72-MM-23

(REPORT NUMBER)

AIR POLLUTION EMISSION TEST

BLECKLEY FARM SERVICE COMPANY

(PLANT NAME)

(COTTON GIN)

COCHRAN, GEORGIA

(PLANT ADDRESS)

U. S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Water Programs
Office of Air Quality Planning and Standards
Emission Standards and Engineering Division
Emission Measurement Branch
Research Triangle Park, N. C. 27711

PARTICULATE EMISSION MEASUREMENTS

FROM COTTON GINS

Plant Tested

Bleckley Farm Service Company
Cochran, Georgia

November 1974

EMB Project Report No. 72-MM-23

Prepared for

Environmental Protection Agency
Office of Air Quality Planning and Standards
Emission Measurement Branch
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Contract No. 68-02-0226, Task No. 6

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SECTION I

INTRODUCTION

This test is part of the Cotton Ginning Industry Study, a project of the Industrial Survey Section, Industrial Studies Branch, Emission Standards and Engineering Division, Office of Air Quality Planning and Standards, Environmental Protection Agency. The field test work was directed by Joseph Bazes, Field Testing Section, Emission Measurement Branch. The sampling was performed by Monsanto Research Corporation. The cotton Ginning Industry Study is being conducted by William O. Herring, Industrial Survey Section.

Under the Clean Air Act of 1970, the Environmental Protection Agency is given the responsibility of establishing performance standards for new installations or modifications to existing installations in stationary source categories. As a contractor, Monsanto Research Corporation, under the Environmental Protection Agency's "Field Sampling of Atmospheric Emissions" Program, was asked to provide emission data from the Bleckley Farm Service Company, Cochran, Georgia. The cotton gins selected and studied were equipped with the best types of pollution control equipment currently available.

This report tabulates the data collected at the Bleckley Farm Service Company during the period from October 9 to October 20, 1972. In this cotton gin, vacuum is used to remove the field picked cotton from the cotton wagons and then the material inside the gin is moved from one operation to the next by a moving air system. Air moves the material to the ginning machines for removal of dirt, plant material, the cotton seeds, and fine lint, and finally to the battery condenser and the press or baling machine. The air from the unloader, feeder, dryer, and lint cleaners is exhausted from the building into a group of fourteen cyclones, while the air from the lint cleaner condenser and battery condenser is exhausted through rotary screen in-line filters. The trash, including plant debris and dirt, is directed to a cyclone mounted on a trash hopper. A schematic diagram of the control devices with respect to the building and indicating which of the devices were sampled is shown in Figure 1. The description of the device and the designation of the sample point numbers are as follows:

		Sample Point Numbers	
Exhaust from:	Control Device	Inlet to Control Device	Outlet from Control Device
Battery Condenser	In-line filter	16	17, 17A
Lint Cleaner Condenser*	In-Line filter	15	14, 14A
Unloading Separator	Cyclone (4)	13	1, 1A, 18, 18A
Inclined Cleaner	Cyclone (2)	10	4, 4A
Extractor Feeders, Gin Stands, Unit-air Lint Cleaners	Cyclone (2)	8	6, 6A
Previous Cyclones and In-line Filters (Trash)	Cyclone (1)	-	7

* No flow was detected on the outlet of this device. No samples were collected.

