1971, pp. 24882 - 24883). The field data sheet with the location of the sampling points is included with other field data in Appendix B.

Figure 1 is a diagram of the baghouse and constructed duct-work with sampling ports.



PLAN VIEW



SIDE VIEW

FIGURE 1

TRANSPORT BELT VENT SYSTEM #3

SAMPLING PROCEDURES

The methods used were those outlined in Method No. 5 of the Federal Register (Vol. 36, No. 247, Part II, December 23, 1971). Upon direction of the EPA project test officer, the probe and filter were not heated. A complete description of the sampling method used is included in Appendix C.

LABORATORY ANALYSIS

All laboratory analyses were performed by Environmental Engineering, Inc. This included analysis of acetone and deionized water blanks removed from the plastic rinse bottles at the testing site.

All analyses were conducted under the guidelines of Method No. 5 of the Federal Register (Vol. 36, No. 159, August 17, 1971).

APPENDIX A

Particulate Emission Calculations

EXPLANATION OF E.E.I. SOURCE SAMPLING CALCULATION SHEET

PB - Barometric pressure, inches Hg
PS - Stack pressure, inches Hg
AS - Stack area, sq. ft.
AS' - Effective area of positive stack gas flow, sq. feet
NPTS - Number of traverse points where the pitot velocity head was greater than zero
TS - Stack temperature, ^{o}R
TM - Meter temperature, ^{o}R
$\bar{H}$ - Average square root of velocity head, $\sqrt{\text{inches } H_2O}$
ΔH - Average meter orifice pressure differential, inches H_2O
AN - Sampling nozzle area, square feet
CP - S-type pitot tube correction factor
VM - Recorded meter volume sample, cubic feet (meter conditions)
VC - Condensate and silica gel increase in impingers, milliliters
P_o - Pressure at the dry test meter orifice, $\left(PB + \frac{H}{13.6}\right)$ inches Hg
STP - Standard conditions, dry, $70^{o}F$, 29.92 inches Hg

- - - - - - - - - - - -

VWV - Conversion of condensate in milliliters to water vapor in cubic feet (STP)
VSTPD - Volume sampled, cubic feet (STP)
VT - Total water vapor volume and dry gas volume sampled, cubic feet (STP)
W - Moisture fraction of stack gas
FDA - Dry gas fraction
- Assumed moisture from preliminary check
MD - Molecular weight of stack gas, lbs/lb-mole (dry conditions)
MS - Molecular weight of stack gas, lbs/lb-mole (stack conditions)
GS - Specific gravity of stack gas, referred to air
EA - Excess air, %
$\sqrt{H \times TS}$ - Average square root of velocity head times stack temperature
$\bar{U}$ - Stack gas velocity, feet per minute
QS - Stack gas flow rate, cubic feet per minute (stack conditions)
QD - Stack gas flow rate, cubic feet per minute (dry conditions)
QSTPD - Stack gas flow rate, cubic feet per minute (STP)
PISO - Percent isokinetic volume sampled (method described in Federal Register)
ESTP - Pollutant concentration, grains per std. cubic feet
E12 - Pollutant concentration, grains per std. cubic feet (Corrected to 12% CO_2)
E50 - Pollutant concentration, grains per std. cubic feet (Corrected to 50% EA)
EM - Pollutant emission rate, lbs. per hour

environmental engineering, inc.

ENVIRONMENTAL ENGINEERING, INCORPORATED
SOURCE SAMPLING CALCULATIONS

PLANT- STOCKTON GRAIN ELEVATORS SAN FRANCISCO, CALIF. DATE- 1/10/73
STACK- TUNNEL BELT OUTLET RUN 1 FROM 9:05-10:35
WEATHER CONDITIONS- CLOUDY PB- 30.12 IN HG PS- 30.12 IN HG
AS'- 2.18 SQ. FEET TS- 522 DEGREES R TM- 514.8 DEGREES R H- 1.513 IN H2O
ΔH- 9.04 IN H2O AN- 0.000341 SQ. FEET CP- 0.83 VM- 129.555 CF VC- 24.7 ML
TOTAL TIME- 80 MIN NPTS- 16 ORSAT:

1) VWV = (0.0474)×(VC)	1)	1.17	SCF
2) VSTPD= ((530)×(VM)×(PB+(ΔH÷13.6)))÷(29.92×TM)	2)	137.248	SCF
3) VT = (VWV) + (VSTPD)	3)	138.418	SCF
4) W = (VWV) ÷ (VT)	4)	0.008	
5) FDA = (1.0 - W)	5)	0.992	
6) ASSUMED MOISTURE FRACTION	6)	0.02	
7) MD = (.44×CO2) + (.32×O2) + (.28×(CO+N2))	7)	28.85	
8) MS = (MD×FDA) + (18×W)	8)	28.76	
9) GS = (MS) ÷ (28.99)	9)	0.99	
10) EA = (100)×(O2-0.5×CO)÷((0.266×N2)-(O2-0.5×CO))	10)	0	%
11) AVG(√(H×TS)) = (1÷N)×SUM(√(H×TS))	11)	34.569	
12) U = (174×CP×(√(29.92÷PS×GS)))×AVG(√(H×TS))	12)	4995.9	FPM
13) QS = (U) × (AS')	13)	10891	ACFM
14) QD = (QS) × (FDA)	14)	10799	CFMD
15) QSTPD= (QD) × (530÷TS) × (PS÷29.92)	15)	11038	SCFM
16) PISO = ((0.00267×VC×TS)+(PO×TS×VM÷TM)) ÷ (TIME×U×PS×AN)	16)	99.4	%
17) ESTP = (15.43×Y) ÷ (VSTPD) UNITS : GRAINS/SCF			
18) E12 = (12×ESTP) ÷ (%CO2) UNITS : GRAINS/SCF			
19) E50 = (ESTP×(100+EA)) ÷ (150) UNITS : GRAINS/SCF			
20) EM = (0.00857)×(ESTP)×(QSTPD) UNITS : POUNDS/HOUR			

PARTICULATE LAB ANALYSIS (MG) (Y)		PARTICULATE CONCENTRATIONS (GR/SCF) (ESTP)	(E12)	EMISSION RATE (LBS/TON)	(LBS/HR
				x10^{-5}	x10^{-3}
FRONT HALF SURT -	.3000	.0337 x 10^{-3}		0.82	3.19
BACK HALF SURTO -	12.0000	1.3491 x 10^{-3}		32.72	127.62
TOTALS -	12.3000	1.3828 x 10^{-3}		33.54	130.81

COMMENTS : _____

TEST CONDUCTED BY : Bob Durgan
Larry Wurts

environmental engineering, inc.

