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Reference ____

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FILE NO. C-4-029

REPORT ON TESTS OF EMISSIONS FROM ALMOND HULLERS IN THE SAN JOAQUIN VALLEY

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File No. C-4-029

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REPORT ON TESTS OF EMISSIONS FROM ALMOND HULLERS IN THE SAN JOAQUIN VALLEY

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Report on Tests of Emissions from Almond Hullers in the San Joaquin Valley

I. Introduction

In response to a request by letter of May 31, 1974 from the Stanislaus County Air Pollution Control District, the California Air Resources Board (ARB) conducted tests on emissions of particulate matter from nine almond hullers in the San Joaquin Valley during September and October, 1974. The Air Pollution Control Districts of San Joaquin, Stanislaus and Merced Counties each selected three representative hullers for the tests.

Particle size distribution, mass rate, and concentration of particulate matter in the emissions were determined. From these results the emission controls were evaluated.

II. Process and Almond Huller Description

A. Almond Harvest:

Almonds are removed from trees by either mechanically shaking the tree or by hitting each limb with a long pole called a "knocker". Although plastic or tarpaulin sheets are sometimes spread under the trees to catch the almonds, the common practice is to let the almonds fall directly onto the ground and sweep them into rows. About 25% of the material in the rows is orchard debris, such as leaves, grass, twigs, pebbles and some soil. Mechanical pickers collect the contents of the

rows and transfer them to special trailers for transport to the almond huller.

B. Almond Huller:

An almond huller has precleaning, in-process storage, hulling, separating and hulled-almond storage sections.

1. Precleaning Section:

The trailer from the orchards dumps the almonds into a receiving hopper or trench. A screw conveyor in the bottom of the hopper or trench conveys the almonds to a bucket elevator which lifts them to a set of vibrating screens. These vibrating screens remove most of the orchard debris which is conveyed by screw and belt conveyors to another area for future disposal. The unhulled almonds are then conveyed to a destoner unit which removes stones and similar material; the particulate trash from the destoner is air conveyed to either a cyclone or a baghouse for collection and disposal. The precleaned unhulled almonds discharged from the destoner are then conveyed by bucket elevators to an in-process storage bin.

2. Hulling Section:

The inlet of the huller receives the unhulled almonds via belt conveyors and bucket elevators from the in-process storage bin. The hulls of the unhulled almonds are cracked open by a sheer roll or by tines on a drum. The cracked

hulls and partially separated almonds are then discharged from the huller to a conveying system which delivers them to the separating section.

3. Separating Section:

The separating section may have one or more separating screens. The screen shakes the unshelled almonds loose from their hulls. The shelled almonds and small pieces of hulls drop through the screens. The large hulls are transferred to storage piles by a system of conveyors.

The hulled almonds and small pieces of hulls that pass through the screen are discharged to an air classifier that separates the hulled almonds from the remaining hulls. These hulls are conveyed to the hull storage pile and the hulled almonds are conveyed by bucket elevators and belt conveyors to a storage bin. Dust is usually aspirated from the sheer roll hullers, the air classifier and the separating screens and routed to a cyclone or baghouse for collection.

III. Description of Tests

Tests for particulate matter concentrations were conducted on 14 cyclones, one air leg and two baghouses. Samples were collected at the inlets and outlets of the 14 cyclones and at outlets of the baghouses for the determination of particle size distributions.

A. Particulate Matter:

Particulate matter concentrations were determined by Environmental Protection Agency (EPA) Method Number 5.

A "candy-cane", as shown in Figure 1, was attached to the vent of the cyclone being tested to straighten the flow. The candy-cane was fabricated from 22 gauge galvanized sheet steel. It had ten 3 feet diameter by 3 feet long sections, two 90° elbows and a 3 feet diameter to 4 feet diameter adapter. Each section and the elbows were tapered for slip-joint fits. Self-tapping sheet metal screws were used to stiffen each joint. The candy-cane was supported by three telescoping legs that were welded to the exit section.

The sampling probe was traversed across the candy cane through a port about five feet upstream from the exit.

B. Particle Size Mass Distribution:

Samples for particle size mass distributions were collected simultaneously at the outlet of the candy-cane and at the inlet to the cyclone with eight stage Andersen Impactors. The sampling rate was 1 CFM at the inlets and at the outlets. The sampling duration was 3 minutes at each inlet and 6 minutes at each outlet. (An Anderson impactor, as shown in Figure 2, separates the particulate matter into seven aerodynamic size ranges on seven stages. The mass of particulate matter collected on each stage is determined gravimetrically.)

IV. Discussion of Test Results

A. Particulate Matter Concentration:

Table 1 shows the concentrations and mass rates of particulate matter in emissions from the 14 cyclones, one air leg and two baghouses. Concentrations of particulate matter in emissions from eleven of the cyclones, the air leg and the two baghouses complied with local district rules (the concentration of 0.107 for Scott is within the

accuracy of the test method). Emissions from all of the cyclones, the air leg and both baghouses complied with the process weight rate rules of the districts.

Summaries of the test data are shown alphabetically, by the huller name, in Appendix I on Tables 1 through 9. The calculator printouts are also shown alphabetically, by huller name, in Appendix I on Tables 10 through 26.

B. Particle Size Mass Distribution:

Table 2 shows the particle size mass cumulative distribution for emissions from the vents of cyclones. It shows that most of the particles are larger than 4 microns in aerodynamic diameter. Table 3 shows the particle size mass frequency and cumulative frequency distributions per stage "out" of the cyclones and baghouses.

Figure 3 shows the average particle size mass frequency distribution polygon for the outlet of the cyclones.

The test data for the particle size mass distribution to the inlet of the cyclones was rejected. The concentrations of particulate matter were so high that the sampler stages overflowed and therefore the data are invalid.

V. Discussion of Control Equipment

A. Cyclones:

The test results show that cyclones are generally effective in the control of particulate matter in the emissions from almond hullers. Table 4 shows the dimensions of each cyclone tested. Table 5 shows the flow-

rates and particulate concentration in the emissions from the vents of the cyclones. The last column in Table 5 shows the value of the parameter $\frac{Q^2(L+C)}{R^4}$ where Q is the flow through the cyclone in acfm, C is the length of the cylinder of the cyclone in inches, L is the length of the cone in inches, and R is the radius of the cylinder in inches. Although there is not an exact relationship between this parameter and the concentration of particulate matter, a trend exists which indicates that high values of the parameter result in low values of concentration. If the value of the parameter is 8000 or greater, all of the concentrations are less than 0.1 grains/SDCF.

B. Baghouses:

The two baghouses that were tested reduced the concentrations of particulate matter in emissions from almond hullers to less than 0.001 grains per standard dry cubic foot.

VI. Fugitive Dust

Fugitive dust appeared to be the largest source of particulate matter emissions at each of the almond hullers that controlled emissions with cyclones. Opacities up to 100 percent were observed in the fugitive dust plumes from the bottom discharge of each cyclone. However, the dust usually settled a short distance downwind from the cyclones. Another source of fugitive dust was the receiving bin where the almonds are dumped. As each trailer load of almonds was dumped a cloud of dust arose. This dust also seemed to settle a short distance downwind. Fugitive dust also originates at the various storage piles of hulls, orchard debris, in-plant operations and from vehicles used in the hulling operations.

VII. Conclusions

1. Fugitive dust is the largest source of emissions from almond hullers.

2. Properly designed and operated cyclones can reduce emissions of particulate matter to levels that comply with district rules and regulations.
3. The higher the flowrates through a given cyclone, the lower will be the concentration of particulate matter in the emissions from the vent of the cyclone.
4. Baghouses are highly effective in the control of particulate matter from almond hullers.
5. For control of emissions of particulate matter from almond hullers by cyclones, the parameter $\frac{Q^2(L+C)}{R^4}$ should be not less than 8,000.

Where Q = flow through cyclone, acfm
L = Length of cone, inches
C = Length of cylinder, inches
R = Radius of cylinder, inches

This equation doesn't work on 1D-1D or 2D-2D

inlet velocity must be between 2700 & 3200

FIGURE 1

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"CANDY CANE"