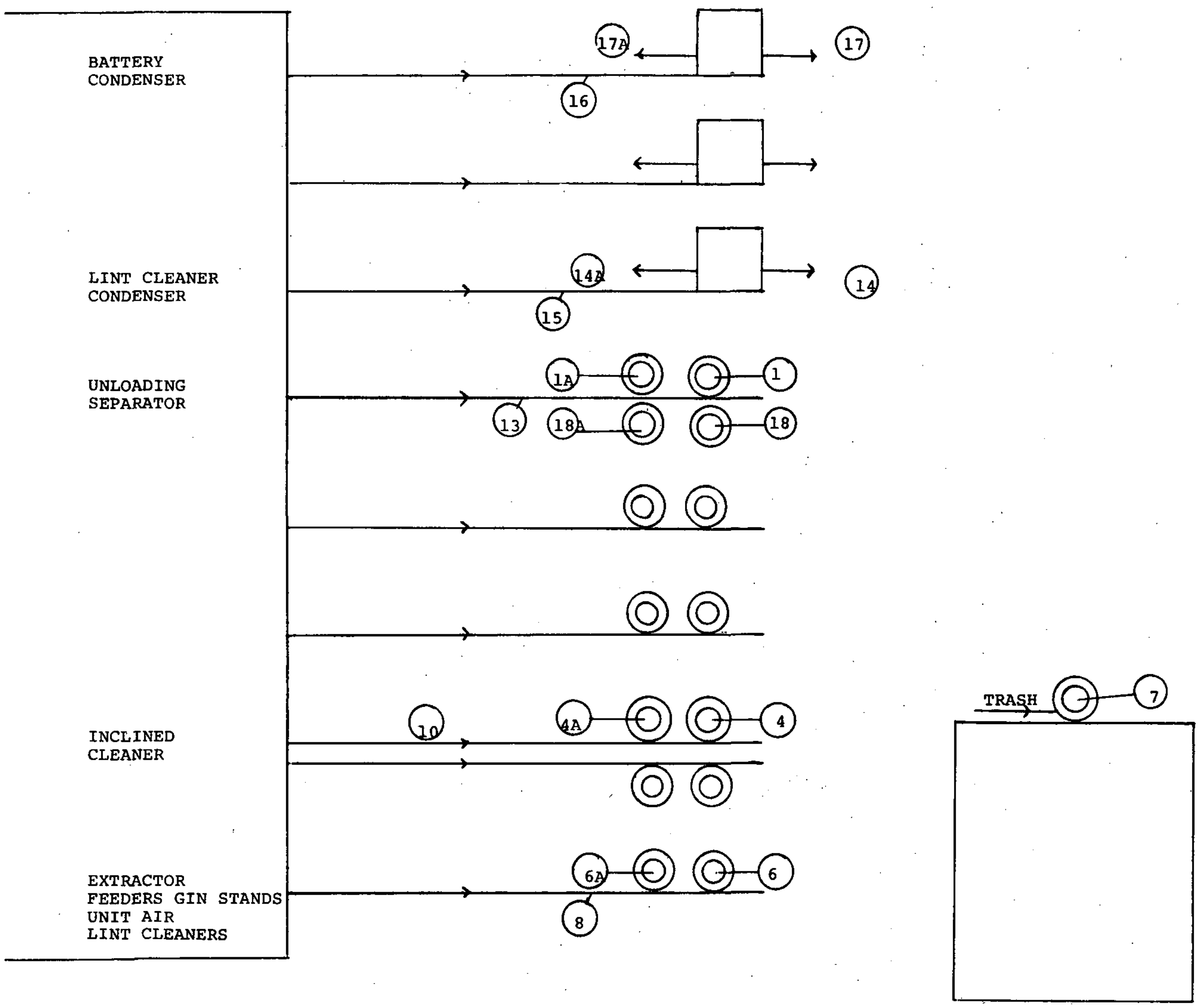

Figure 1. Schematic Diagram of Control Devices, Bleckley Farm Services Co., Cochran, Georgia (Note: No flow was detected on outlets 14 and 14A, therefore no samples were collected)

The major emphasis of the study was to obtain accurate data on the particulate emissions and the efficiency of the control device for the removal of particulate matter. To accomplish this objective, simultaneous measurements were made on the inlets and atmospheric outlets of the devices. Outlets to the atmosphere were measured for particulate concentrations using Method 5, "Determination of Particulate Emissions from Stationary Sources." Other procedures that were required during the study included Method 1, "Sample and Velocity Traverses for Stationary Sources," Method 2, Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)," Method 3, "Gas Analysis for Carbon Dioxide, Excess Air and Dry Molecular Weight," and Method 4, "Determination of Moisture in Stack Gases." The particulate loading in the inlets to the control devices was determined using a high-volume source sampler constructed by the EPA and operated by both EPA and MRC personnel. A detailed description of this sampler is given in a later section of this report. Pesticide analysis was performed on samples of seed cotton and gin trash. Samples of particulate collected on runs 18-1, and 2 were analyzed for trace metal and from runs 18-3, and 4 for arsenic content.

Extensive modifications were required to prepare the cotton gin for sampling. The outlets of the in-line filters, partly covered with a rain shield, were vented directly in the outside air. This shield was removed and replaced on both sides with a 42" diameter duct 160" long. The cyclone outlets were also covered with a rain shield. As the gas flow from the cyclone would definitely have a cyclonic flow pattern, the rain shields were removed and replaced with a large radius 180° bend, 16" I.D., to direct the flow downward followed by a straightening vane to eliminate cyclonic flow, then a straight duct 16" in diameter by 194" long. The entire duct modification for the cyclones resembled a large "candy cane." The reasons for this type of duct system were to: (1) provide a long straight run that would be close to the ground, (2) to permit incorporation of the straightening vane to eliminate cyclonic flow, and (3) provide sufficient duct after the vane to provide relatively stable flow at the sampling point. Detail of these modifications are given in Section IV.

The following sections of this report include (1) summary of results, (2) description of the process, (3) location of sampling points and traverse data, (4) process operating conditions, and (5) sampling and analytical procedures. Appendix C includes all field data from this cotton gin.

SECTION II

SUMMARY AND DISCUSSION OF RESULTS

The Bleckley Farm Service Company cotton gin employs both in-line filters and cyclones as control devices. The in-line filters, used on emissions from the battery condensor and the lint cleaner condensor, have a single inlet pipe leading to the rotating screen filter. Each filter has two outlets venting directly from the side of the filter into the outside air. A small rain shield was used to cover the outlet. Sampling criteria required that the rain shields be removed and replaced with long horizontal ducts.

The exhaust from the other systems (unloading separator, inclined cleaner, extractor feeders, gin stands, and trash lines) were directed to cyclones, which were grouped in banks of 2 or 4 from each inlet line. The cyclones were capped with a rain shield, adjusted by the gin builder to yield a back pressure that would provide good separation efficiency. Such a system however, is not suitable for testing from two points of view. First, no suitable location is available in the exhaust from the cyclone, due to the short length of outlet pipe, and second, the flow from these devices is cyclonic and thus would require a device to eliminate the spiral flow pattern. The sampling modifications for these devices were required to provide a sampling location consistent with good sampling practice and also include straightening vanes.

Specific details of the duct additions are given in Section III A. In brief, the in-line filters were provided with two long ducts attached to each outlet. The cyclones were provided with a large radius 180° bends, a straighten vane and a long straight length of pipe in place of the rain shield. The duct additions resembled a large "candy cane." Each cyclone in a bank was provided with the same type of device so that charges in back pressure would not change the proportion of air to each cyclone in the bank.

Measurements of the static pressure were made on the inlet to each bank of cyclones before the rain sheilds were removed. After installation of the candy canes the measurements were repeated. The static pressure data referring to the sample point number indicated in the Introduction, are as follows:

Inlet to Point No.	Static Pressure with Rain Cap (inches of water)	Static Pressure with Candy Cane (inches of water)
7	5.0	6.5
8	0.5 to 1.0	0.85
10	not available	2.0
13	-0.3 to -1.0	0.1

This data indicates that the candy cane duct design does increase the static pressure in the system and may change the operation of the cyclone. Without actual velocity data on the inlet, we must assume that an increase in static pressure means a decrease in velocity in the duct. This would mean that the cyclone would not be as efficient and, therefore, the emission rate with the candy cane would be higher. If, however, the fan on the system is able to maintain the velocity under the increased static pressure, then the emission rate would not be appreciably different under the two conditions.

Although the outlet of the cyclones varied from 16" to 17", a 16" diameter "candy cane" was used for all units. An adapter was constructed for the outlets that were over 16" to allow the 16" duct to fit. All joints were sealed with furnace tape.