ENVIRONMENTAL ENGINEERING, INCORPORATED
SOURCE SAMPLING CALCULATIONS

PLANT- STOCKTON GRAIN ELEVATORS SAN FRANCISCO, CALIF. DATE- 1/10/73
STACK- TUNNEL BELT OUTLET RUN 2 FROM 11:15-12:40
WEATHER CONDITIONS- CLOUDY PB- 30.12 IN HG PS- 30.12 IN HG
AS'- 2.18 SQ. FEET TS- 524 DEGREES R TM- 516.6 DEGREES R H- 1.512 IN H2O
ΔH- 9.08 IN H2O AN- 0.000341 SQ. FEET CP- 0.83 VM- 130.521 CF VC- 28.4 ML
TOTAL TIME- 80 MIN NPTS- 16 ORSAT:

1)	VWV = (0.0474)×(VC)	1) 1.35	SCF
2)	VSTPD= ((530)×(VM)×(PB+(ΔH÷13.6)))÷(29.92×TM)	2) 137.798	SCF
3)	VT = (VWV) + (VSTPD)	3) 139.144	SCF
4)	W = (VWV) ÷ (VT)	4) 0.01	
5)	FDA = (1.0 - W)	5) 0.99	
6)	ASSUMED MOISTURE FRACTION	6) 0.02	
7)	MD = (.44×CO2) + (.32×O2) + (.28×(CO+N2))	7) 28.85	#
8)	MS = (MD×FDA) + (18×W)	8) 28.75	
9)	GS = (MS) ÷ (28.99)	9) 0.99	
10)	EA = (100)×(O2-0.5×CO)÷((0.266×N2)-(O2-0.5×CO))	10) 0	%
11)	AVG(√(H×TS)) = (1÷N)×SUM(√(H×TS))	11) 34.61	
12)	U = (174×CP×(√(29.92÷PS×GS)))×AVG(√(H×TS))	12) 5003	FPS
13)	QS = (U) × (AS')	13) 10906	ACFM
14)	QD = (QS) × (FDA)	14) 10801	CFMD
15)	QSTPD= (QD) × (530÷TS) × (PS÷29.92)	15) 10998	SCFM
16)	PISO = ((0.00267×VC×TS)+(PO×TS×VM÷TM)) ÷ (TIME×U×PS×AN)	16) 100.2	%
17)	ESTP = (15.43×Y) ÷ (VSTPD) UNITS : GRAINS/SCF		
18)	E12 = (12×ESTP) ÷ (%CO2) UNITS : GRAINS/SCF		
19)	E50 = (ESTP×(100+EA)) ÷ (150) UNITS : GRAINS/SCF		
20)	EM = (0.00857)×(ESTP)×(QSTPD) UNITS : POUNDS/HOUR		

PARTICULATE LAB ANALYSIS (MG) (Y)		PARTICULATE CONCENTRATIONS (GR/SCF) (ESTP)	(E12)	EMISSION RATE (LBS/TON)	(LBS/HR
				x10^{-5}	x10^{-3}
FRONT HALF SUBT -	.4000	.0448 x10^{-3}		1.08	4.22
BACK HALF SUBTO -	13.2000	1.4781 x10^{-3}		35.72	139.31
TOTALS -	13.6000	1.5229 x10^{-3}		36.80	143.53

COMMENTS : _____

TEST CONDUCTED BY : Bob Durgan
Larry Wurts

environmental engineering, inc.

ENVIRONMENTAL ENGINEERING, INCORPORATED
SOURCE SAMPLING CALCULATIONS

PLANT- STOCKTON GRAIN ELEVATORS SAN FRANCISCO, CALIF. DATE- 1/10/73
STACK- TUNNEL BELT OUTLET RUN 3 FROM 2:05-3:40
WEATHER CONDITIONS- CLOUDY PB- 30.12 IN HG PS- 30.12 IN HG
AS'- 2.18 SQ. FEET TS- 524 DEGREES R TM- 517.1 DEGREES R H- 1.586 IN H2O
ΔH- 9.69 IN H2O AN- 0.000341 SQ. FEET CP- 0.83 VM- 137.153 CF VC- 27.4 ML
TOTAL TIME- 80 MIN NPTS- 16 ORSAT:

1) $VWV = (0.0474)\times(VC)$	1) 1.3	SCF
2) $VSTPD = ((530)\times(VM)\times(PB+(\Delta H \div 13.6)))\div(29.92\times TM)$	2) 144.863	SCF
3) $VT = (VWV) + (VSTPD)$	3) 146.161	SCF
4) $W = (VWV) \div (VT)$	4) 0.009	
5) $FDA = (1.0 - W)$	5) 0.991	
6) ASSUMED MOISTURE FRACTION	6) 0.02	
7) $MD = (.44\times CO2) + (.32\times O2) + (.28\times(CO+N2))$	7) 28.85	
8) $MS = (MD\times FDA) + (18\times W)$	8) 28.75	
9) $GS = (MS) \div (28.99)$	9) 0.99	
10) $EA = (100)\times(O2-0.5\times CO)\div((0.266\times N2)-(O2-0.5\times CO))$	10) 0	%
11) $AVG(\sqrt{(H\times TS)}) = (1\div N)\times SUM(\sqrt{(H\times TS)})$	11) 36.302	
12) $U = (174\times CP\times(\sqrt{(29.92\div PS\times GS)})\times AVG(\sqrt{(H\times TS)})$	12) 5246.7	FPS
13) $QS = (U)\times(AS')$	13) 11438	ACFM
14) $QD = (QS)\times(FDA)$	14) 11336	CFMD
15) $QSTPD = (QD)\times(530\div TS)\times(PS\div 29.92)$	15) 11543	SCFM
16) $PISO = ((0.00267\times VC\times TS)+(PO\times TS\times VM\div TM))\div(TIME\times U\times PS\times AN)$	16) 100.3	%
17) $ESTP = (15.43\times Y)\div(VSTPD)$ UNITS : GRAINS/SCF		
18) $E12 = (12\times ESTP)\div(\%CO2)$ UNITS : GRAINS/SCF		
19) $E50 = (ESTP\times(100+EA))\div(150)$ UNITS : GRAINS/SCF		
20) $EM = (0.00857)\times(ESTP)\times(QSTPD)$ UNITS : POUNDS/HOUR		

PARTICULATE LAB ANALYSIS (MG) (Y)		PARTICULATE CONCENTRATIONS (GR/SCF) (ESTP)	(E12)	EMISSION RATE (LBS/TON)	(LBS/HR
				$\times 10^{-5}$	$\times 10^{-3}$
FRONT HALF SUBT -	.2000	$.0213 \times 10^{-3}$		0.52	2.11
BACK HALF SUBTO -	5.4000	$.5752 \times 10^{-3}$		14.05	56.90
TOTALS -	5.6000	$.5965 \times 10^{-3}$		14.57	59.00

COMMENTS : _____

TEST CONDUCTED BY : Bob Durgan
Larry Wurts

environmental engineering, inc.