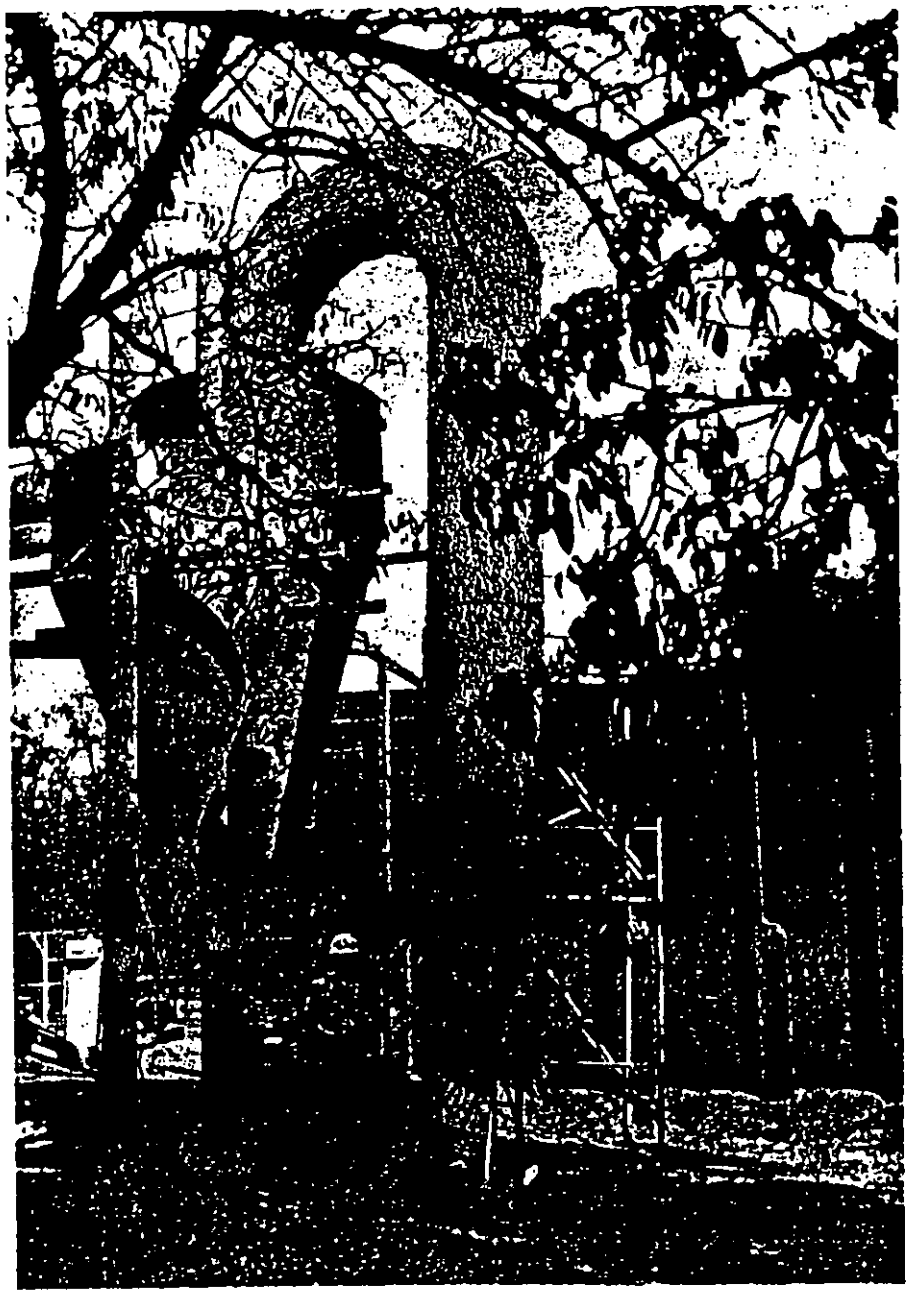

FIGURE 2

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ANDERSEN SAMPLER

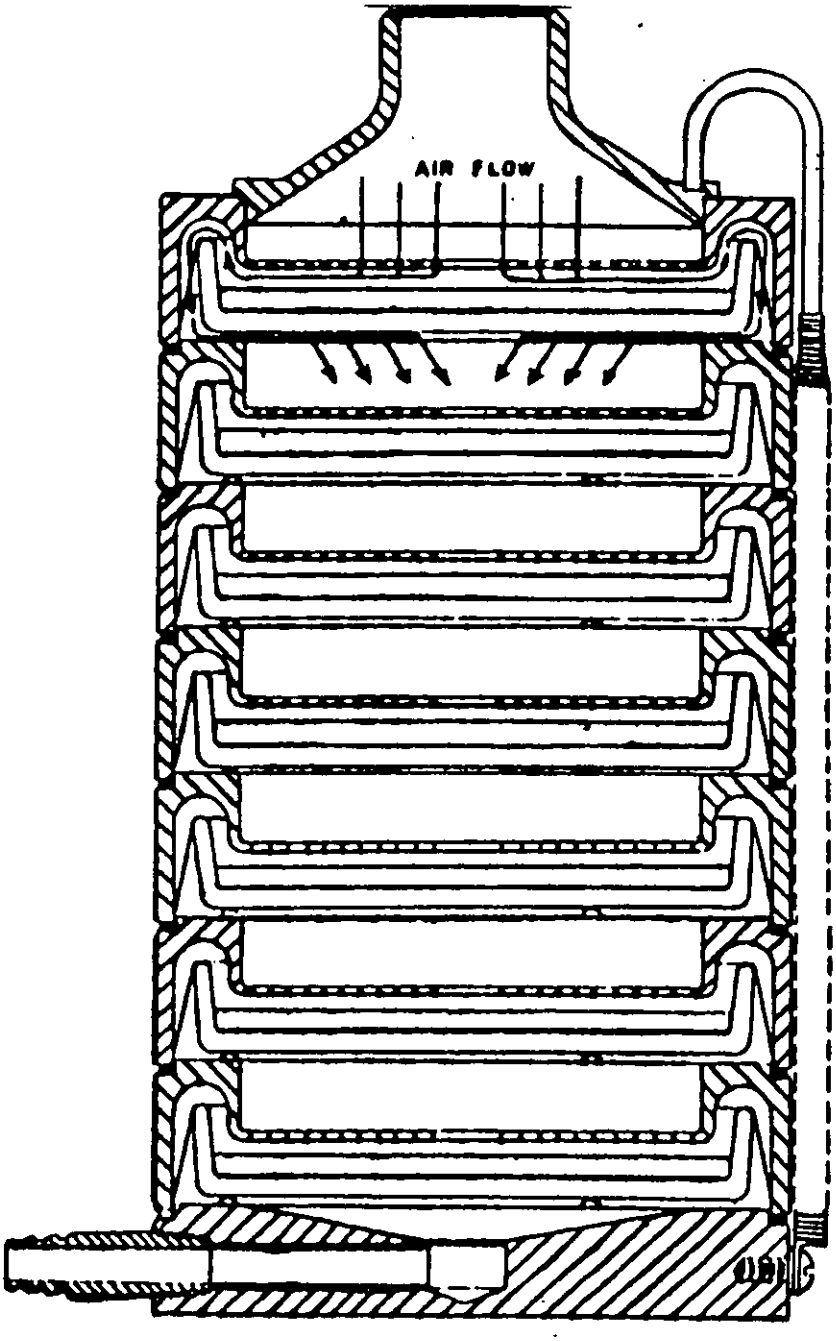

FIGURE 3

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AVERAGE PARTICULATE

SIZE MASS DISTRIBUTIONS

AT CYCLONE OUTLET

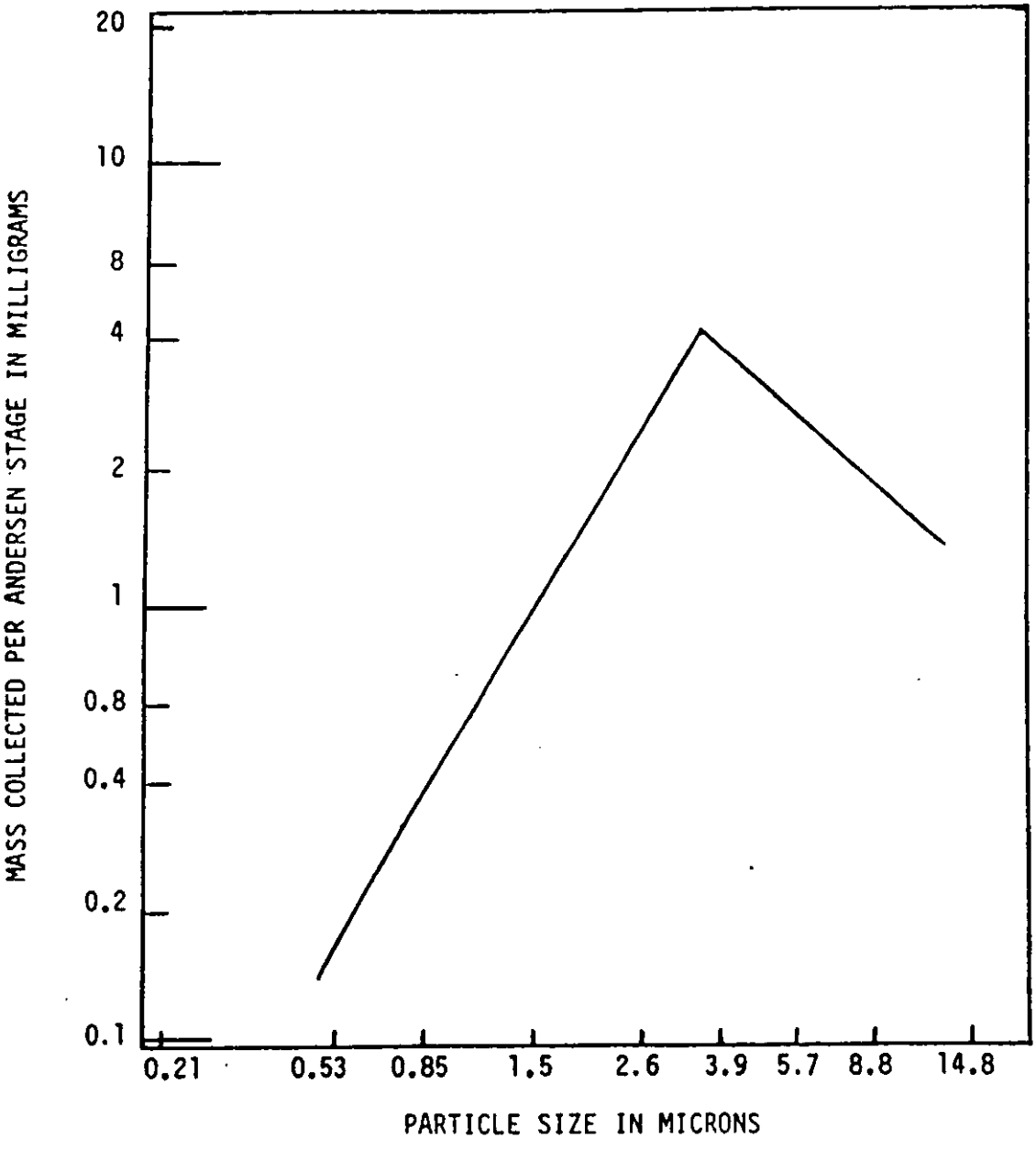

TABLE 1

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SUMMARY OF EMISSIONS

NAME AND LOCATION OF ALMOND HULLER	* CONTROL DEVICE	PATRICULATE CONC GRAINS/ SDCF	PROCESS WT. RATE		
			PROC. TONS/HR.	EMITTED LBS/HR.	ALLOWABLE LBS/HR.
BOGETTI SAN JOAQ. CO.	P	0.695	4.0	7.92	8.47
BOERSMA SAN JOAQ. CO.	P H,LA	0.021 0.150	10.0 8.0	2.31 11.14	14.96 13.03
DEGROOT SAN JOAQ. CO.	P H,LA	0.014 0.057	2.0 1.5	1.47 2.67	5.51 4.61
WINCHESTER STANISLAUS CO.	P H,LA AL	0.034 0.050 0.027	4.0 3.0 1.5	3.50 2.26 0.77	8.47 7.09 4.61
SCOTT STANISLAUS CO.	P	0.107	1.25	1.80	4.12
DUNLAP-BORMAN STANISLAUS CO.	P,LA H	0.066 0.164	4.0 3.0	7.13 3.89	8.47 7.09
N.M.H.A. MERCED CO.	P C,SD	0.027 0.022	12.0 9.0	4.21 3.60	16.76 14.01
ATWATER FRUIT EXC. MERCED CO.	P H	0.013 0.090	10.0 7.0	2.07 3.09	14.97 12.00
CORTEZ GROWERS MERCED CO.	B-P B-H	0.00014 0.00091	12.0 8.0	0.017 0.124	16.75 13.03

* P = PRECLEANER CYCLONE
H = HULLER
LA = LEAF ASPIRATOR
C = CLASSIFIER CYCLONE
SD = SCREEN DECKS CYCLONE
B-P= PRECLEANER BAGHOUSE
B-H= HULLER BAGHOUSE

TABLE 2

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PARTICLE SIZE CUMULATIVE MASS DISTRIBUTION
FROM VENTS OF CYCLONES OF ALMOND HULLERS

AERODYNAMIC PARTICLE SIZE IN MICRONS		LESS THAN 0.65	LESS THAN 1.1	LESS THAN 2.1	LESS THAN 3.3	LESS THAN 4.7	LESS THAN 7.0	LESS THAN 11	11 AND ABOVE
NAME OF ALMOND HULLER	*	WEIGHT OF PARTICULATE MATTER COLLECTED SMALLER THAN SIZE SHOWN (IN MILLIGRAMS)							
BOGETTI	P	0.31	1.68	10.87	34.71	73.27	107.24	133.92	162.15
BOERSMA	P	0.17	0.55	2.93	7.83	16.27	20.50	22.29	23.35
	H,LA	0.15	0.39	1.41	3.77	10.00	15.34	18.73	22.07
DEGROOT	P	0.18	0.34	0.72	1.37	2.29	2.83	3.15	3.47
	H,LA	-	0.44	2.35	6.19	13.92	18.90	22.21	25.02
DUNLAP	P-LA	0.14	0.37	1.23	3.89	9.86	14.67	17.42	18.54
	H	0.11	0.26	0.95	2.71	10.21	12.69	16.41	-
SCOTT	P	0.05	0.23	0.93	2.89	8.20	12.34	14.45	15.35
WINCHESTER	P	0.07	0.36	1.40	4.16	11.64	17.29	20.69	22.65
	H,LA	0.13	0.26	0.57	1.50	4.44	7.10	9.02	10.43
NO. MERCED HULL, ASSOC.	P	0.11	0.33	1.01	2.41	4.21	5.24	5.95	6.95
	C,SD	0.33	0.75	1.06	1.57	2.59	3.56	4.52	5.76
ATWATER FRUIT EXC.	P	0.19	0.44	1.07	2.07	3.09	3.65	4.11	4.81
	H	0.25	0.65	2.33	6.86	17.99	37.55	50.10	93.85

* See footnote at bottom of Table 1

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TABLE 3, PAGE 1 of 2

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PARTICLE SIZE MASS DISTRIBUTION SHOWN AS
PERCENT PER STAGE AND CUMULATIVE PERCENT PER STAGE