A summary of the emission data collected at this gin is given in Table I. The test numbers indicate both the sampling point (as shown in the Introduction) as well as the run number at that point.

Inlets to each control device could not be sampled by the EPA 5 Particulate technique due to the large size of the material in the duct. A high volume in-stack sampler, designed and fabricated by EPA was employed at these points. This device is described in detail in Section IV and Appendix F. A comparison study of the high volume and the EPA 5 sampling trains was made on duct 18, run numbers 18-4 and 18-4H. For comparison, only the front half mass data (from probe tip to filter) from run 18-4 can be compared to the high volume data. The emission rate in lb/hr was found to be 0.597 for the EPA 5 Method and 1.32 for the high volume method. The high volume run was above acceptable isokinetic conditions (111%), but this is not high enough to account for the difference in the observed emission rates. One possible reason for this difference is that the high volume sampler could collect large particles that could not pass through the EPA 5 probe tip. If this were the case, these particles would tend to clog the probe tip of the EPA 5 sampling train. This did not occur during the run.

Sample Number 18-4 (by EPA 5) was also used for arsenic analysis. The second impinger in the sampling train was filled with 2% NaOH instead of water. The solution was then analyzed by EPA for arsenic content. The filter and

Table 1

SUMMARY OF EMISSION MEASUREMENTS

MADE AT BLECKLY FARM SERVICES COMPANY, COCHRAN, GEORGIA

Date 1972	Test No.	Test Site	Sampling Method	Average Velocity ft/sec	(m/sec)	Average Temperature °F	(°C)	% O_2	%CO_2	%CO	%N_2	Particulate Emission Rate* lbs/hr	(kg/hr)	%H_2O
10/10	16-1	Inlet Battery Condenser	High Volume	65.2	(19.9)	88.7	(31.5)	21.0	0	0	79.0	8.61	(3.91)	2.0
10/10	16-2	Inlet Battery Condenser	High Volume	60.9	(18.6)	92.5	(33.6)	21.0	0	0	79.0	8.44	(3.83)	2.0
10/10	17-1	Outlet Battery Condenser	Method 5	12.2	(3.72)	114.	(45.6)	21.0	0	0	79.0	2.57	(1.17)	1.87
10/10	17-2	Outlet Battery Condenser	Method 5	12.4	(3.77)	101.	(38.3)	21.0	0	0	79.0	3.44	(1.56)	0.0
10/11	7-1	Trash Hopper Cyclone	Method 5	37.7	(11.5)	98.0	(36.7)	21.4	0	0	78.6	1.13	(0.513)	0.72
10/11	16-3	Inlet Battery Condenser	High Volume	59.7	(18.2)	87.7	(30.9)	21.0	0	0	79.0	11.0	(4.99)	2.0
10/11	17-3	Outlet Battery Condenser	Method 5	13.0	(3.96)	103.	(39.4)	21.0	0	0	79.0	2.71	(1.23)	0.5
10/12	6-1	Extractor Feeder Cyclone	Method 5	18.0	(5.49)	111.	(43.9)	21.4	0	0	78.6	0.532	(0.241)	1.66
10/12	7-2	Trash Hopper Cyclone	Method 5	36.5	(11.1)	105.	(40.6)	21.4	0	0	78.6	1.32	(.599)	1.05
10/13	8-2	Inlet/Extractor Feeders	High Volume	69.0	(21.0)	90.0	(32.2)	21.4	0	0	78.6	174.0	(78.8)	1.64
10/16	4-1	Inclined Cleaner Cyclone	Method 5	26.7	(8.14)	124.	(51.1)	21.2	0	0	78.8	0.838	(0.380)	6.34
10/16	4-2	Inclined Cleaner Cyclone	Method 5	28.0	(8.53)	121.	(49.4)	21.2	0	0	78.8	0.591	(.263)	4.58
10/16	6-2	Extractor Feeder Cyclone	Method 5	13.8	(4.20)	95.0	(34.0)	21.4	0	0	78.6	0.272	(0.123)	2.42
10/16	6-3	Extractor Feeder Cyclone	Method 5	15.8	(4.82)	96.0	(35.6)	21.4	0	0	78.6	0.220	(0.100)	1.81
10/16	8-3	Inlet/Extractor Feeders	High Volume	70.5	(21.5)	111.	(43.9)	21.4	0	0	78.6	145.0	(65.7)	2.42
10/16	8-4	Inlet/Extractor Feeders	High Volume	70.4	(21.5)	111.	(43.9)	21.4	0	0	78.6	205.0	(92.9)	1.80
10/16	10-1	Inlet Inclined Cleaner	High Volume	65.9	(20.1)	163.	(72.8)	21.2	0	0	78.8	43.3	(19.6)	6.34
10/16	10-2	Inlet Inclined Cleaner	High Volume	61.9	(18.9)	163.	(72.8)	21.2	0	0	78.8	59.7	(27.1)	4.55
10/17	4-3	Inclined Cleaner Cyclone	Method 5	26.8	(8.19)	97.0	(30.1)	21.2	0	0	78.8	0.564	(.256)	3.02
10/17	10-3	Inlet Inclined Cleaner	High Volume	70.7	(21.6)	150.	(65.6)	21.2	0	0	78.8	38.5	(17.5)	3.01
10/18	1-1	Unloading Separator Cyc.	Method 5	18.8	(5.73)	106.	(41.1)	21.4	0	0	78.6	0.709	(.322)	1.87
10/18	1-2	Unloading Separator Cyc.	Method 5	20.0	(6.10)	107.	(41.7)	21.4	0	0	78.6	0.855	(.388)	1.45
10/18	13-1	Inlet Unloading Separator	High Volume	65.9	(20.1)	102.	(38.9)	21.4	0	0	78.6	40.3	(18.3)	1.86
10/18	13-2	Inlet Unloading Separator	High Volume	79.9	(24.4)	95.0	(35.0)	21.4	0	0	78.6	21.3	(9.66)	1.44
10/18	18-1	Unloading Separator Cyc.	Method 5	17.7	(5.39)	109.	(42.8)	21.4	0	0	78.6	1.04	(.472)	2.60
10/18	18-2	Unloading Separator Cyc.	Method 5	18.2	(5.55)	96.0	(35.6)	21.4	0	0	78.6	1.09	(.494)	1.88
10/19	1-3	Unloading Separator Cyc.	Method 5	18.8	(5.73)	92.0	(33.3)	21.4	0	0	78.6	0.748	(.339)	1.28
10/19	13-3	Inlet Unloading Separator	High Volume	80.4	(24.5)	97.3	(36.3)	21.4	0	0	78.6	34.1	(15.5)	1.28
10/19	18-3	Unloading Separator Cyc.	Method 5	18.7	(5.70)	98.0	(36.7)	21.4	0	0	78.6	0.785	(.356)	2.17
10/19	18-4H	Unloading Separator Cyc.	High Volume	18.1	(5.52)	82.0	(27.8)	21.4	0	0	78.6	1.32	(.599)	0.86
10/19	18-4	Unloading Separator Cyc.	Method 5-As.	20.3	(6.19)	82.0	(27.8)	21.4	0	0	78.6	0.597	(.271)	0.87