ENVIRONMENTAL ENGINEERING, INCORPORATED
SOURCE SAMPLING CALCULATIONS

PLANT- STOCKTON GRAIN ELEVATORS SAN FRANCISCO, CALIF. DATE- 1/11/73
STACK- TUNNEL BELT OUTLET RUN 4 FROM 9:10-10:35
WEATHER CONDITIONS- CLOUDY PB- 30.12 IN HG PS- 30.12 IN HG
AS'- 2.18 SQ. FEET TS- 522 DEGREES R TM- 513.1 DEGREES R U- 1.514 IN H2O
ΔH- 9.05 IN H2O AN- 0.000341 SQ. FEET CP- 0.83 VM- 130.557 CF VC- 18.7 ML
TOTAL TIME- 80 MIN NPTS- 16 ORSAT:

1)	VWV = (0.0474)×(VC)	1) 0.89	SCF
2)	VSTPD= ((530)×(VM)×(PB+(ΔH÷13.6)))÷(29.92×TM)	2) 138.751	SCF
3)	VT = (VWV) + (VSTPD)	3) 139.638	SCF
4)	W = (VWV) ÷ (VT)	4) 0.006	
5)	FDA = (1.0 - W)	5) 0.994	
6)	ASSUMED MOISTURE FRACTION	6) 0.02	
7)	MD = (.44×CO2) + (.32×O2) + (.28×(CO+N2))	7) 28.85	
8)	MS = (MD×FDA) + (18×W)	8) 28.78	
9)	GS = (MS) ÷ (28.99)	9) 0.99	
10)	EA = (100)×(O2-0.5×CO)÷((0.266×N2)-(O2-0.5×CO))	10) 0	%
11)	AVG(√(H×TS)) = (1÷N)×SUM(√(H×TS))	11) 34.597	
12)	U = (174×CP×(√(29.92÷PS×GS))×AVG(√(H×TS))	12) 4997.9	FPM
13)	QS = (U) × (AS')	13) 10895	ACFM
14)	QD = (QS) × (FDA)	14) 10826	DCFM
15)	QSTPD= (QD) × (530÷TS) × (PS÷29.92)	15) 11066	SCFM
16)	PISO = ((0.00267×VC×TS)+(PO×TS×VM÷TM)) ÷ (TIME×U×PS×AN)	16) 100.2	%
17)	ESTP = (15.43×Y) ÷ (VSTPD) UNITS : GRAINS/SCF		
18)	E12 = (12×ESTP) ÷ (%CO2) UNITS : GRAINS/SCF		
19)	E50 = (ESTP×(100+EA)) ÷ (150) UNITS : GRAINS/SCF		
20)	EM = (0.00857)×(ESTP)×(QSTPD) UNITS : POUNDS/HOUR		

PARTICULATE LAB ANALYSIS (MG) (Y)		PARTICULATE CONCENTRATIONS (GR/SCF) (ESTP) (E12)	EMISSION RATE (LBS/TON) (LBS/HR)
			x10^{-5} x10^{-3}
FRONT HALF SUBT -	312.2000	34.7186 x10^{-3}	979.89 3292.44
BACK HALF SUBTO -	1.3000	.1446 x10^{-3}	4.08 13.71
TOTALS -	313.5000	34.8632 x10^{-3}	983.97 3306.15

COMMENTS : _____

TEST CONDUCTED BY : Bob Durgan
Larry Wurts

environmental engineering, inc.

ENVIRONMENTAL ENGINEERING, INCORPORATED
SOURCE SAMPLING CALCULATIONS

PLANT- STOCKTON GRAIN ELEVATORS SAN FRANCISCO, CALIF. DATE- 1/11/73
STACK- TUNNEL BELT OUTLET RUN 5 FROM 11:10-12:25
WEATHER CONDITIONS- CLOUDY PB- 30.12 IN HG PS- 30.12 IN HG
AS'- 2.18 SQ. FEET TS- 522 DEGREES R TM- 515.3 DEGREES R H- 1.547 IN H2O
ΔH- 9.43 IN H2O AN- 0.000341 SQ. FEET CP- 0.83 VM- 115.384 CF VC- 24.1 ML
TOTAL TIME- 70 MIN NPTS- 16 ORSAT:

1) VWV = (0.0474)×(VC)	1) 1.14	SCF
2) VSTPD= ((530)×(VM)×(PB+(ΔH÷13.6)))÷(29.92×TM)	2) 122.215	SCF
3) VT = (VWV) + (VSTPD)	3) 123.357	SCF
4) W = (VWV) ÷ (VT)	4) 0.009	
5) FDA = (1.0 - W)	5) 0.991	
6) ASSUMED MOISTURE FRACTION	6) 0.02	
7) MD = (.44×CO2) + (.32×O2) + (.28×(CO+N2))	7) 28.85	
8) MS = (MD×FDA) + (18×W)	8) 28.75	
9) GS = (MS) ÷ (28.99)	9) 0.99	
10) EA = (100)×(O2-0.5×CO)÷((0.266×N2)-(O2-0.5×CO))	10) 0	%
11) AVG(√(H×TS)) = (1÷N)×SUM(√(H×TS))	11) 35.334	
12) U = (174×CP×(√(29.92÷PS×GS))×AVG(√(H×TS))	12) 5107.2	FPM
13) QS = (U) × (AS')	13) 11134	ACFM
14) QD = (QS) × (FDA)	14) 11031	CFMD
15) QSTPD= (QD) × (530÷TS) × (PS÷29.92)	15) 11275	SCFM
16) PISO = ((0.00267×VC×TS)+(PO×TS×VM÷TM)) ÷ (TIME×U×PS×AN)	16) 99	%
17) ESTP = (15.43×Y) ÷ (VSTPD)	UNITS : GRAINS/SCF	
18) E12 = (12×ESTP) ÷ (%CO2)	UNITS : GRAINS/SCF	
19) E50 = (ESTP×(100+EA)) ÷ (150)	UNITS : GRAINS/SCF	
20) EM = (0.00857)×(ESTP)×(QSTPD)	UNITS : POUNDS/HOUR	

PARTICULATE LAB ANALYSIS (MG) (Y)		PARTICULATE CONCENTRATIONS (GR/SCF) (ESTP)	(E12)	EMISSION RATE (LBS/TON)	(LBS/HR
				$x10^{-5}$	$x10^{-3}$
FRONT HALF SUBT -	1.0000	$.1263x10^{-3}$		3.33	12.20
BACK HALF SUBTO -	5.2000	$.6565x10^{-3}$		17.33	63.43
TOTALS -	6.2000	$.7828x10^{-3}$		20.66	75.63

COMMENTS : _____

TEST CONDUCTED BY : Bob Durgan
Larry Wurts

environmental engineering, inc.