NAME OF HULLER	*	**	STAGE NO. OF ANDERSON SAMPLER							
			7	6	5	4	3	2	1	0
			AERODYNAMIC PARTICLE SIZE IN MICRONS							
			<0.65	<1.1	<2.1	<3.3	<4.7	<7.0	<11	>11
BOGETTI	P	B	0.1	0.8	5.6	14.7	23.7	20.9	16.4	17.4
	P	D	0.1	1.0	6.8	21.4	45.1	66.1	82.5	100
BOERSMA	P	B	0.07	1.6	10.2	21.0	36.1	18.1	7.7	4.5
	P	D	0.7	2.3	12.5	33.5	69.6	87.7	95.4	100
	H	B	0.7	1.1	4.6	10.7	28.2	24.2	15.4	15.1
	H	D	0.6	1.7	6.3	17.0	45.3	69.5	84.8	100
DEGROOT	P	B	5.2	4.6	11.0	18.7	26.5	15.6	9.2	9.2
	P	D	5.1	9.7	20.7	39.4	65.9	81.5	90.7	100
	H	B	-	1.8	7.6	15.3	30.8	19.9	13.2	11.2
	H	D	-	1.7	9.3	24.7	55.6	75.5	88.7	100
SCOTT	P	B	0.32	1.17	4.6	12.8	34.6	27.0	13.7	5.9
	P	D	0.32	1.50	6.06	18.83	53.42	80.4	94.1	100
WINCHESTER	P	B	0.3	1.3	4.6	12.2	33.0	24.9	15.0	8.7
	P	D	0.3	1.6	6.2	18.4	51.4	76.3	91.3	100
	H	B	1.2	1.2	3.0	8.4	28.2	25.5	18.4	13.5
	H	D	1.2	2.5	5.5	14.4	42.6	68.1	86.5	100
DUNLAP	P	B	0.79	1.3	4.9	15.0	33.7	27.2	15.5	6.3
	P	D	0.79	2.03	6.5	21.2	53.7	79.1	93.8	100
N.M.H.A.	P	B	1.6	3.2	9.8	20.1	25.9	14.8	10.2	14.4
	P	D	1.6	4.7	14.5	34.7	60.6	75.4	85.6	100
	SD	B	5.7	7.3	5.4	8.9	17.7	16.8	16.7	21.5
	SD	D	5.7	13.0	18.4	27.3	45.0	61.8	78.5	100
ATWATER	P	B	4.0	5.2	13.1	20.8	21.2	11.6	9.6	14.6
	P	D	4.0	9.1	22.2	43.0	64.2	75.9	85.4	100
	H	B	0.27	0.43	1.79	4.83	11.86	20.84	13.37	46.64
	H	D	0.27	0.69	2.48	7.31	19.17	40.01	53.38	100
							51.66			

*,P = Precleaner
H = Huller
SD = Screen decks and classifier

**,B = % of mass collected per stage at outlet of cyclone.
D = Cumulative % of mass collected per stage at outlet of cyclone.

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TABLE 3, PAGE 2 OF 2

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PARTICLE SIZE MASS DISTRIBUTION SHOWN AS
PERCENT PER STAGE AND CUMULATIVE PERCENT PER STAGE

NAME OF HULLER	•	**	STAGE NO. OF ANDERSON SAMPLER							
			7	6	5	4	3	2	1	0
			AERODYNAMIC PARTICLE SIZE IN MICRONS							
			<0.65	<1.1	<2.1	<3.3	<4.7	<7.0	<11	>11
CORTEZ (BAGHOUSES)	P	B	26.4	8.6	10.9	11.5	10.3	13.2	7.5	11.5
	P	D	26.4	35.1	46.0	57.5	67.8	81.0	88.5	100
	H	B	13.5	11.5	12.2	12.8	7.7	13.5	14.1	14.7
	H	D	13.5	25.0	37.2	50.0	57.7	71.2	85.3	100

*See footnote at the bottom of page 1, Table 3
**See footnote at the bottom of page 1, Table 3

TABLE 4

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DIMENSIONS OF CYCLONES, IN INCHES

NAME OF ALMOND HULLER	*	DIAMETERS			LENGTHS		
		CYLIN-DER	DIS-CHARGE	VENT	CYLIN-DER	CONE	VENT
BOGETTI	P	64	10	30	31	86	36
BOERSMA		90	12	42	59	120	48
	H, LA	72	10	36	40	96	36
DEGROOT	P	48	14	24	96	96	36
	H, LA	44	14	22	90	96	26
WINCHESTER	P	84	-	42	48	120	-
	H, LA	60	-	26	36	108	-
SCOTT	P	40	-	15	27	73	-
DUNLAP	P, LA	84	-	42	48	108	-
	H	60	-	24	36	72	-
N.M.H.A.	P	88	12	32	48	82	36
	SD, C	88	12	32	48	82	36
ATWATER	P	96	10	42	48	132	72
	H	52	8	17	36	48	6