*For Method 5 Samples, Emission Rate is Total Emission Rate dried residues from all parts of the sampling train were also analyzed for arsenic. The results indicated (1) that a greater portion of the arsenic is caught in the impingers rather than in the probe and filter, and (2) the NaOH is not required to trap the arsenic. This data, presented in Appendix I is summarized as follows:

	18-3	18-4
Total Gas Volume DSCF	22.8	26.0
Arsenic Front Half (mg)	1.15	1.75
Arsenic Total Train (mg)	7.85	6.60
Arsenic in Blanks	<0.4	<0.4

Residues from runs 18-1 and 18-2 were analyzed by Batelle Memorial Institute for trace metal content. This data is presented in Appendix J. The elements Ba, Mg, Si, Ca, K, Na, Fe, Cu, and As were found in appreciable quantities.

Pesticides analysis was performed on the gin trash and seed cotton. High concentrations of both organochlorine and organophosphous compounds were found. The concentrations levels in the trash is considerably higher than in the seed cotton. The data given in detail in Appendix H is summarized as follows:

	Concentrations ppm by Weight	
Compound	Seed Cotton	Trash
p,p'-DDT	4.1	19.5
o,p-DDT	0.63	3.57
Toxaphene	4.6	22.5
Methyl Parathion	0.22	0.33

Other material found included degradation products of DDT and also endrin, the latter just barely detectable.

It was assumed that the loading in grains/DSCF would be the same in each portion of the system and the outlet emission rate in lb/hr would vary with the velocity at each outlet point. Thus, the emission rate of each outlet is known or calculated and the total emissions is equal to the sum of the emission from all outlets in the system. As the inlet loading is known from the high volume samplings runs, an efficiency can be calculated in each individual control system, either cyclone bank or in-line filter.

The high volume sampler does not collect any material or condensate after the filter. The data from the high volume runs would, therefore, correlate with the "front half" of the Method 5 samples. Only "front half" data was used to determine efficiencies. The sampling schedule, shown in Table 2 describes which units were sampled or traversed during the same time interval. Additional information on the schedule are given in Appendix G - Sampling Log.

The efficiency data on the control devices is summarized in Table 3. The complete data and example calculations on all inlet ducts, sampled and unsampled outlet ducts are given in Appendix A1-A6. In general, the efficiencies of the cyclones varied from at low of 82.9% to 99.9%. The cyclones on the unloading separator are the least efficient indicating that the cyclones could not easily separate the type of material being fed to them. The inclined cleaner and extractor feeder cyclones were much more efficient. Only very short sampling runs were possible on the inlets to these cyclones due to the high loadings and the large size of debris present in the ducts.

The results on the cyclones indicate they are very efficient in removing large material from fine material, but

TABLE 2

SAMPLING SCHEDULE

Date	Exhaust From	Control Device	Sample Point No. Inlet	Outlet	Traversed Duct
10/10	Battery Condenser	In-line Filter	16-1	17-1	17A-1
10/10	Battery Condenser	In-line Filter	16-2	17-2	17A-2
10/11	Battery Condenser	In-line Filter	16-3	17-3	17A-3
10/18	Unloading Separator	Cyclone (4)	13-1	1-1, 18-1	1A-1, 18A-1
10/18	Unloading Separator	Cyclone (4)	13-2	1-2, 18-2	1A-2, 18A-2
10/19	Unloading Separator	Cyclone (4)	13-3	1-3, 18-3	1A-3, 18A-3
10/19	Unloading Separator	Cyclone (4)		18-4, 18-4H	
10/16	Inclined Cleaner	Cyclone (2)	10-1	4-1	4A-1
10/16	Inclined Cleaner	Cyclone (2)	10-2	4-2	4A-2
10/17	Inclined Cleaner	Cyclone (2)	10-3	4-3	4A-3
10/12	Extractor Feeders, etc.	Cyclone (2)	*	6-1	6A-1
10/16	Extractor Feeders, etc.	Cyclone (2)	8-2	6-2	6A-2
10/16	Extractor Feeders, etc.	Cyclone (2)	8-3	6-3	6A-3
10/16			8-4	--	--
10/11	Trash Hopper	Cyclone (1)	--	7-1	--
10/12	Trash Hopper	Cyclone (1)	--	7-2	--

* High Volume samples run was aborted. The high particulate loading in duct clogged the sampler.