APPENDIX B

FIELD DATA SHEETS

PRELIMINARY VELOCITY TRAVERSE

PLANT S.F. GRAIN TERM. Pier 90
DATE 1-10-73
LOCATION TUNNEL BELT OUTLET
STACK I.D. 20"
BAROMETRIC PRESSURE, in. Hg 30.12
STACK GAUGE PRESSURE, in. H_2O
OPERATORS R. DURGAN L. INUETS

SCHEMATIC OF TRAVERSE POINT LAYOUT

PORT #1

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
1	1.5	62°
2	2.2	"
3	2.9	"
4	2.3	"
1	1.80	"
2	2.50	"
3	2.8	"
4	2.5	"
AVERAGE		

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

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TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT S.F. GRAIN TERMINAL PIER 90
DATE 1-10-73
SAMPLING LOCATION TUNNEL BELT OUTLET
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE A) 20"
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE, (DISTANCE B) —
STACK I.D., (DISTANCE A - DISTANCE B) 20"
NEAREST UPSTREAM DISTURBANCE 40"
NEAREST DOWNSTREAM DISTURBANCE
CALCULATOR R. DURGAN

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 NIPPLE (SUM OF COLUMNS 4 & 5)
1	6.7	20"	1 1/3"	—	1 1/3"
2	25	20"	5"	—	5"
3	75	20"	15"	—	15"
4	93.3	20"	18 2/3"	—	18 2/3"

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NOMOGRAPH DATA

PLANT S.F. GRAIN TERMINAL PIER 90

DATE 1-10-73

SAMPLING LOCATION TUNNEL BELT OUTLET

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.70
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	50
PERCENT MOISTURE IN GAS STREAM BY VOLUME	B_{wo}	2%
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	30.12
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.073$ x STACK GAUGE PRESSURE in in. H_2O)	P_s	30.12
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1
AVERAGE STACK TEMPERATURE, °F.	$T_{s_{avg.}}$	62
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	2.3
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	2.9
C FACTOR		0.94
CALCULATED NOZZLE DIAMETER, in.		1/4"
ACTUAL NOZZLE DIAMETER, in.		1/4"
REFERENCE Δp, in. H_2O		0.47

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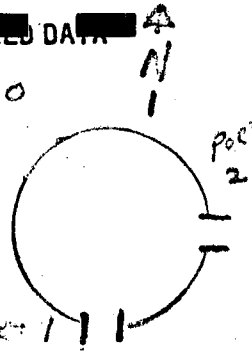
[redacted] [redacted] [redacted]

Stack Diameter 20"

[redacted] DATA [redacted]

PLANT S.F. GRAIN TERMINAL PIER 90
DATE 1-10-73
SAMPLING LOCATION TUNNEL BELT OUTLET
SAMPLE TYPE PARTICULATE
RUN NUMBER 1
OPERATOR R. DURGAN L. COURTS
AMBIENT TEMPERATURE 50
BAROMETRIC PRESSURE 30.12
STATIC PRESSURE, (P_s) 30.12
FILTER NUMBER (s) 000025
SILICA GEL 270



SCHEMATIC OF TRAVERSE POINT LAYOUT

PROBE LENGTH AND TYPE 6' GLASS
NOZZLE I.D. 1/4
ASSUMED MOISTURE, % 2%
SAMPLE BOX NUMBER —
METER BOX NUMBER 1
METER ΔH@ 1.72
C FACTOR 0.97 ← 0.83
PROBE HEATER SETTING 70%
HEATER BOX SETTING —
REFERENCE Δp 0.47

Total Sample = 24.7 min.

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		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
				DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F			
		171.665									
Start 9:05 1	1½"	[illegible]	[illegible]	[illegible]	[illegible]	62	52	51	4.0	—	48
			[illegible]	[illegible]	[illegible]	62	52	51	4.0	—	47
2	5"	[illegible]	2.40	9.60	[illegible]	62	53	52	5.0	—	47
Port #1			2.40	9.60	9.60	62	[illegible]	[illegible]	5.0	—	45
3	15"	[illegible]	[illegible]	11.0	10.5	[illegible]	54	52	5.0	—	44
		[illegible]	3.90	11.0	10.5	62	[illegible]	[illegible]	[illegible]	—	[illegible]
4	19 3/4	[illegible]	3.35	1.50	1.50	62	[illegible]	[illegible]	5.0	—	41
5 9:40		221.219	3.35	1.50	1.50	62	57	52	[illegible]	—	41
							71.8	71.5			
Start 9:50 1	1 1/3"	226.9	1.75	7.00	7.00	62	[illegible]	[illegible]	11.0	—	48
		232.5	1.25	7.00	7.00	62	57	54	4.0	—	45
2	5"	231.0	2.40	9.60	9.60	62	57	55	5.0	—	42
Port #2		—	2.40	[illegible]	9.60	62	[illegible]	55	5.0	—	43
3	15"	242.5	2.50	10.5	10.5	62	58	56	5.0	—	42
		251.5	2.50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.0	—	45
4	19 3/4"	260.0	2.40	9.60	9.60	62	[illegible]	55	5.0	—	45
Stop 10:20		272.643	2.40	9.60	9.60	62	[illegible]	[illegible]	5.0	—	45
		100.978				62	57.62	54.15			
			$\sqrt{\Delta p}$ = 1.5130		9.04		76.25	73.25			
		171.665									

COMMENTS:

80 min.

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FIELD DATA

PLANT S.E.G. BAIN TERM. PIER 90
DATE 1-10-73
SAMPLING LOCATION TERM. FLT OUTLET
SAMPLE TYPE CONDENSATE
RUN NUMBER 2
OPERATOR T. DURHAM L. WURTS
AMBIENT TEMPERATURE 55
BAROMETRIC PRESSURE 30.12
STATIC PRESSURE, (P_s) 30.12
FILTER NUMBER (s) 0010 84

PROBE LENGTH AND TYPE 6' GLASS
NOZZLE I.D. 1/4
ASSUMED MOISTURE, % 2%
SAMPLE BOX NUMBER —
METER BOX NUMBER 1
METER $\Delta H_@$ 1.79
C FACTOR 0.84 ← 0.83
PROBE HEATER SETTING 2.7%
HEATER BOX SETTING —
REFERENCE Δp 0.47

SILICA GEL #277 28.4 ML

SCHEMATIC OF TRAVERSE POINT LAYOUT

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		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
				DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F			
START 11:15		276.700									
1	1 2/3"	282.4	1.80	7.20	7.20	64	56	56	6.5	—	46
		290.1	1.80	7.20	7.20	64	56	56	6.5	—	46
2	5"	299.5	2.40	9.60	9.60	64	56	56	9.0	—	46
		—	2.40	9.60	9.60	64	56	56	9.0	—	46
3	15"	307.9	2.70	10.50	10.50	64	57	56	9.5	—	46
		316.7	2.70	10.50	10.50	64	57	56	9.5	—	46
4	18 2/3"	325.4	2.40	9.60	9.60	64	58	56	9.5	—	46
		327.9 45	2.40	9.60	7.50	64	58	56	9.5	—	50
						64	57.8	56.00			
START 12:00											
1	1 1/3"	333.8	1.90	7.60	7.60	64	58	56	8.0	—	50
		339.7	1.90	7.60	7.60	64	57	56	8.0	—	50
2	5"	346.2	2.60	10.00	10.00	64	57	56	9.5	—	50
		353.0	2.60	10.00	10.00	64	57	56	9.5	—	50
3	15"	359.8	2.70	10.50	10.50	64	57	56	9.5	—	50
		366.6	2.70	10.50	10.50	64	57	56	9.5	—	50
4	18 2/3"	372.6	1.90	7.60	7.60	64	58	56	8.0	—	50
		378.431	1.90	7.60	7.60	64	58	56	8.0	—	50
		101.731	1.512		9.025	64	57.38	56			

COMMENTS:

80 min.