*See Table 1

TABLE 5

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CYCLONE SELECTION CRITERION

NAME OF ALMOND HULLER	FUNCTION	FLOWRATE ACFM*	CONC. GR./SDCF	$\frac{Q^2(L+C)}{R^4}$ **
BOGETTI	PRECLEANER	1,508	0.695	254
BOERSMA	PRECLEANER	14,185	0.021	8,784
	HULLER & LEAF ASPIRATOR	9,120	0.150	6,734
DEGROOT	PRECLEANER	13,425	0.014	104,300
	HULLER & LEAF ASPIRATOR	6,025	0.057	28,823
WINCHESTER	PRECLEANER	12,430	0.034	8,342
	HULLER & LEAF ASPIRATOR	5,941	0.050	6,275
SCOTT	PRECLEANER	2,056	0.107	2,641
DUNLAP - BORMAN	PRECLEANER	13,122	0.066	8,632
	HULLER	2,951	0.161	1,161
NO. MERCED HULL. ASSOC.	PRECLEANER	20,701	0.027	14,863
	SCREEN DECKS & CLASSIFIER	20,065	0.022	13,964
ATWATER FRUIT EXC.	PRECLEANER	20,353	0.013	14,046
	HULLER	4,533	0.088	3,777

* = ACTUAL CUBIC FEET PER MINUTE

**,Q=FLOWRATE IN ACFM
L=LENGTH OF CONE, IN INCHES
C=LENGTH OF CYLINDER, IN INCHES
R=RADIUS OF CYLINDER, IN INCHES

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DIVISION OF IMPLEMENTATION AND ENFORCEMENT

ENGINEERING EVALUATION UNIT

FILE NO. C-4-029

REPORT ON TESTS OF EMISSIONS FROM ALMOND HULLERS IN THE SAN JOAQUIN VALLEY

APPENDIX I

SUMMARY OF TEST DATA
SOURCE TEST PROGRAM PRINT OUT

State of California

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Division of Implementation and Enforcement

Engineering Evaluation Unit

TABLE 1
File No. C-4-029

SUMMARY OF TEST DATA

Sampling Station: Atwater Fruit Exchange Almond Huller, Merced County

Material Collected: Particulate Matter

	Precleaner Cyclone	Huller Cyclone	
1. P_{bar}, Barometric Pressure, in. Hg	30.16	30.16	
2. Δh_{avg}, Average Orifice Pressure, in. H_2O	1.22	1.06	
3. V_m, Sample Gas Volume (Meter Cond.), cu. ft.	39.79	31.33	
4. T_m, Average Meter Temperature, °F	90	98	
5. V_{wc}, Condensed Water Vapor, ml.	0.0	0.0	
6. T_i, Average Impinger Temperature, °F	90	98	
7. T_s, Average Stack Temperature, °F	90	98	
8. Stack Gas Analysis (Dry Basis)			
% CO_2	0.3	0.3	
% O_2	21.0	21.0	
% CO	0.0	0.0	
9. $(\sqrt{\Delta P})$ Average (in. H_2O)$^{\frac{1}{2}}$	0.82	0.81	
10. D_s, Stack Diameter, in.	36	17	
11. Θ_m, Sampling Time, min.	70	60	
12. D_n, Sampling Nozzle Diameter, in.	0.187	0.187	
13. M_n, Sample Weight Collected, mg.			
Probe Rinse A.	8.9	72.1	
Filter Catch B.	23.4	100.9	
C.			
D.			
Total Weight, mg	32.3	173.0	
14. C_p, Pitot Tube Coefficient	0.855	0.855	
15. P_s, Stack Pressure (absolute) in. Hg	30.16	30.16	
16. T_a, Ambient Temperature, °F	98	98	

17. Additional Data _____

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Engineering Evaluation Unit

TABLE 2
File No. C-4-(99)

SUMMARY OF TEST DATA

Sampling Station: Boersma Almond Huller, San Joaquin County

Material Collected: Particulate Matter

	Huller-LA Cyclone	Precleaner Cyclone	
1. P_{bar}, Barometric Pressure, in. Hg	30.25	30.14	
2. Δh_{avg}, Average Orifice Pressure, in. H_2O	0.73	1.76	
3. V_m, Sample Gas Volume (Meter Cond.), cu. ft.	30.61	43.63	
4. T_m, Average Meter Temperature, °F	77	88	
5. V_{wc}, Condensed Water Vapor, ml.	0.0	0.0	
6. T_i, Average Impinger Temperature, °F	77	88	
7. T_s, Average Stack Temperature, °F	77	88	
8. Stack Gas Analysis (Dry Basis)			
% CO_2	0.3	0.3	
% O_2	21.0	21.0	
% CO	0.0	0.0	
9. $(\sqrt{\Delta P})$ Average (in. $H_2O)^{\frac{1}{2}}$	0.37	0.37	
10. D_t, Stack Diameter, in.	36	36	
11. Θ_m, Sampling Time, min.	64	64	
12. D_n, Sampling Nozzle Diameter, in.	0.25	0.25	
13. M_n, Sample Weight Collected, mg.			
Probe Rinse A.	129.2	26.2	
Filter Catch B.	163.6	30.4	
C.			
D.			
Total Weight, mg	292.8	56.6	
14. C_p, Pitot Tube Coefficient	0.855	0.855	
15. P_s, Stack Pressure (absolute) in. Hg	30.25	30.25	
16. T_a, Ambient Temperature, °F	77	88	

17. Additional Data _____

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TABLE 3
File No. C-4-029

Division of Implementation and Enforcement

Engineering Evaluation Unit

SUMMARY OF TEST DATA

Sampling Station: Bogetti Almond Huller, San Joaquin County

Material Collected: Particulate Matter

		Precleaner		
1. P_{bar}, Barometric Pressure, in. Hg		29.86		
2. Δh_{avg}, Average Orifice Pressure, in. H_2O		1.20		
3. V_m, Sample Gas Volume (Meter Cond.), cu. ft.		41.04		
4. T_m, Average Meter Temperature, °F		95		
5. V_{wc}, Condensed Water Vapor, ml.		0.0		
6. T_i, Average Impinger Temperature, °F		95		
7. T_s, Average Stack Temperature, °F		95		
8. Stack Gas Analysis (Dry Basis)	% CO_2	0.3		
	% O_2	21.0		
	% CO	0.0		
9. $(\sqrt{\Delta P})$ Average (in. H_2O)$^{1/2}$		0.06		
10. D_s, Stack Diameter, in.		36		
11. θ_m, Sampling Time, min.		80		
12. D_n, Sampling Nozzle Diameter, in.		0.75		
13. M_n, Sample Weight Collected, mg.	Probe Rinse A.	497.0		
	Filter Catch B.	1237.8		
	C.			
	D.			
	Total Weight, mg	1734.8		
14. C_p, Pitot Tube Coefficient		0.855		
15. P_s, Stack Pressure (absolute) in. Hg		29.86		
16. T_a, Ambient Temperature, °F		95		

17. Additional Data _____

State of California

AIR RESOURCES BOARD

Division of Implementation and Enforcement

Engineering Evaluation Unit

TABLE 4

File No. C-4-029

SUMMARY OF TEST DATA

Sampling Station: Cortez Growers Assoc. Almond Huller, Merced County

Material Collected: Particulate Matter

		Precleaner Baghouse	Huller Baghouse	
1.	P_{bar}, Barometric Pressure, in. Hg	30.14	30.14	
2.	Δh_{avg}, Average Orifice Pressure, in. H_2O	2.48	2.44	
3.	V_m, Sample Gas Volume (Meter Cond.), cu. ft.	67.80	54.41	
4.	T_m, Average Meter Temperature, °F	90	84	
5.	V_{wc}, Condensed Water Vapor, ml.	0.0	0.0	
6.	T_i, Average Impinger Temperature, °F	90	84	
7.	T_s, Average Stack Temperature, °F	90	84	
8.	Stack Gas Analysis (Dry Basis)			
	% CO_2	0.3	0.3	
	% O_2	21.0	21.0	
	% CO	0.0	0.0	
9.	$(\sqrt{\Delta P})$ Average (in. $H_2O)^{\frac{1}{2}}$	0.74	1.35	
10.	D_s, Stack Diameter, in.	33	26	
11.	θ_m, Sampling Time, min.	80	64	
12.	D_n, Sampling Nozzle Diameter, in.	0.25	0.187	
13.	M_n, Sample Weight Collected, mg.			
	Probe Rinse A.	0.8	1.0	
	Filter Catch B.	-0.2	2.1	
	C.			
	D.			
	Total Weight, mg	0.6	3.1	
14.	C_p, Pitot Tube Coefficient	0.855	0.855	
15.	P_s, Stack Pressure (absolute) in. Hg	30.14	30.14	
16.	T_a, Ambient Temperature, °F	84	84	

17. Additional Data _____

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TABLE 5
File No. C-4-029

SUMMARY OF TEST DATA

Sampling Station: Degroot Almond Huller, San Joaquin County

Material Collected: Particulate Matter

	Precleaner Cyclone	Huller-LA Cyclone	
1. P_{bar}, Barometric Pressure, in. Hg	30.10	30.09	
2. Δh_{avg}, Average Orifice Pressure, in. H_2O	4.07	3.63	
3. V_m, Sample Gas Volume (Meter Cond.), cu. ft.	38.60	41.50	
4. T_m, Average Meter Temperature, °F	91	90	
5. V_{wc}, Condensed Water Vapor, ml.	0.0	0.0	
6. T_i, Average Impinger Temperature, °F	91	90	
7. T_s, Average Stack Temperature, °F	91	90	
8. Stack Gas Analysis (Dry Basis)			
% CO_2	0.3	0.3	
% O_2	21.0	21.0	
% CO	0.0	0.0	
9. $(\sqrt{\Delta P})$ Average (in. H_2O)$^{1/2}$	0.54	0.24	
10. D_s, Stack Diameter, in.	36	36	
11. θ_n, Sampling Time, min.	40	40	
12. D_n, Sampling Nozzle Diameter, in.	0.375	0.50	
13. M_n, Sample Weight Collected, mg.			
Probe Rinse A.	15.3	54.2	
Filter Catch B.	18.6	93.5	
C.			
D.			
Total Weight, mg	33.9	147.7	
14. C_p, Pitot Tube Coefficient	0.855	0.855	
15. P_s, Stack Pressure (absolute) in. Hg	30.10	30.09	
16. T_a, Ambient Temperature, °F	91	90	