TABLE 3

EFFICIENCY COMPARISON SUMMARY

Process and Control Device	Run Numbers Inlet	Run Numbers Outlet	(Hi-vol) Inlet lb/hr	Outlet lb/hr	Efficiency
Unloading Separator - Cyclone	13-1	1-1, 1A-1, 18-1, 18A-1	40.3	3.10	92.3
	13-2	1-2, 1A-2, 18-2, 18A-2	21.3	3.65	82.9
	13-3	1-3, 1A-3, 18-3, 18A-3	34.1	2.34	93.1
	Average		31.9	3.03	90.5
Inclined Cleaner - Cyclone	10-1	4-1, 4A-1,	43.3	1.331	96.9
	10-2	4-2, 4A-2	59.7	0.918	98.5
	10-3	4-3, 4A-3	38.5	0.934	97.6
	Average		47.2	1.06	97.8
Extractor Feeder, Gin Stands - Cyclone	8-2	6-1, 6A-1	174.7	1.01	99.4
	8-3	6-2, 6A-2	145.9	0.473	99.7
	8-4	6-3, 6A-3	205.8	0.304	99.9
	Average		175.5	0.596	99.7
Battery Condenser - In-line Filter	16-1	17-1, 17A-1	8.64	4.67	45.9
	16-2	17-2, 17A-2	8.44	5.35	36.6
	16-3	17-3, 17A-3	11.0	3.80	65.5
	Average		9.36	4.61	50.7

are not very efficient in separating relatively fine material from the gas stream.

As might be expected, the in-line filters are not very efficient. These filters consist of a rotating screen of wire mesh and as a result, can not remove any fine particles from the gas stream. The separation efficiency will increase as the screen becomes clogged, but when this happens, the velocity from the filter outlets will be greatly decreased.

A summary of the data collected on each individual sampling site is given in Tables 4-14. In these tables the data in parenthesis is the value given in metric units. Also included in these tables are the values of the loading in terms of lbs of cotton produced. This value allows the emission rate to vary with the production which is more representative than the grains/DSCF or lbs/hr emission figures.

Table 4 - SUMMARY OF RESULTS - INLET TO UNLOADING SEPARATOR CYCLONE - POINT 13

Run Number:	13-1	13-2	13-3	Average
Date:	10-18-72	10-18-72	10-19-72	
Method Type:	High Vol. Sampler	High Vol. Sampler	High Vol. Sampler	
Volume of gas sampled-DSCF[1]-(Nm^3)[4]	2795 (79.2)	3110 (88.1)	3267 (92.5)	3057 (86.6)
Percent Moisture by Volume	1.86	1.44	1.28	1.53
Average Stack Temperature-°F-(°C)	102 (38.9)	95 (35)	97.2 (36.2)	97.3 (36.3)
Stack Volumetric Flow Rate-DSCFM[2]-(Nm^3/sec)	4535 (2.14)	5570 (2.63)	5622 (2.65	5243 (2.47)
Stack Volumetric Flow Rate-ACFM[3]-(m^3/sec)	4849 (2.29)	5878 (2.77)	5914 (2.79)	5547 (2.62)
Percent Isokinetic	106	97	101	101
Product Rate-ton lint cotton/hr-(M ton/hr)[5]	1.98 (1.80)	2.04 (1.85)	2.96 (2.69)	2.33 (2.11)
Duration of run - minutes	64.0	64.0	64.0	64.0
<u>Particulates</u> - probe, cyclone and filter catch				
mg	188356.4	89903.8	150071.7	142777.3
grains/DSCF[6]-(mg/Nm^3)	1040 (2.38×10^6)	446 (1.02×10^6)	709 (1.62×10^6)	732 (1.68×10^6)
lb/hr-(kg/hr)	40.3 (18.3)	21.3 (9.66)	34.1 (15.5)	31.9 (14.5)
lb/ton of lint cotton produced (Kg/M ton of lint cotton produced)	20.4 (10.2)	10.4 (5.22)	11.5 (5.76)	14.1 (7.06)

[1]Dry Standard Cubic Feet @ 70°F, 29.92 in Hg
[2]Dry Standard Cubic Feet per Minute @70°F, 29.92 in Hg
[3]Actual Cubic Feed per Minute - Stack Conditions
[4]Normal Cubic Meters at 21.1°C, 760 mm Hg
[5]Metric Tons per Hour (1 metric ton = 1000 Kg)
[6]Grains per Dry Standard Cubic Feet

Table 5 - SUMMARY OF RESULTS - OUTLET OF UNLOADING SEPARATOR CYCLONES - POINT 1

Run Number:	1-1	1-2	1-3	Average
Date:	10-18-72	10-18-72	10-19-72	
Method Type:	EPA Method 5	EPA Method 5	EPA Method 5	
Volume of gas sampled-DSCF[1]-(Nm^3)[4]	23.12 (0.657)	24.8 (0.702)	24.2 (0.685)	24.1 (0.681)
Percent Moisture by Volume	1.87	1.45	1.28	1.53
Average Stack Temperature-°F-(°C)	106 (41.1)	107 (41.7)	92 (33.3)	102 (38.7)
Stack Volumetric Flow Rate-DSCFM[2]-(Nm^3/sec)	1460 (0.689)	1550 (0.732)	1510 (0.713)	1507 (0.711)
Stack Volumetric Flow Rate-ACFM[3]-(m^3/sec)	1570 (0.741)	1670 (0.788)	1580 (0.746)	1610 (0.760)
Percent Isokinetic	105.6	107.3	107.2	106.7
Product Rate-ton lint cotton/hr-(M ton/hr)[5]	1.98 (1.80)	2.04 (1.85)	2.96 (2.69)	2.33 (2.11)
Duration of run - minutes	64.0	64.0	64.0	64.0
<u>Particulates</u> - probe, cyclone and filter catch				
mg	72.8	92.2	73.0	79.3
grains/DSCF[6]-(mg/Nm^3)	0.0483 (111)	0.0573 (131)	0.0465 (106)	0.0507 (116)
lb/hr-(Kg/hr)	0.604 (0.274)	0.761 (0.345)	0.602 (0.273)	0.656 (0.297)
lb/ton of lint cotton produced (kg/M ton of lint cotton produced)	.305 (.152)	.373 (.186)	.203 (.101)	.294 (.146)
<u>Particulates</u> - total catch				
mg	85.4	103.7	90.8	93.3
grains/DSCF[6]-(mg/Nm^3)	0.0567 (130)	0.0644 (147)	0.0578 (132)	0.0597 (137)
lb/hr-(Kg/hr)	0.709 (0.322)	0.855 (0.388)	0.748 (0.339)	0.771 (0.350)
lb/ton of lint cotton produced (Kg/M ton of lint cotton produced)	.358 (.179)	.419 (.210)	.253 (.126)	.343 (.172)
percent impinger catch	14.8	11.1	19.6	15.2