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[redacted] [redacted] FIELD DATA [redacted]

PLANT S.F. GRAIN TERMINAL PIER 90
DATE 7-10-73
SAMPLING LOCATION TUNNEL BELT OUTLET
SAMPLE TYPE PARTICULATE
RUN NUMBER 3
OPERATOR P. DURGAN - L. WURTS
AMBIENT TEMPERATURE 50
BAROMETRIC PRESSURE 30.12
STATIC PRESSURE, (P_s) 30.12
FILTER NUMBER (s) [illegible]
- SILICA GEL # 279 27.4 ML

PROBE LENGTH AND TYPE 6' GLASS
NOZZLE I.D. 1/4
ASSUMED MOISTURE, % 2%
SAMPLE BOX NUMBER —
METER BOX NUMBER 1
METER $\Delta H_@$ 1.70
C FACTOR 0.94 ← 0.83
PROBE HEATER SETTING 70%
HEATER BOX SETTING —
REFERENCE Δp 0.47

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 5 MINUTES

TRAVERSE POINT NUMBER	CLOCK TIME (24-hr CLOCK) / SAMPLING TIME, min	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
				DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F			
		378.432									
START 2:05 Port #1 1	1 1/3"	384.9	2.30	9.20	9.20	64	56	56	7.5	—	52
		391.3	2.30	9.20	9.20	64	56	56	7.5	—	52
2	5"	398.8	2.90	11.0	10.5	64	56	56	8.0	—	52
		405.5	2.90	11.0	10.5	64	56	56	8.0	—	52
3	15"	412.3	2.80	10.5	10.5	64	57	56	7.0	—	52
		419.1	2.80	10.5	10.5	64	58	56	7.0	—	52
4	18 2/3"	425.4	2.20	8.90	8.90	64	54	56	5.0	—	50
STOP 2:45		431.907	2.20	8.90	8.90	64	59	56	5.0	—	50
						64	7.12	56			
		431.957									
START 3:00 Port #2 1	1 1/3"	438.7	2.00	8.00	8.00	64	59	56	4.5	—	50
		444.8	2.00	8.00	8.00	64	58	57	4.5	—	50
2	5"	451.5	2.50	9.90	9.90	64	58	57	5.0	—	48
		458.2	2.50	9.90	9.90	64	58	57	5.0	—	48
3	15"	465.0	2.90	11.0	10.5	64	58	57	5.0	—	48
		471.8	2.90	11.0	10.5	64	58	57	5.0	—	48
4	18 2/3"	—	2.60	10.0	10.0	64	59	57	5.0	—	46
STOP 3:40		485.332	2.60	10.0	10.0	64	59	57	5.0	—	46
	/	106.900 $\sqrt{\Delta h}$	1.526		9.618	64	58.38	56.88			
	S. [illegible]	515.585									

COMMENTS:

80 min.

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FIELD DATA

PLANT S.E. GRAIN TERM PIER 90
DATE 1-11-73
SAMPLING LOCATION TUNNEL BELT OUTLET
SAMPLE TYPE PARTICULATE
RUN NUMBER 4
OPERATOR R. DUGGAN G. WURTS
AMBIENT TEMPERATURE 55
BAROMETRIC PRESSURE 30.13
STATIC PRESSURE, (P_s) 30.12
FILTER NUMBER (s)
SILICA GEL
13.9 ML

PROBE LENGTH AND TYPE 6' GLASS
NOZZLE I.D. .A1
ASSUMED MOISTURE, % 2%
SAMPLE BOX NUMBER —
METER BOX NUMBER 1
METER $\Delta H_@$ 1.70
C FACTOR 0.94 ← 0.83
PROBE HEATER SETTING —
HEATER BOX SETTING
REFERENCE Δp 0.47

SCHEMATIC OF TRAVERSE POINT LAYOUT

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		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
				DESIRED	ACTUAL		INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F			
	0 / 9:10	480.332									
1	5	—	1.75	7.00	7.00	62	54	54	5		45
	10	—	1.75	7.00	7.00		52	54	5		
2	15	503.4	2.3	9.9	9.4		53	54	6		
	20	509.8	2.5	9.4	9.4		53	52	6.5		
3	25	516.6	3.0	12.0	10.5		53	52	8		
	30	523.4	3.0	12.0	10.5		53	52	8		
4	35	530.0	2.5	10.0	10.0		54	52	8		
	40 / 9:50	536.767	2.5	10.0	10.0	▽	53	52	8		47
						62	52.15	52.05			
	0 / 9:55										
1	5	542.7	2.0	8.0	8.0	62	54	53	8		45
	10	548.7	2.0	8.0	8.0		54	53	8		47
2	15	555.5	2.7	10.5	10.5		54	53	8.5		
	20	562.2	2.7	10.5	10.5		54	53	8.5		
3	25	569.0	2.5	10.0	10.0		54	53	8		
	30	—	2.5	10.0	10.0		54	53	8		
4	35	581.5	1.75	7.0	7.0		54	53	7		
	40 / 10:35	587.091	1.75	7.0	7.0	▽	54	53	7		▽
		101.759 ÷5 =	1.514		4.05	62	54	53			
							53.37	51.88			
		615.341									

Point 2

Point 1

COMMENTS:

80 min.