17. Additional Data _____

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Engineering Evaluation Unit

TABLE 6
File No. C-4-029

SUMMARY OF TEST DATA

Sampling Station: Dunlap-Borman Almond Huller, Stanislaus County

Material Collected: Particulate Matter

	Precleaner LA-Cyclone	Huller Cyclone	
1. P_{bar}, Barometric Pressure, in. Hg	30.05	30.07	
2. Δh_{avg}, Average Orifice Pressure, in. H_2O	1.25	1.09	
3. V_m, Sample Gas Volume (Meter Cond.), cu. ft.	38.35	35.86	
4. T_m, Average Meter Temperature, °F	74	80	
5. V_{wc}, Condensed Water Vapor, ml.	0.0	0.0	
6. T_i, Average Impinger Temperature, °F	74	80	
7. T_s, Average Stack Temperature, °F	74	80	
8. Stack Gas Analysis (Dry Basis) % CO_2	0.3	0.3	
% O_2	21.0	21.0	
% CO	0.0	0.0	
9. $(\sqrt{\Delta P})$ Average (in. $H_2O)^{1/2}$	0.54	0.12	
10. D_s, Stack Diameter, in.	36	36	
11. θ_m, Sampling Time, min.	64	64	
12. D_n, Sampling Nozzle Diameter, in.	0.25	0.50	
13. M_n, Sample Weight Collected, mg. A. Probe Rinse	71.0	108.8	
B. Filter Catch	91.8	263.0	
C.			
D.			
Total Weight, mg	162.8	371.8	
14. C_p, Pitot Tube Coefficient	0.855	0.855	
15. P_s, Stack Pressure (absolute) in. Hg	30.05	30.07	
16. T_a, Ambient Temperature, °F	80	80	

17. Additional Data _____

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TABLE 7

File No. C-4-029

SUMMARY OF TEST DATA

Sampling Station: No. Merced Hulling Assoc., Merced County

Material Collected: Particulate Matter

	Precleaner Cyclone	Class-S.D. Cyclone	
1. P_{bar}, Barometric Pressure, in. Hg	30.12	30.21	
2. Δh_{avg}, Average Orifice Pressure, in. H_2O	1.17	1.01	
3. V_m, Sample Gas Volume (Meter Cond.), cu. ft.	49.38	34.37	
4. T_m, Average Meter Temperature, °F	99	82	
5. V_{wc}, Condensed Water Vapor, ml.	0.0	0.0	
6. T_i, Average Impinger Temperature, °F	99	82	
7. T_s, Average Stack Temperature, °F	99	82	
8. Stack Gas Analysis (Dry Basis)			
% CO_2	0.3	0.3	
% O_2	21.0	21.0	
% CO	0.0	0.0	
9. $(\sqrt{\Delta P})$ Average (in. $H_2O)^{1/2}$	0.82	0.82	
10. D_s, Stack Diameter, in.	36	36	
11. θ_m, Sampling Time, min.	64	64	
12. D_n, Sampling Nozzle Diameter, in.	0.187	0.187	
13. M_n, Sample Weight Collected, mg.			
Probe Rinse A.	31.3	24.4	
Filter Catch B.	50.2	24.2	
C.			
D.			
Total Weight, mg	81.5	48.6	
14. C_p, Pitot Tube Coefficient	0.855	0.855	
15. P_s, Stack Pressure (absolute) in. Hg	30.12	30.21	
16. T_a, Ambient Temperature, °F	99	82	

17. Additional Data _____

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TABLE 8
File No. C-4-020

SUMMARY OF TEST DATA

Sampling Station: Scott Almond Huller, Stanislaus County

Material Collected: Particulate Matter

	Precleaner Cyclone		
1. P_{bar}, Barometric Pressure, in. Hg	30.08		
2. Δh_{avg}, Average Orifice Pressure, in. H_2O	0.87		
3. V_m, Sample Gas Volume (Meter Cond.), cu. ft.	46.90		
4. T_m, Average Meter Temperature, °F	75		
5. V_{wc}, Condensed Water Vapor, ml.	0.0		
6. T_i, Average Impinger Temperature, °F	75		
7. T_s, Average Stack Temperature, °F	75		
8. Stack Gas Analysis (Dry Basis)			
% CO_2	0.3		
% O_2	21.0		
% CO	0.0		
9. $(\sqrt{\Delta P})$ Average (in. H_2O)$^{1/2}$	0.48		
10. D_s, Stack Diameter, in.	15		
11. θ_m, Sampling Time, min.	80		
12. D_n, Sampling Nozzle Diameter, in.	0.25		
13. M_n, Sample Weight Collected, mg.			
Probe Rinse A.	113.4		
Filter Catch B.	207.1		
C.			
D.			
Total Weight, mg	320.5		
14. C_p, Pitot Tube Coefficient	0.855		
15. P_s, Stack Pressure (absolute) in. Hg	30.08		
16. T_a, Ambient Temperature, °F	75		

17. Additional Data _____

State of California

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TABLE 9

File No. C-4-029

SUMMARY OF TEST DATA

Sampling Station: Winchester Almond Huller, Stanislaus County

Material Collected: Particulate Matter

	Precleaner Cyclone	Huller-LA Cyclone	North Air Leg
1. P_{bar}, Barometric Pressure, in. Hg	30.00	30.01	29.99
2. Δh_{avg}, Average Orifice Pressure, in. H_2O	1.51	4.61	2.92
3. V_m, Sample Gas Volume (Meter Cond.), cu. ft.	44.30	65.80	65.00
4. T_m, Average Meter Temperature, °F	67	95	89
5. V_{wc}, Condensed Water Vapor, ml.	0.0	0.0	0.0
6. T_i, Average Impinger Temperature, °F	67	95	89
7. T_s, Average Stack Temperature, °F	67	95	89
8. Stack Gas Analysis (Dry Basis)			
% CO_2	0.3	0.3	0.3
% O_2	21.0	21.0	21.0
% CO	0.0	0.0	0.0
9. $(\sqrt{\Delta P})$ Average (in. $H_2O)^{\frac{1}{2}}$	0.51	0.24	0.21
10. D_s, Stack Diameter, in.	36	36	30
11. θ_m, Sampling Time, min.	80	64	64
12. D_n, Sampling Nozzle Diameter, in.	0.25	0.50	0.50
13. M_n, Sample Weight Collected, mg.			
Probe Rinse A.	47.7	78.8	18.5
Filter Catch B.	49.2	124.0	89.2
C.			
D.			
Total Weight, mg	96.9	202.8	107.7
14. C_p, Pitot Tube Coefficient	0.855	0.855	0.855
15. P_s, Stack Pressure (absolute) in. Hg	30.00	30.01	29.99
16. T_a, Ambient Temperature, °F	67	95	89

17. Additional Data _____

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Division of Implementation and Enforcement
Engineering Evaluation Unit
Program 002 Print Out
(Particulate Source Test)

TABLE 10
File No. C-4-029

Atwater Fruit Exchange
Precleaner
Cyclone

1.		
30.160		P_{bar} = Barometric pressure (in. Hg)
1.220		Δh = Pressure drop across orifice (in. H_2O)
39.790		V_m = Volume of gas sample (cu. ft.)
90.000		T_m = Meter temperature (°F)
0.000		V_l = Volume of condensate collected (ml)
90.000		T_l = Impinger temperature (°F)
90.000		T_s = Stack temperature (°F)
-4.716	S	S or $\hat{S}$ = % H_2O ($\hat{S}$-oversat. S-undersat.)
2.		
0.300		% CO_2
21.000		% O_2
0.000		% CO
-28.374	M	M_s = Molecular weight
3.		
0.819		$(\sqrt{\Delta P})_{Av}$ = (in. H_2O)$^{1/2}$
36.000		D_s = Stack diameter (in.)
-47.989	J	V_s = Velocity (fps)
-18,483.912	F	Q_s = Flow rate, dry basis (SDCFM)
4.		
70.000		θ = Total sampling time (min.)
0.187		D_n = Nozzle diameter (in.)
-108.940	I	I = % Isokinetic
5.		
32.300		M_n = Particulate matter collected (mg)
-0.0130	G	C' = Particulate concentration, dry basis (gr/SDCF
-2.071	P	W_m = Particulate emission rate (lb/hr.)
6.		
38.034	2	$V_{m(std.)}$ = Std. volume of dry gas metered (cu. ft.)
-0.002	3	$V_{w(std.)}$ = Std. volume of water vapor collected (cu. ft.
1.428	4	V.P. = Vapor pressure (in. Hg)
1.885	5	$V_{wv(std.)}$ = Std. volume of water vapor metered (cu. ft.)
4.723	S	S = % H_2O (includes free water)
6.		

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AIR RESOURCES BOARD

TABLE 11

Division of Implementation and Enforcement

File No. C-4-029

Engineering Evaluation Unit

Program 002 Print Out
(Particulate Source Test)

Atwater Fruit Exchange
Huller
Cyclone

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1.

30.100		P_{bar} = Barometric pressure (in. Hg)
1.060		Δh = Pressure drop across orifice (in. H_2O)
31.330		V_m = Volume of gas sample (cu. ft.)
98.000		T_m = Meter temperature (°F)
0.000		V_c = Volume of condensate collected (ml)
98.000		T_i = Impinger temperature (°F)
98.000		T_s = Stack temperature (°F)
-6.055	S	S or $\hat{S}$ = % H_2O ($\hat{S}$-oversat. S-undersat.)