[1]Dry Standard Cubic Feet @ 70°F, 29.92 in Hg
[2]Dry Standard Cubic Feet per Minute @ 70°F, 29.92 in Hg
[3]Actual Cubic Feed per Minute - Stack Conditions
[4]Normal Cubic Meters at 21.1°C, 760 mm Hg
[5]Metric Tons per Hour (1 metric ton = 1000 Kg)
[6]Grains per Dry Standard Cubic Feet

Table 6 - SUMMARY OF RESULTS - OUTLET OF UNLOADING SEPARATOR CYCLONE - POINT 18

Run Number:	18-1	18-2	18-3	Average
Date:	10-18-72	10-18-72	10-19-72	
Method Type:	EPA Method 5	EPA Method 5	EPA Method 5	
Volume of gas sampled-DSCF[1]-(Nm^3)[4]	21.5 (0.609)	22.5 (0.637)	22.9 (0.648)	22.3 (0.631)
Percent Moisture by Volume	2.60	1.88	2.76	2.41
Average Stack Temperature-°F-(°C)	109 (42.8)	96 (35.6)	98 (36.7)	101 (38.3)
Stack Volumetric Flow Rate-DSCFM[2]-(Nm^3/sec)	1350 (0.637)	1430 (0.675	1460 (0.689)	1413 (0.667)
Stack Volumetric Flow Rate-ACFM[3]-(m^3/sec)	1480 (0.698)	1520 (0.717)	1570 (0.741)	1523 (0.719)
Percent Isokinetic	105.9	104.8	104.6	105
Product Rate-ton lint cotton/hr-(M ton/hr)[5]	1.98 (1.80)	2.04 (1.85)	2.96 (2.69)	2.33 (2.11)
Duration of run - minutes	64.0	64.0	64.0	64.0
<u>Particulates</u> - probe, cyclone and filter catch				
mg	111.4	114.7	65.8	97.3
grains/DSCF[6]-(mg/Nm^3)	0.0798 (183)	0.0785 (180)	0.0442 (101)	0.0675 (155)
lb/hr-(Kg/hr)	0.923 (0.418)	0.962 (0.436)	0.553 (0.251)	0.813 (0.368)
lb/ton of lint cotton produced (kg/M ton of lint cotton produced)	.466 (.232)	.472 (.236)	.187 (.0933)	.375 (.187)
<u>Particulates</u> - total catch				
mg	125.6	129.5	93.3	116.1
grains/DSCF[6]-(mg/Nm^3)	0.0900 (206)	0.0886 (203)	0.0627 (143)	0.0804 (184)
lb/hr-(Kg/hr)	1.04 (.472)	1.09 (0.494)	0.785 (.356)	0.972 (0.441)
lb/ton of lint cotton produced (Kg/M ton of lint cotton produced)	.521 (.262)	.534 (.267)	.265 (.132)	.440 (.220)
percent impinger catch	42.3	11.4	29.5	27.7

[1]Dry Standard Cubic Feet @ 70°F, 29.92 in Hg
[2]Dry Standard Cubic Feet per Minute @ 70°F, 29.92 in Hg
[3]Actual Cubic Feed per Minute - Stack Conditions
[4]Normal Cubic Meters at 21.1°C, 760 mm Hg
[5]Metric Tons per Hour (1 metric ton = 1000 Kg)
[6]Grains per Dry Standard Cubic Feet

Table 7 - SUMMARY OF RESULTS - INLET TO INCLINED CLEANER CYCLONES - POINT 10

Run Number:	10-1	10-2	10-3	Average
Date:	10-16-72	10-16-72	10-17-72	
Method Type:	High Vol. Sampler	High Vol. Sampler	High Vol. Sampler	
Volume of gas sampled-DSCF[1]-(Nm^3)[4]	491 (13.91)	236 (6.68)	241 (6.81)	322 (9.13)
Percent Moisture by Volume	6.34	4.55	3.02	4.64
Average Stack Temperature-°F-(°C)	163 (72.8)	163 (72.8)	150 (65.6)	159 (70.4)
Stack Volumetric Flow Rate-DSCFM[2]-(Nm^3/sec)	2486 (1.17)	2380 (1.12)	2810 (1.33)	2559 (1.21)
Stack Volumetric Flow Rate-ACFM[3]-(m^3/sec)	3103 (1.47)	2914 (1.38)	3328 (1.57)	3115 (1.47)
Percent Isokinetic	116	117	101	111
Product Rate-ton lint cotton/hr-(M ton/hr)[5]	2.33 (2.11)	1.88 (1.71)	1.37 (1.24)	1.86 (1.69)
Duration of run - minutes	12.0	6.0	6.0	8.0
Particulates - probe, cyclone and filter catch				
mg	64717.8	44798.8	24987.5	44834.7
grains/DSCF[6]-(mg/Nm^3)	2.03 (4647)	2.93 (6707)	1.60 (3662)	2.15 (4921)
lb/hr-(kg/hr)	43.3 (19.6)	59.7 (27.1)	38.5 (17.5)	47.2 (21.4)
lb/ton of lint cotton produced (Kg/M ton of lint cotton produced)	18.6 (9.29)	31.8 (15.8)	28.1 (14.1)	26.2 (13.1)