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[redacted] FIELD DATA [redacted]

PLANT S.F. GRAIN TERM. PIER 90
DATE 1-11-75
SAMPLING LOCATION TUNNEL BELT OUTLET
SAMPLE TYPE PARTICULATE
RUN NUMBER 5
OPERATOR R. DURGAN L. WURTS
AMBIENT TEMPERATURE 55
BAROMETRIC PRESSURE 30.12
STATIC PRESSURE, (P_s) 30.12
FILTER NUMBER (s)
SILICA GEL
24 ML

PROBE LENGTH AND TYPE 6' GLASS
NOZZLE I.D. 1/4
ASSUMED MOISTURE, % 2%
SAMPLE BOX NUMBER —
METER BOX NUMBER 1
METER $\Delta H_@$ 1.70
C FACTOR 0.94 — 0.93
PROBE HEATER SETTING —
HEATER BOX SETTING —
REFERENCE Δp 0.47

SCHEMATIC OF TRAVERSE POINT LAYOUT

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	11:10	587.120									
1	5		593.8	2.5	10.0	10.0	62	54	54	8		45
	10		—	2.5	10.0	10.0		54	54	8		
2	15		607.3	2.7	10.5	10.5		54	53	5		
	20		614.1	2.7	10.5	10.5		54	53	5		
3	25		621.0	2.5	10.0	10.0		56	54	5		
	30		627.7	2.5	10.0	10.0		56	54	5		
4	35		633.7	2.0	8	8		57	55	5		
	40	11:50	640.075	2.0	8	8		57	55	5		
							62	55.25	54.00			
	0	11:[illegible]										
1	5		—	1.75	7.0	7.0	62	57	55	4		45
	10		651.3	1.75	7.0	7.0		57	55	4		
2	15		—	2.3	9.4	9.4		56	56	5		
	20	12:15	664.1	2.3	9.4	9.4		56	56	5		
3	25	12:20	670.4	3.0	12.0	10.5		56	55	7		
4	30	12:25	677.653	2.5	10.0	10.0		56	56	7		
			89.933	$\sqrt{h}$ = 1.546			62	56.33	55.33			
								55.79	54.66			
	SHOULD BE		702.2001									

Part 1

NOTE: Last two points = 5 min instead of 10 min/pt because plant closing down early

COMMENTS:

EPA (Dur) 235
4/72

70 min

APPENDIX C

SAMPLING PROCEDURES

SAMPLING PROCEDURES USED AT STOCKTON GRAIN ELEVATORS

Prior to performing the actual tests, it was necessary to determine the following stack parameters: average temperature, velocity head, moisture content, and number of sampling points to be used.

The average stack gas temperature was determined with a bi-metallic dial type thermometer.

The average velocity head was found by making a traverse of the stack with a calibrated type "S" pitot tube and inclined manometer. A copy of this preliminary velocity traverse is included in Appendix B.

Moisture content of the stack gases was estimated from local weather data.

The number and location of the sampling points was found using Method No. 1 of the Federal Register (Vol. 36, No. 247, December 23, 1971, Section 2.1.3 and Table 1-1, pp. 24882 - 24883). A copy of the traverse point locations on each diameter sampled is included in Appendix B.

The sampling train used consisted of the following equipment: a stainless steel nozzle; a glass-lined probe; a Gelman Type "A" glass fiber filter; two Greenburg-Smith impingers, each containing 100ml deionized water; one dry impinger; one impinger containing about 180 grams of silica gel (the first, third, and fourth impingers had modified tips with 1/2-inch I.D. openings, the second impinger had a standard tip); a thermometer on the fourth impinger; flexible sampling

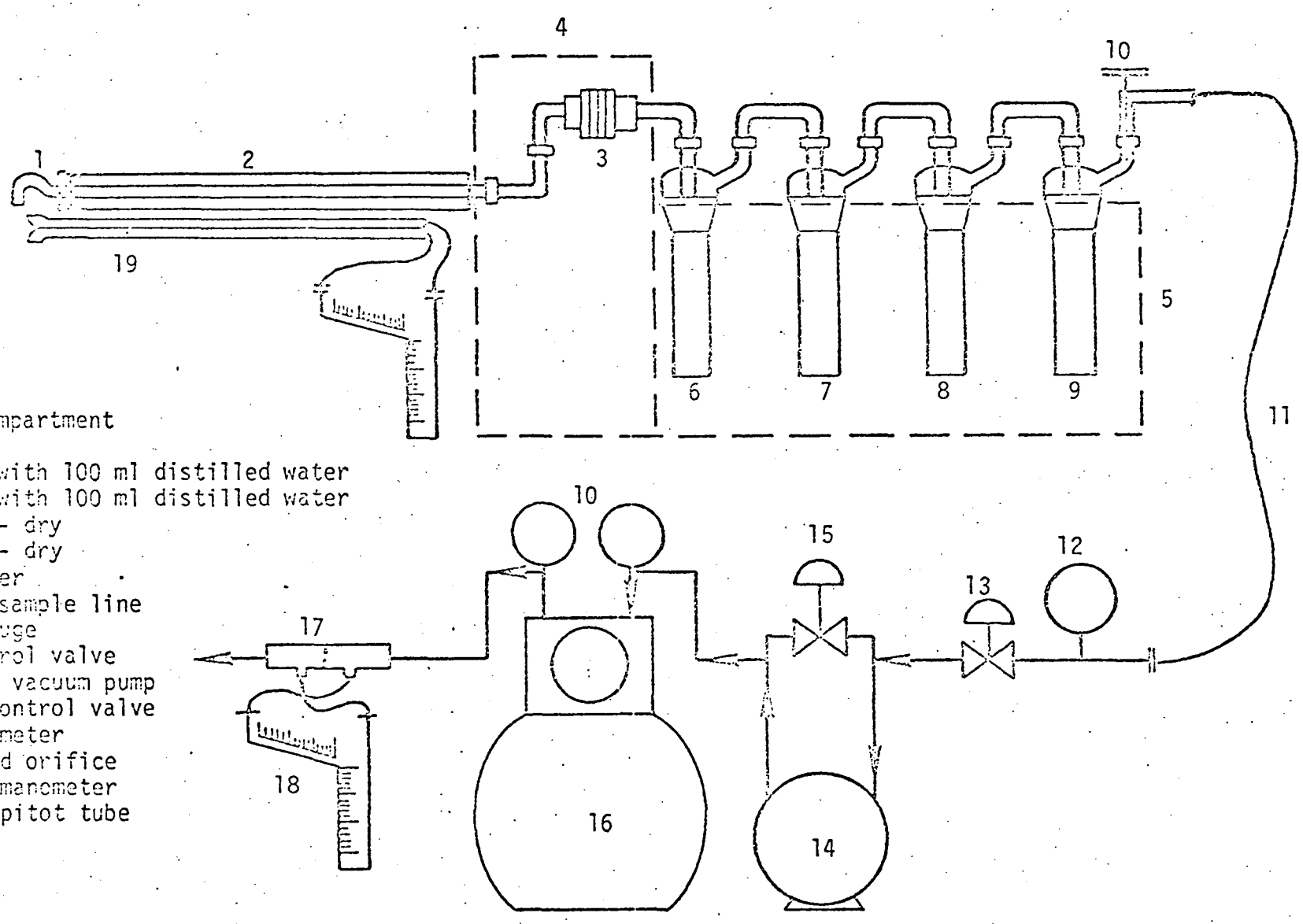
line, air-tight pump; dry test gas meter; and a calibrated orifice with inclined manometer attached. Figure 2 is a schematic diagram of the sampling train.

The impingers were held in an ice bath to condense the moisture in the stack gas.