2.

0.300		% CO_2
21.000		% O_2
0.000		% CO
-28.228	M	M_s = Molecular weight

3.

0.810		$(\sqrt{\Delta P})_{av}$ = $(\text{in. } H_2O)^{1/2}$
17.000		D_s = Stack diameter (in.)
-47.929	V	V_s = Velocity (fps)
-4,000.610	F	Q_s = Flow rate, dry basis (SDCFM)

4.

60.000		θ = Total sampling time (min.)
0.187		D_n = Nozzle diameter (in.)
-101.588	I	I = % Isokinetic

5.

173.000		M_n = Particulate matter collected (mg)
-0.0902	G	C' = Particulate concentration, dry basis (gr/SDC
-3.096	P	W_m = Particulate emission rate (lb/hr.)

6.

29.507		2	$V_{m_{std.}}$ = Std. volume of dry gas metered (cu. ft.)
-0.004		3	$V_{w_{std.}}$ = Std. volume of water vapor collected (cu. ft
1.835		4	V.P. = Vapor pressure (in. Hg)
1.906		5	$V_{w_{std.}}$ = Std. volume of water vapor metered (cu. ft.)
6.069	S		S = % H_2O (includes free water)

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AIR RESOURCES BOARD
Division of Implementation and Enforcement
Engineering Evaluation Unit
Program 002 Print Out
(Particulate Source Test)

TABLE 12
File No. C-4-029

Boersma
Precleaner
Cyclone

. . . . . .

1.

30.140		P_{bar} = Barometric pressure (in. Hg)
1.760		Δh = Pressure drop across orifice (in. H_2O)
43.630		V_m = Volume of gas sample (cu. ft.)
88.000		T_m = Meter temperature (°F)
0.000		V_c = Volume of condensate collected (ml)
88.000		T_i = Impinger temperature (°F)
88.000		T_s = Stack temperature (°F)
-4.426	S	S or $\hat{S}$ = % H_2O ($\hat{S}$-oversat. S-undersat.)

2.

0.300		% CO_2
21.000		% O_2
0.000		% CO
-28.406	M	M_s = Molecular weight

3.

0.572		$(\sqrt{\Delta P})_{Av}$ = $(\text{in. } H_2O)^{1/2}$
36.000		D_s = Stack diameter (in.)
-33.447	f	V_s = Velocity (fps)
-12,960.819	F	Q_s = Flow rate, dry basis (SDCFM)

4.

64.000		θ = Total sampling time (min.)
0.250		D_n = Nozzle diameter (in.)
-104.700	I	I = % Isokinetic

5.

56.600		M_n = Particulate matter collected (mg)
-0.0208	G	C' = Particulate concentration, dry basis (gr/SDCF
-2.311	P	W_m = Particulate emission rate (lb/hr.)

6.

41.884	2	$V_{m_{STD}}$ = Std. volume of dry gas metered (cu. ft.)
-0.001	3	$V_{w_{STD}}$ = Std. volume of water vapor collected (cu. ft.
1.340	4	V.P. = Vapor pressure (in. Hg)
1.941	5	$V_{mw_{STD}}$ = Std. volume of water vapor metered (cu. ft.)
4.429	S	S = % H_2O (includes free water)

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Division of Implementation and Enforcement

Engineering Evaluation Unit

Program 002 Print Out
(Particulate Source Test)

TABLE 13

File No. C-4-029

Boersma
Huller and
Leaf Aspirator
Cyclone

1.		
30.250		P_{bar} = Barometric pressure (in. Hg)
0.730		Δh = Pressure drop across orifice (in. H_2O)
30.610		V_m = Volume of gas sample (cu. ft.)
77.300		T_m = Meter temperature (°F)
0.000		V_c = Volume of condensate collected (ml)
77.300		T_i = Impinger temperature (°F)
77.300		T_s = Stack temperature (°F)
-3.121	S	S or $\hat{S}$ = % H_2O ($\hat{S}$-oversat. S-undersat.)
2.		
0.300		% CO_2
21.000		% O_2
0.000		% CO
-28.548	M	M_s = Molecular weight
3.		
0.373		$(\sqrt{\Delta P})_{Av}$ = $(\text{in. } H_2O)^{1/2}$
36.000		D_s = Stack diameter (in.)
-21.504	J	V_s = Velocity (fps)
-8,646.187	F	Q_s = Flow rate, dry basis (SDCFM)
4.		
64.000		θ = Total sampling time (min.)
0.250		D_n = Nozzle diameter (in.)
-112.432	I	I = % Isokinetic
5.		
292.800		M_n = Particulate matter collected (mg)
-0.1502	G	C' = Particulate concentration, dry basis (gr/SDCF
-11.137	P	W_m = Purticulate emission rate (lb/hr.)
6.		
30.004	2	$V_{m_{std}}$ = Std. volume of dry gas metered (cu. ft.)
0.000	3	$V_{w_{std}}$ = Std. volume of water vapor collected (cu. ft.
0.945	4	V.P. = Vapor pressure (in. Hg)
0.966	5	$V_{w_{met}}$ = Std. volume of water vapor metered (cu. ft.)
3.121	S	S = % H_2O (includes free water)

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Program 002 Print Out
(Particulate Source Test)

TABLE 14
File No. C-4-029

Bogetti
Precleaner
Cyclone

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1.

29.860		P_{bar} = Barometric pressure (in. Hg)
1.200		Δh = Pressure drop across orifice (in. H_2O)
41.040		V_m = Volume of gas sample (cu. ft.)
95.400		T_m = Meter temperature (°F)
0.000		V_c = Volume of condensate collected (ml)
95.400		T_i = Impinger temperature (°F)
95.400		T_s = Stack temperature (°F)
-5.587	S	S or $\hat{S}$ = % H_2O ($\hat{S}$-oversat. S-undersat.)

2.

0.300		% CO_2
21.000		% O_2
0.000		% CO
-28.279	M	M_s = Molecular weight

3.

0.060		$(\sqrt{\Delta P})_{Av}$ = (in. $H_2O)^{1/2}$
36.000		D_s = Stack diameter (in.)
-3.556	f	V_s = Velocity (fps)
-1,330.788	F	Q_s = Flow rate, dry basis (SDCFM)

4.

80.000		θ = Total sampling time (min.)
0.750		D_n = Nozzle diameter (in.)
-83.230	I	I = % Isokinetic

5.

1,734.800		M_n = Particulate matter collected (mg)
-0.6946	G	C' = Particulate concentration, dry basis (gr/SDCF)
-7.923	P	W_m = Particulate emission rate (lb/hr.)

6.

38.461	2	$V_{m_{STD}}$ = Std. volume of dry gas metered (cu. ft.)
-0.028	3	$V_{w_{STD}}$ = Std. volume of water vapor collected (cu. ft.)
1.693	4	V.P. = Vapor pressure (in. Hg)
2.304	5	$V_{wv_{STD}}$ = Std. volume of water vapor metered (cu. ft.)
5.653	S	S = % H_2O (includes free water)

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Program 002 Print Out
(Particulate Source Test)

TABLE 15
File No. C-4-029

Cortez Growers Assoc.
Precleaner
Baghouse

1.		
30.140		P_{bar} = Barometric pressure (in. Hg)
2.480		Δh = Pressure drop across orifice (in. H_2O)
67.800		V_m = Volume of gas sample (cu. ft.)
90.000		T_m = Meter temperature (°F)
0.000		V_c = Volume of condensate collected (ml)
90.000		T_i = Impinger temperature (°F)
90.000		T_s = Stack temperature (°F)
-4.712	S	S or $\bar{S}$ = % H_2O ($\bar{S}$-oversat. S-undersat.)
2.		
0.300		% CO_2
21.000		% O_2
0.000		% CO
-28.374	M	M_s = Molecular weight
3.		
0.740		$(\sqrt{\Delta P})_{av}$ = (in. H_2O)$^{1/2}$
33.000		D_s = Stack diameter (in.)
-43.374	f	V_s = Velocity (fps)
-14,029.319	F	Q_s = Flow rate, dry basis (SDCFM)
4.		
80.000		θ = Total sampling time (min.)
0.250		D_n = Nozzle diameter (in.)
-100.850	I	I = % Isokinetic
5.		
0.600		M_n = Particulate matter collected (mg)
-0.0001	G	C' = Particulate concentration, dry basis (gr/SDCF
-0.017	P	W_m = Particulate emission rate (lb/hr.)
6.		
64.965	2	$V_{m(std)}$ = Std. volume of dry gas metered (cu. ft.)
0.000	3	$V_{w(std)}$ = Std. volume of water vapor collected (cu. ft.
1.428	4	V.P. = Vapor pressure (in. Hg)
3.212	5	$V_{wv(std)}$ = Std. volume of water vapor metered (cu. ft.)
4.712	S	S = % H_2O (includes free water)

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Engineering Evaluation Unit

TABLE 16
File No. C-4-029

Program 002 Print Out
(Particulate Source Test)

Cortez Growers Assoc.
Huller
Baghouse

1.			
30.140			P_{bar} = Barometric pressure (in. Hg)
2.440			Δh = Pressure drop across orifice (in. H_2O)
54.410			V_m = Volume of gas sample (cu. ft.)
84.000			T_m = Meter temperature (°F)
0.000			V_c = Volume of condensate collected (ml)
84.000			T_i = Impinger temperature (°F)
84.000			T_s = Stack temperature (°F)
-3.887	S		S or $\hat{S}$ = % H_2O ($\hat{S}$-oversat. S-undersat.)
2.			
0.300			% CO_2
21.000			% O_2
0.000			% CO
-28.464	M		M_s = Molecular weight
3.			
1.350			$(\sqrt{\Delta P})_{av}$ = (in. $H_2O)^{1/2}$
26.000			D_s = Stack diameter (in.)
-78.571	ſ		V_s = Velocity (fps)
-16,087.780	F		Q_s = Flow rate, dry basis (SDCFM)
4.			
64.000			θ = Total sampling time (min.)
0.187			D_n = Nozzle diameter (in.)
-98.950	I		I = % Isokinetic
5.			
3.100			M_n = Particulate matter collected (mg)
-0.0009	G		C′ = Particulate concentration, dry basis (gr/SDCF
-0.124	P		W_m = Particulate emission rate (lb/hr.)
6.			
52.704		2	$V_{m(std)}$ = Std. volume of dry gas metered (cu. ft.)
0.000		3	$V_{w(std)}$ = Std. volume of water vapor collected (cu. ft.
1.178		4	V.P.= Vapor pressure (in. Hg)
2.131		5	$V_{w(std)}$ = Std. volume of water vapor metered (cu. ft.)
3.887	S		S = % H_2O (includes free water)

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TABLE 17
File No. C-4-029

Degroot
Precleaner
Cyclone

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1.