[1]Dry Standard Cubic Feet @ 70°F, 29.92 in Hg
[2]Dry Standard Cubic Feet per Minute @70°F, 29.92 in Hg
[3]Actual Cubic Feed per Minute - Stack Conditions
[4]Normal Cubic Meters at 21.1°C, 760 mm Hg
[5]Metric Tons per Hour (1 metric ton = 1000 Kg)
[6]Grains per Dry Standard Cubic Feet

Table 8 - SUMMARY OF RESULTS - OUTLET OF INCLINED CLEANER CYCLONES - POINT 4

Run Number:	4-1	4-2	4-3	Average
Date:	10-16-72	10-16-72	10-17-72	
Method Type:	EPA Method 5	EPA Method 5	EPA Method 5	
Volume of gas sampled-DSCF[1]-(Nm^3)[4]	30.0 (0.849)	31.8 (0.900)	32.8 (0.929)	31.5 (0.893)
Percent Moisture by Volume	6.34	4.56	3.02	4.64
Average Stack Temperature-°F-(°C)	124 (51.1)	121 (49.4)	97 (36.1)	114 (45.6)
Stack Volumetric Flow Rate-DSCFM[2]-(Nm^3/sec)	1920 (0.906)	2060 (0.972)	2090 (0.986)	2023 (0.955)
Stack Volumetric Flow Rate-ACFM[3]-(m^3/sec)	2240 (1.06)	2350 (1.11)	2250 (1.06)	2280 (1.08)
Percent Isokinetic	104.5	102.8	104.7	104
Product Rate-ton lint cotton/hr-(M ton/hr)[5]	2.33 (2.11)	1.88 (1.71)	1.37 (1.24)	1.86 (1.69)
Duration of run - minutes	64.0	64.0	64.0	64.0
Particulates - probe, cyclone and filter catch				
mg	74.4	52.2	52.4	59.7
grains/DSCF[6]-(mg/Nm^3)	0.0382 (87.4)	0.0253 (57.9)	0.0246 (56.3)	0.0294 (67.2)
lb/hr-(Kg/hr)	0.629 (0.285)	0.447 (0.203)	0.441 (.200)	0.506 (0.229)
lb/ton of lint cotton produced (kg/M ton of lint cotton produced)	.270 (.135)	.238 (.119)	.322 (.161)	.277 (.139)
Particulates - total catch				
mg	99.1	69.1	67.0	78.4
grains/DSCF[6]-(mg/Nm^3)	0.0509 (116.5)	0.0335 (76.7)	0.0315 (72.1)	0.0387 (88.4)
lb/hr-(Kg/hr)	0.838 (0.380)	0.591 (0.268)	0.564 (0.256)	0.664 (0.301)
lb/ton of lint cotton produced (Kg/M ton of lint cotton produced)	.360 (.180)	.314 (.157)	.412 (.206)	.362 (.181)
percent impinger catch	24.9	24.5	21.8	23.7

[1]Dry Standard Cubic Feet @ 70°F, 29.92 in Hg
[2]Dry Standard Cubic Feet per Minute @ 70°F, 29.92 in Hg
[3]Actual Cubic Feed per Minute - Stack Conditions
[4]Normal Cubic Meters at 21.1°C, 760 mm Hg
[5]Metric Tons per Hour (1 metric ton = 1000 Kg)
[6]Grains per Dry Standard Cubic Feet

Table 9 - SUMMARY OF RESULTS - INLET TO EXTRACTOR FEEDER, GIN STAND CYCLONES - POINT 8

Run Number:	8-2	8-3	8-4	Average
Date:	10-13-72	10-16-72	10-16-72	
Method Type:	High Vol. Sampler	High Vol. Sampler	High Vol. Sampler	
Volume of gas sampled-DSCF[1]-(Nm^3)[4]	73.9 (2.09)	125 (3.55)	33.8 (0.956)	77.7 (2.20)
Percent Moisture by Volume	1.64	2.42	1.80	1.95
Average Stack Temperature-°F-(°C)	90 (32.2)	111 (43.9)	111 (43.9)	104 (40)
Stack Volumetric Flow Rate-DSCFM[2]-(Nm^3/sec)	3110 (1.47)	3030 (1.43)	3040 (1.44)	3060 (1.44)
Stack Volumetric Flow Rate-ACFM[3]-(m^3/sec)	3250 (1.53)	3320 (1.57)	3310 (1.56)	3293 (1.55)
Percent Isokinetic	112	98.1	78.9	96.3
Product Rate-ton lint cotton/hr-(M ton/hr)[5]	1.86 (1.69)	1.63 (1.48)	1.88 (1.71)	1.79 (1.63)
Duration of run - minutes	1.5	3.0	1.0	1.83
Particulates - probe, cyclone and filter catch				
mg	31331.3	45395.3	17215.3	31314.0
grains/DSCF[6]-(mg/Nm^3)	6.54 (15000)	5.59 (12800)	7.87 (18000)	6.22 (15300)
lb/hr-(kg/hr)	174 (78.8)	145 (65.7)	205 (92.9)	175 (79.2)
lb/ton of lint cotton produced (Kg/M ton of lint cotton produced)	93.5 (46.6)	89.0 (44.4)	109 (54.3)	97.2 (48.4)

[1]Dry Standard Cubic Feet @ 70°F, 29.92 in Hg
[2]Dry Standard Cubic Feet per Minute @70°F, 29.92 in Hg
[3]Actual Cubic Feed per Minute - Stack Conditions
[4]Normal Cubic Meters at 21.1°C, 760 mm Hg
[5]Metric Tons per Hour (1 metric ton = 1000 Kg)
[6]Grains per Dry Standard Cubic Feet