Two ports located at right angles to each other were used for sampling. Four points on each diameter were sampled each for ten minutes making each test a total of 80 minutes. One exception to this procedure occurred on run No. 5. The last two points sampled during this test were sampled for five minutes each in order to finish the test before the plant shut down.

SAMPLE RECOVERY

Sample recovery was carried out in accordance with Method No. 5 of the Federal Register (Vol. 36, No. 159, August 17, 1971). To insure that the samples remained uncontaminated between testing and lab analysis, they were stored in clean glass mason jars equipped with teflon seals.



1. Nozzle
2. Probe
3. Filter
4. Heated Compartment
5. Ice Bath
6. Impinger with 100 ml distilled water
7. Impinger with 100 ml distilled water
8. Impinger - dry
9. Impinger - dry
10. Thermometer
11. Flexible sample line
12. Vacuum gauge
13. Main control valve
14. Air tight vacuum pump
15. By-pass control valve
16. Dry test meter
17. Calibrated orifice
18. Inclined manometer
19. "S" type pitot tube

Figure 2

APPENDIX D

PLANT OPERATING DATA

A. Process Description

The tunnel belt system collects the dust generated as grain is discharged from the storage silos onto any of the three conveyor belts in the tunnel. The belts are 42 inches wide and have a carrying capacity of 750 T/hr. They are hooded along their entire length. Dust is aspirated at several points along the belt and also from the leg boots into which the grain discharges from the belts. Inlet and outlet tests were conducted on the fabric filter while milo was being transferred from one storage bin to another. This transfer of the grain called "turning" is done to cool it after heat builds up spontaneously.

B. Equipment tested

Collection System #3
Mikro D Pulsaire filter w/reverse jet cleaning
Serial No. 69H232
Type 100S 8.20
Air flow rate - 13,000 cfm
Air/cloth ratio 14/1
Bags: polypropylene felt (Mikro style 17406)
Fan size: 60MW
41 B. HP
1201 RPM
Motor: 50HP
1750 RPM

C. Discussion of Test

During test run #1, #2 yellow milo with 5% broken kernels and foreign material (BCFM) and 13% moisture content, was transferred from one bin to another. The conveyor belts in the tunnel are numbered 5, 6 and 7. Grain was carried only on belt #5 at about 13000#/minute (390T/hr). The milo weighed about 57.5 lb/bu. The first bin was emptied at 10:05 a.m. There was no flow on the belt for about 2 minutes while the operator switched to another bin.

During test run #2, also, #2 yellow milo was transferred from one bin to another on belt #5. Grain flow on the belt was about 13000 lb/min.

During test run #3, the flow of #2 yellow milo on belt #5 was about 13500 lb/min.

Test run #4 was conducted from 8:55 a.m. until 10:30 a.m., January 11, 1973. The flow of #2 yellow milo on belt #5 averaged 11,200 lb/min.

Test run #5 was conducted from 11:05 a.m. until 12:25 p.m. on January 11, 1973. During the test, #1 hard winter wheat was transferred from one bin to another.

There were no visible emissions at anytime during the tests.

D. Process Data

Test run	Material	Grade	%FM	%H_2O	Process rate lb/min	Process rate tons/hr
1	Yellow milo	#2	5	13	13000	390
2	Yellow milo	#2	5	13	13000	390
3	Yellow milo	#2	5	13	13500	405
4	Yellow milo	#2	5	13	11200	336
5	Hard winter wheat	1YH	0.15	12.7	12200	366
		1HH	0.2	12.0		
		1HH	0.15	13.2		

APPENDIX E

ANALYTICAL DATA

EEI LABORATORY DATA

PROBE (Total) ACETONE		Run #				
		#1	#2	#3	#4	#5
Volume of Sample, ml		124	82	122	286	114
Final Wt. of Beaker, g.		65.4049	101.0602	85.5197	90.6697	88.1292
Initial Wt. of Beaker, g.		65.4007	101.0568	85.5157	90.3510	88.1248
Wt. of Residue, g.		0.0042	0.0034	0.0040	0.3187	0.0044
(-)Beaker Blank, g.	(-)	0.0012	0.0012	0.0012	0.0012	0.0012
Wt. of Resideu		0.0030	0.0022	0.0028	0.3175	0.0032
(-)Soluvent Blank (Corrected for Sample Volume)	(-)	0.0026	0.0017	0.0026	0.0060	0.0024
Corrected Wt. of Sample, g.		0.0004	0.0005	0.0002	0.3115	0.0008

FRONT-HALF (Total) H_2O		#1	#2	#3	#4	#5
Volume of Sample, ml		655	556	500	510	577
Final Wt. of Beaker, g.		115.7263	104.6304	148.8509	149.2793	150.1017
(-)Initial Wt. of Beaker, g		115.7150	104.6208	148.8452	149.2748	150.0943
Wt. of Residue		0.0113	0.0096	0.0057	0.0045	0.0074
(-)Beaker Blank,g	(-)	0.0012	0.0012	0.0012	0.0012	0.0012
Wt. of Residue, g		0.0101	0.0084	0.0045	0.0033	0.0062
(-)Solvent Blank (Corrected for Sample Volume)	(-)	0.0039	0.0033	0.0030	0.0031	0.0035
Corrected Wt. of Sample, g.		0.0062	0.0051	0.0015	0.0002	0.0027

EEI LABORATORY DATA (Cont'd)

BACK-HALF (Total) ACETONE		Run# #1	#2	#3	#4	#5
Volume of Sample, ml		122	57	178	251	160
Final Wt. of Beaker, g.		112.6146	146.3437	150.8597	147.6111	136.4617
Initial Wt. of Beaker, g.	(-)	112.6050	146.3332	150.8509	147.6035	136.4546
Wt. of Residue		0.0096	0.0105	0.0088	0.0076	0.0071
(-)Beaker Blank, g	(-)	0.0012	0.0012	0.0012	0.0012	0.0012
Wt. of Residue		0.0084	0.0093	0.0076	0.0064	0.0059
(-)Salvent Blank, G (Corrected for Sample Volume)	(-)	0.0026	0.0012	0.0037	0.0053	0.0034
Corrected Wt. of Sample, g.		0.0058	0.0081	0.0039	0.0011	0.0025

BLANKS		ACETONE	WATER	BEAKER
Volume of Sample, ml		100	100	
Final Wt. of Beaker, g.		98.5538	149.7052	150.2129
Initial Wt. of Beaker, g.	(-)	98.5505	149.7034	150.2117
		0.0033	0.0018	0.0012
(-)Beaker Blank	(-)	0.0012	0.0012	-
Corrected Wt		0.0021	0.0006	0.0012

ANALYTICAL DATA

PLANT St. Louis Terminal Power COMMENTS:

DATE 1-10-73

SAMPLING LOCATION Terminal Boat Outlet

SAMPLE TYPE Prot.