30.100		P_{bar} = Barometric pressure (in. Hg)
4.070		Δh = Pressure drop across orifice (in. H_2O)
38.600		V_m = Volume of gas sample (cu. ft.)
91.130		T_m = Meter temperature (°F)
0.000		V_l = Volume of condensate collected (ml)
91.130		T_i = Impinger temperature (°F)
91.130		T_s = Stack temperature (°F)
-4.871	S	S or $\bar{S}$ = % H_2O ($\bar{S}$-oversat. S-undersat.)

2.

0.300		% CO_2
21.000		% O_2
0.000		% CO
-28.357	M	M_s = Molecular weight

3.

0.539		$(\sqrt{\Delta P})_{av}$ = (in. H_2O)$^{1/2}$
36.000		D_s = Stack diameter (in.)
-31.655	f	V_s = Velocity (fps)
-12,123.910	F	Q_s = Flow rate, dry basis (SDCFM)

4.

40.000		θ = Total sampling time (min.)
0.375		D_n = Nozzle diameter (in.)
-70.317	I	I = % Isokinetic

5.

33.900		M_n = Particulate matter collected (mg)
-0.0141	G	C' = Particulate concentration, dry basis (gr/SDCF
-1.466	P	W_m = Particulate emission rate (lb/hr.)

6.

37.003		2	$V_{m_{STD.}}$ = Std. volume of dry gas metered (cu. ft.)
0.000		3	$V_{w_{STD.}}$ = Std. volume of water vapor collected (cu. ft.
1.480		4	V.P.= Vapor pressure (in. Hg)
1.895		5	$V_{w_{STD.}}$ = Std. volume of water vapor metered (cu. ft.)
4.871	S		S = % H_2O (includes free water)

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TABLE 18
File No. C-4-029

Degroot
Huller-Leaf Aspirator
Cyclone

1.		
30.090		P_{bar} = Barometric pressure (in. Hg)
3.630		Δh = Pressure drop across orifice (in. H_2O)
41.500		V_m = Volume of gas sample (cu. ft.)
90.600		T_m = Meter temperature (°F)
0.000		V_c = Volume of condensate collected (ml)
90.600		T_i = Impinger temperature (°F)
90.600		T_s = Stack temperature (°F)
-4.797	S	B or $\hat{S}$ = % H_2O ($\hat{S}$-oversat. S-undersat.)
2.		
0.300		% CO_2
21.000		% O_2
0.000		% CO
-28.365	M	M_s = Molecular weight
3.		
0.242		$(\sqrt{\Delta P})_{Av}$ = (in. H_2O)$^{1/2}$
36.000		D_s = Stack diameter (in.)
-14.206		V_s = Velocity (fps)
-5,448.579	F	Q_s = Flow rate, dry basis (SDCFM)
4.		
40.000		θ = Total sampling time (min.)
0.500		D_n = Nozzle diameter (in.)
-94.584	I	I = % Isokinetic
5.		
147.700		M_n = Particulate matter collected (mg)
-0.0571	G	C' = Particulate concentration, dry basis (gr/SDCF
-2.671	P	W_m = Particulate emission rate (lb/hr.)
6.		
39.766	2	$V_{m(std)}$ = Std. volume of dry gas metered (cu. ft.)
0.000	3	$V_{w(std)}$ = Std. volume of water vapor collected (cu. ft.
1.456	4	V.P. = Vapor pressure (in. Hg)
2.003	5	$V_{ww(std)}$ = Std. volume of water vapor metered (cu. ft.)
4.797	S	S = % H_2O (includes free water)

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TABLE 19
File No. C-4-029

Program 002 Print Out
(Particulate Source Test)

Dunlap-Borman
Precleaner, Leaf Aspirator
Cyclone

1.

30.050		P_{bar} = Barometric pressure (in. Hg)
1.250		Δh = Pressure drop across orifice (in. H_2O)
38.350		V_m = Volume of gas sample (cu. ft.)
73.770		T_m = Meter temperature (°F)
0.000		V_c = Volume of condensate collected (ml)
73.770		T_i = Impinger temperature (°F)
73.770		T_s = Stack temperature (°F)
-2.786	S	S or $\hat{S}$ = % H_2O ($\hat{S}$-oversat. S-undersat.)

2.

0.300		% CO_2
21.000		% O_2
0.000		% CO
-28.584	M	M_s = Molecular weight

3.

0.537		$(\sqrt{\Delta P})_{Av}$ = (in. H_2O)$^{1/2}$
36.000		D_s = Stack diameter (in.)
-30.940	f	V_s = Velocity (fps)
-12,482.494	F	Q_s = Flow rate, dry basis (SDCFM)

4.

64.000		θ = Total sampling time (min.)
0.250		D_n = Nozzle diameter (in.)
-97.690	I	I = % Isokinetic

5.

162.800		M_n = Particulate matter collected (mg)
-0.0666	G	C' = Particulate concentration, dry basis (gr/SDCF
-7.126	P	W_m = Particulate emission rate (lb/hr.)

6.

37.638		2	$V_{m_{std}}$ = Std. volume of dry gas metered (cu. ft.)
-0.0006		3	$V_{w_{std}}$ = Std. volume of water vapor collected (cu. ft.
0.840		4	V.P.= Vapor pressure (in. Hg)
1.079		5	$V_{w_{std}}$ = Std. volume of water vapor metered (cu. ft.)
2.788	S		S = % H_2O (includes free water)

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TABLE 20
File No. C-4-029

Dunlap-Borman
Huller
Cyclone

1.			
30.070			P_{bar} = Barometric pressure (in. Hg)
1.090			Δh = Pressure drop across orifice (in. H_2O)
35.860			V_m = Volume of gas sample (cu. ft.)
79.930			T_m = Meter temperature (°F)
0.000			V_c = Volume of condensate collected (ml)
79.930			T_i = Impinger temperature (°F)
79.930			T_s = Stack temperature (°F)
-3.412	S		S or $\widehat{S}$ = % H_2O ($\widehat{S}$-oversat. S-undersat.)
2.			
0.300			% CO_2
21.000			% O_2
0.000			% CO
-28.516	M		M_s = Molecular weight
3.			
0.120			$(\sqrt{\Delta P})_{av}$ = $(\text{in. } H_2O)^{1/2}$
36.000			D_s = Stack diameter (in.)
-6.959	f		V_s = Velocity (fps)
-2,759.791	F		Q_s = Flow rate, dry basis (SDCFM)
4.			
64.000			θ = Total sampling time (min.)
0.500			D_n = Nozzle diameter (in.)
-102.140	I		I = % Isokinetic
5.			
371.800			M_n = Particulate matter collected (mg)
-0.1645	G		C' = Particulate concentration, dry basis (gr/SDCF
-3.891	P		W_m = Particulate emission rate (lb/hr.)
6.			
34.802		2	V_{msm} = Std. volume of dry gas metered (cu. ft.)
-0.003		3	V_{wsm} = Std. volume of water vapor collected (cu. ft.
1.031		4	V.P. = Vapor pressure (in. Hg)
1.233		5	V_{wvm} = Std. volume of water vapor metered (cu. ft.)
3.422	S		S = % H_2O (includes free water)
H			

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TABLE 21
File No. C-4-029

No. Merced Hulling Assoc.
Precleaner
Cyclone

1.		
30.120		P_{bar} = Barometric pressure (in. Hg)
1.170		Δh = Pressure drop across orifice (in. H_2O)
49.380		V_m = Volume of gas sample (cu. ft.)
99.300		T_m = Meter temperature (°F)
0.000		V_l = Volume of condensate collected (ml)
99.300		T_i = Impinger temperature (°F)
99.300		T_s = Stack temperature (°F)
-6.301	S	S or $\bar{S}$ = % H_2O ($\bar{S}$-oversat. S-undersat.)
2.		
0.300		% CO_2
21.000		% O_2
0.000		% CO
-28.201	M	M_s = Molecular weight
3.		
0.823		$(\sqrt{\Delta P})_{Av}$ = (in. H_2O)$^{1/2}$
36.000		D_s = Stack diameter (in.)
-48.810	f	V_s = Velocity (fps)
-18,155.996	F	Q_s = Flow rate, dry basis (SDCFM)
4.		
90.000		θ = Total sampling time (min.)
0.187		D_n = Nozzle diameter (in.)
-105.120	I	I = % Isokinetic
5.		
81.500		M_n = Particulate matter collected (mg)
-0.0270	G	C' = Particulate concentration, dry basis (gr/SDCF
-4.214	P	W_m = Particulate emission rate (lb/hr.)
6.		
46.349	2	$V_{m(std)}$ = Std. volume of dry gas metered (cu. ft.)
-0.011	3	$V_{w(std)}$ = Std. volume of water vapor collected (cu. ft.
1.910	4	V.P. = Vapor pressure (in. Hg)
3.128	5	$V_{w(std)}$ = Std. volume of water vapor metered (cu. ft.)
6.323	S	S = % H_2O (includes free water)