RUN NUMBER 1

SAMPLE BOX NUMBER _____

CLEAN-UP MAN _____

FRONT HALF

LABORATORY RESULTS

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

CONTAINER S-73-005-001-2 0.4 mg

FILTER NUMBER 000025

CONTAINER S-73-005-001-1 -0.10 mg

FRONT HALF SUBTOTAL 0.3 ~~0.4~~ mg

BACK HALF

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

CONTAINER S-73-005-002-3 6.2 mg

ETHER-CHLOROFORM EXTRACTION _____ mg

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

CONTAINER S-73-005-003-5 5.8 mg

BACK HALF SUBTOTAL 12.0 mg

TOTAL WEIGHT ~~12.4~~ 12.3 mg

MOISTURE

IMPINGERS

FINAL VOLUME 609 ml

INITIAL VOLUME 300 ml

NET VOLUME 309 ml

SILICA GEL Tared 215

FINAL WEIGHT	217.7 g	_____ g	_____ g
INITIAL WEIGHT	200.0 g	_____ g	_____ g
NET WEIGHT	17.7 g	_____ g	_____ g

TOTAL MOISTURE 24.7 g

EPA (Dur) 231
4/72

ANALYTICAL DATA

PLANT SFO. [illegible]
DATE 1-16-73
SAMPLING LOCATION [illegible]
SAMPLE TYPE [illegible]
RUN NUMBER 2
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 S-73-005-004-2	0.5 mg
FILTER NUMBER 00034	CONTAINER S-73-005-005-1	-0.1 0 mg
	FRONT HALF SUBTOTAL	~~0.5~~ 0.4 mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER	CONTAINER S-73-005-006-3	5.1 mg
	ETHER-CHLOROFORM EXTRACTION	mg
ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER	CONTAINER S-73-005-007-5	8.1 mg
	BACK HALF SUBTOTAL	13.2 mg
	TOTAL WEIGHT	13.6 mg

MOISTURE

IMPINGERS

FINAL VOLUME	204	ml
INITIAL VOLUME	200	ml
NET VOLUME	4	ml

SILICA GEL # 277

FINAL WEIGHT	[illegible] g	g	g
INITIAL WEIGHT	[illegible] g	g	g
NET WEIGHT	[illegible] g	g	g

TOTAL MOISTURE 28.4 g

EPA (Dur) 231
4/72

ANALYTICAL DATA

PLANT S.F.O. [illegible] Terminal [illegible] 90

DATE 1-10-73

SAMPLING LOCATION Tunnel [illegible]

SAMPLE TYPE Part.

RUN NUMBER 3

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 S-73-005-008-2 — 0.2 mg

FILTER NUMBER 000036 — CONTAINER S-73-005-009-1 — 0 mg

FRONT HALF SUBTOTAL 0.2 mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER S-73-005-010-3 — 1.5 mg

ETHER-CHLOROFORM EXTRACTION — mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER S-73-005-011-5 — 3.9 mg

BACK HALF SUBTOTAL 5.4 mg

TOTAL WEIGHT 5.6 mg

MOISTURE

IMPINGERS

FINAL VOLUME 205 ml

INITIAL VOLUME 200 ml

NET VOLUME 5.0 ml

SILICA GEL # 219

FINAL WEIGHT	[illegible] g	g	g
INITIAL WEIGHT	[illegible] g	g	g
NET WEIGHT	[illegible] g	g	g

TOTAL MOISTURE 22.4 g

EPA (Dur) 231
4/72

ANALYTICAL DATA

PLANT S.F.O. Grain Terminal Pier 90

DATE 1-11-73

SAMPLING LOCATION Tunnel Belt Outlet

SAMPLE TYPE Part.

RUN NUMBER 4

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 S-73-005-012-2 311.5 mg

FILTER NUMBER 000027

CONTAINER S-73-005-013-1 +0.70 mg

FRONT HALF SUBTOTAL ~~311.5~~ 312.2 mg

BACK HALF

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

CONTAINER S-73-005-014-3 0.2 mg

ETHER-CHLOROFORM EXTRACTION _____ mg

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

CONTAINER S-73-005-015-5 1.1 mg

BACK HALF SUBTOTAL 1.3 mg

TOTAL WEIGHT ~~312.8~~ 313.5 mg

MOISTURE

IMPINGERS

FINAL VOLUME 204 ml

INITIAL VOLUME 200 ml

NET VOLUME 4 ml

SILICA GEL # 288

FINAL WEIGHT	247.8 g	_____ g	_____ g
INITIAL WEIGHT	229.1 g	_____ g	_____ g
NET WEIGHT	18.7 g	_____ g	_____ g

TOTAL MOISTURE 18.7 g

EPA (Dur) 231
4/72

ANALYTICAL DATA

PLANT S.F.O. Bransi Terminal Pier 90

DATE 1-11-73

SAMPLING LOCATION Tunnel Belt Outlet

SAMPLE TYPE Prel.

RUN NUMBER 5

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 S-73-005-016-2 0.8 mg

FILTER NUMBER 000030

CONTAINER S-73-005-017-1 +0.20 mg

FRONT HALF SUBTOTAL ~~0.8~~ 1.0 mg

BACK HALF

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

CONTAINER S-73-005-018-3 2.7 mg

ETHER-CHLOROFORM EXTRACTION _____ mg

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

CONTAINER S-73-009-019-5 2.5 mg

BACK HALF SUBTOTAL 5.2 mg

TOTAL WEIGHT ~~6.0~~ 6.2 mg

MOISTURE

IMPINGERS

FINAL VOLUME	210 ml		
INITIAL VOLUME	200 ml		
NET VOLUME	10 ml		

SILICA GEL #230

FINAL WEIGHT	~~317.4~~ g	_____ g	_____ g
INITIAL WEIGHT	~~303.3~~ g	_____ g	_____ g
NET WEIGHT	~~14.1~~ 13.1 g	_____ g	_____ g

TOTAL MOISTURE 211.1 g

EPA (Dur) 231
4/72

APPENDIX F

FIELD TEST LOG

FIELD TEST LOG

January 4, 1973	Arrived San Francisco, California 11:00 pm EST
January 5, 1973	Met Mr. Farr at Grain Terminal Purchased materials to build stack and began construction of same
January 8, 1973	Purchased remainder of hardware Worked on stack construction - rain prevented its erection
January 9, 1973	Erected stack and prepared to test
January 10, 1973	Began testing - three tests conducted
January 11, 1973	Finished final two tests and shipped equipment back to Gainesville

APPENDIX G

PROJECT PARTICIPANTS

PROJECT PARTICIPANTS

Environmental Engineering, Inc.

Jack Riggenbach	Project Manager
Bob Durgan, Senior Technician	Environmental Specialist
Larry Wurts, Senior Technician	Environmental Specialist

Environmental Protection Agency

Thomas E. Ward	Project Test Officer
Ken Woodard	Project Engineer
Roy Neulicht	Engineer
Bob Vollaro	Engineer