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TABLE 22
File No. C-4-029

No. Merced Hulling Assoc.
Classifier & Screen Decks
Cyclone

1.		
30.210		P_{bar} = Barometric pressure (in. Hg)
1.010		Δh = Pressure drop across orifice (in. H_2O)
34.370		V_m = Volume of gas sample (cu. ft.)
81.700		T_m = Meter temperature (°F)
0.000		V_c = Volume of condensate collected (ml)
81.700		T_i = Impinger temperature (°F)
81.700		T_s = Stack temperature (°F)
-3.611	S	S or $\bar{S}$ = % H_2O ($\bar{S}$-oversat. S-undersat.)
2.		
0.300		% CO_2
21.000		% O_2
0.000		% CO
-28.494	M	M_s = Molecular weight
3.		
0.816		$(\sqrt{\Delta P})_{av}$ = (in. $H_2O)^{1/2}$
36.000		D_s = Stack diameter (in.)
-47.311	f	V_s = Velocity (fps)
-18,747.891	F	Q_s = Flow rate, dry basis (SDCFM)
4.		
64.000		θ = Total sampling time (min.)
0.187		D_n = Nozzle diameter (in.)
-103.146	I	I = % Isokinetic
5.		
48.600		M_n = Particulate matter collected (mg)
-0.0224	G	C' = Particulate concentration, dry basis (gr/SDCF
-3.601	P	W_m = Particulate emission rate (lb/hr.)
6.		
33.395	2	$V_{m(std)}$ = Std. volume of dry gas metered (cu. ft.)
0.000	3	$V_{w(std)}$ = Std. volume of water vapor collected (cu. ft.
1.093	4	V.P. = Vapor pressure (in. Hg)
1.251	5	$V_{w(std)}$ = Std. volume of water vapor metered (cu.
3.611	S	S = % H_2O (includes free water)

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TABLE 23
File No. C-4-029

Scott
Precleaner
Cyclone

1.		
30.080		P_{bar} = Barometric pressure (in. Hg)
0.866		Δh = Pressure drop across orifice (in. H_2O)
46.900		V_m = Volume of gas sample (cu. ft.)
75.300		T_m = Meter temperature (°F)
0.000		V_c = Volume of condensate collected (ml)
75.300		T_i = Impinger temperature (°F)
75.300		T_s = Stack temperature (°F)
-2.931	S	S or $\bar{S}$ = % H_2O ($\bar{S}$-oversat. S-undersat.)
2.		
0.300		% CO_2
21.000		% O_2
0.000		% CO
-28.568	M	M_s = Molecular weight
3.		
0.484		$(\sqrt{\Delta P})_{av}$ = (in. H_2O)$^{1/2}$
15.000		D_s = Stack diameter (in.)
-27.920	J	V_s = Velocity (fps)
-1,949.029	F	Q_s = Flow rate, dry basis (SDCFM)
4.		
80.000		θ = Total sampling time (min.)
0.250		D_n = Nozzle diameter (in.)
-105.972	I	I = % Isokinetic
5.		
320.500		M_n = Particulate matter collected (mg)
-0.1075	G	C' = Particulate concentration, dry basis (gr/SDC
-1.796	P	W_m = Particulate emission rate (lb/hr.)
6.		
45.900	2	$V_{m(std)}$ = Std. volume of dry gas metered (cu. ft.)
-0.001	3	$V_{w(std)}$ = Std. volume of water vapor collected (cu. ft
0.884	4	V.P. = Vapor pressure (in. Hg)
1.388	5	$V_{w(std)}$ = Std. volume of water vapor metered (cu. ft.)
2.935	S	S = % H_2O (includes free water)

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TABLE 24
File No. C-4-029

Winchester
Precleaner
Cyclone

1.			
30.000			P_{bar} = Barometric pressure (in. Hg)
1.510			Δh = Pressure drop across orifice (in. H_2O)
44.300			V_m = Volume of gas sample (cu. ft.)
67.130			T_m = Meter temperature (°F)
0.000			V_c = Volume of condensate collected (ml)
67.130			T_i = Impinger temperature (°F)
67.130			T_s = Stack temperature (°F)
-2.225		S	S or $\bar{S}$ = % H_2O ($\bar{S}$-oversat. S-undersat.)
2.			
0.300			% CO_2
21.000			% O_2
0.000			% CO
-28.645		M	M_s = Molecular weight
3.			
0.512			$(\sqrt{\Delta P})_{Av}$ = $(\text{in. } H_2O)^{1/2}$
36.000			D_s = Stack diameter (in.)
-29.308		f	V_s = Velocity (fps)
-12022.377		F	Q_s = Flow rate, dry basis (SDCFM)
4.			
80.000			θ = Total sampling time (min.)
0.250			D_n = Nozzle diameter (in.)
-94.816		I	I = % Isokinetic
5.			
96.900			M_n = Particulate matter collected (mg)
-0.0339		G	C' = Particulate concentration, dry basis (gr/SDCF
-3.496		P	W_m = Particulate emission rate (lb/hr.)
6.			
43.980		2	$V_{m(std)}$ = Std. volume of dry gas metered (cu. ft.)
0.000		3	$V_{w(std)}$ = Std. volume of water vapor collected (cu. ft.
0.670		4	V.P. = Vapor pressure (in. Hg)
1.001		5	$V_{w(std)}$ = Std. volume of water vapor metered (cu. ft.)
2.225		S	S = % H_2O (includes free water)

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TABLE 25
File No. C-4-029

Winchester
Huller, Leaf Aspirator
Cyclone

1.		
30.010		P_{bar} = Barometric pressure (in. Hg)
4.610		Δh = Pressure drop across orifice (in. H_2O)
65.800		V_m = Volume of gas sample (cu. ft.)
95.200		T_m = Meter temperature (°F)
0.000		V_l = Volume of condensate collected (ml)
95.200		T_i = Impinger temperature (°F)
95.200		T_s = Stack temperature (°F)
-5.544	S	B or $\hat{S}$ = % H_2O ($\hat{S}$-oversat. S-undersat.)
2.		
0.300		% CO_2
21.000		% O_2
0.000		% CO
-28.284	M	M_s = Molecular weight
3.		
0.237		$(\sqrt{\Delta P})_{Av}$ = (in. H_2O)$^{1/2}$
36.000		D_s = Stack diameter (in.)
-14.009	J	V_s = Velocity (fps)
-5,272.712	F	Q_s = Flow rate, dry basis (SDCFM)
4.		
64.000		θ = Total sampling time (min.)
0.500		D_n = Nozzle diameter (in.)
-96.028	I	I = % Isokinetic
5.		
202.800		M_n = Particulate matter collected (mg)
-0.0499	G	C' = Particulate concentration, dry basis (gr/SDC
-2.257	P	W_m = Particulate emission rate (lb/hr.)
6.		
62.512	2	$V_{m\,std}$ = Std. volume of dry gas metered (cu. ft.)
0.000	3	$V_{w\,std}$ = Std. volume of water vapor collected (cu. ft.
1.682	4	V.P. = Vapor pressure (in. Hg)
3.669	5	$V_{wv\,std}$ = Std. volume of water vapor metered (cu. ft.)
5.544	S	S = % H_2O (includes free water)

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TABLE 26
File No. C-4-029

Winchester
North
Air Leg

1.			
	29.990		P_{bar} = Barometric pressure (in. Hg)
	2.920		Δh = Pressure drop across orifice (in. H_2O)
	65.000		V_m = Volume of gas sample (cu. ft.)
	88.800		T_m = Meter temperature (°F)
	0.000		V_c = Volume of condensate collected (ml)
	88.800		T_i = Impinger temperature (°F)
	88.800		T_s = Stack temperature (°F)
	-4.540	S	S or $\bar{S}$ = % H_2O ($\bar{S}$-oversat. S-undersat.)
2.			
	0.300		% CO_2
	21.000		% O_2
	0.000		% CO
	-28.393	M	M_s = Molecular weight
3.			
	0.214		$(\sqrt{\Delta P})_{Av}$ = (in. H_2O)$^{1/2}$
	30.000		D_s = Stack diameter (in.)
	-12.556	f	V_s = Velocity (fps)
	-3,353.232	F	Q_s = Flow rate, dry basis (SDCFM)
4.			
	64.000		θ = Total sampling time (min.)
	0.500		D_n = Nozzle diameter (in.)
	-104.294	I	I = % Isokinetic
5.			
	107.700		M_n = Particulate matter collected (mg)
	-0.0266	G	C′ = Particulate concentration, dry basis (gr/SDCF
	-0.766	P	W_m = Particulate emission rate (lb/hr.)
6.			
	62.176	2	$V_{m_{std}}$ = Std. volume of dry gas metered (cu. ft.)
	-0.008	3	$V_{w_{std}}$ = Std. volume of water vapor collected (cu. ft.
	1.375	4	V.P. = Vapor pressure (in. Hg)
	2.966	5	$V_{wr_{std}}$ = Std. volume of water vapor metered (cu. ft.)
	4.553	S	S = % H_2O (includes free water)