Table 10 - SUMMARY OF RESULTS - OUTLET OF EXTRACTOR FEEDER, GIN STAND CYCLONES - POINT 6

Run Number:	6-1	6-2	6-3	Average
Date:	10-12-72	10-16-72	10-16-72	
Method Type:	EPA Method 5	EPA Method 5	EPA Method 5	
Volume of gas sampled-DSCF[1]-(Nm^3)[4]	52.6 (1.49)	40.4 (1.14)	45.5 (1.29)	46.1 (1.31)
Percent Moisture by Volume	1.65	2.42	1.80	1.96
Average Stack Temperature-°F-(°C)	111 (43.9)	95 (35)	96 (35.6)	101 (38.2)
Stack Volumetric Flow Rate-DSCFM[2]-(Nm^3/sec)	1390 (0.656)	1080 (0.5098)	1250 (0.590)	1240 (0.585)
Stack Volumetric Flow Rate-ACFM[3]-(m^3/sec)	1500 (0.708)	1150 (0.543)	1320 (0.623)	1323 (0.624)
Percent Isokinetic	108.0	106.7	104.3	106
Product Rate-ton lint cotton/hr-(M ton/hr)[5]	1.86 (1.69)	1.63 (1.48)	1.88 (1.71)	1.79 (1.63)
Duration of run - minutes	64.0	64.0	64.0	64.0
<u>Particulates</u> - probe, cyclone and filter catch				
mg	138.8	60.8	39.4	79.7
grains/DSCF[6]-(mg/Nm^3)	0.0406 (92.9)	0.0232 (53.1)	0.0133 (30.4)	0.0257 (58.8)
lb/hr-(Kg/hr)	0.484 (0.220)	0.215 (0.098)	0.142 (0.064)	0.282 (0.127)
lb/ton of lint cotton produced (kg/M ton of lint cotton produced)	.260 (.130)	.132 (.0662)	.0755 (.0374)	.156 (.0779)
<u>Particulates</u> - total catch				
mg	152.6	77.1	60.5	96.7
grains/DSCF[6]-(mg/Nm^3)	0.0447 (102)	0.0294 (67.3)	0.0205 (46.9)	0.0315 (72.1)
lb/hr-(Kg/hr)	0.532 (0.241)	0.272 (0.123)	0.220 (0.100)	0.343 (0.155)
lb/ton of lint cotton produced (Kg/M ton of lint cotton produced)	.286 (.143)	.167 (.0831)	.117 (.0585)	.190 (.0949)
percent impinger catch	9.04	21.1	34.9	21.7

[1]Dry Standard Cubic Feet @ 70°F, 29.92 in Hg
[2]Dry Standard Cubic Feet per Minute @ 70°F, 29.92 in Hg
[3]Actual Cubic Feed per Minute - Stack Conditions
[4]Normal Cubic Meters at 21.1°C, 760 mm Hg
[5]Metric Tons per Hour (1 metric ton = 1000 Kg)
[6]Grains per Dry Standard Cubic Feet

Table 11 - SUMMARY OF RESULTS - INLET TO BATTERY CONDENSER FILTER - POINT 16

Run Number:	16-1	16-2	16-3	Average
Date:	10-10-72	10-10-72	10-11-72	
Method Type:	High Vol. Sampler	High Vol. Sampler	High Vol. Sampler	
Volume of gas sampled-DSCF[1]-(Nm^3)[4]	2870 (81.3)	2948 (83.5)	3295 (93.3)	3038 (86.0)
Percent Moisture by Volume	2.0	2.0	2.0	2.0
Average Stack Temperature-°F-(°C)	88.7 (31.5)	92.5 (33.6)	87.7 (30.9)	89.63 (32.0)
Stack Volumetric Flow Rate-DSCFM[2]-(Nm^3/sec)	15608 (7.36)	15880 (7.49)	15781 (7.45)	15756 (7.44)
Stack Volumetric Flow Rate-ACFM[3]-(m^3/sec)	17917 (8.46)	16743 (7.9)	16412 (7.75)	17024 (8.04)
Percent Isokinetic	95	80	82	80.67
Product Rate-ton lint cotton/hr-(M ton/hr)[5]	1.72 (1.56)	1.64 (1.49)	1.70 (1.54)	1.69 (1.53)
Duration of run - minutes	80.0	80.0	82.0	80.7
<u>Particulates</u> - probe, cyclone and filter catch				
mg	12045.7	11863.1	17404.8	13771.2
grains/DSCF[6]-(mg/Nm^3)	0.065 (148.8)	0.062 (141.9)	0.082 (187.7)	0.0697 (159.5)
lb/hr-(kg/hr)	8.61 (3.91)	8.44 (3.83)	11.0 (4.99)	9.35 (4.24)
lb/ton of lint cotton produced (Kg/M ton of lint cotton produced)	5.00 (2.50)	5.15 (2.58)	6.47 (3.24)	5.54 (2.77)

[1] Dry Standard Cubic Feet @ 70°F, 29.92 in Hg
[2] Dry Standard Cubic Feet per Minute @70°F, 29.92 in Hg
[3] Actual Cubic Feed per Minute - Stack Conditions
[4] Normal Cubic Meters at 21.1°C, 760 mm Hg
[5] Metric Tons per Hour (1 metric ton = 1000 Kg)
[6] Grains per Dry Standard Cubic Feet

Table 12 - SUMMARY OF RESULTS - OUTLET OF BATTERY CONDENSER FILTER - POINT 17

Run Number:	17-1	17-2	17-3	Average
Date:	10-10-72	10-10-72	10-11-72	
Method Type:	EPA Method 5	EPA Method 5	EPA Method 5	
Volume of gas sampled-DSCF[1]-(Nm^3)[4]	70.3 (1.99)	44.5 (1.26)	47.2 (1.34)	54.0 (1.53)
Percent Moisture by Volume	1.86	0.0	0.5	0.79
Average Stack Temperature-°F-(°C)	114 (45.6)	101 (38.3)	103 (39.4)	106 (41.1)
Stack Volumetric Flow Rate-DSCFM[2]-(Nm^3/sec)	7140 (3.37)	7560 (3.57)	7910 (3.73)	7537 (3.56)
Stack Volumetric Flow Rate-ACFM[3]-(m^3/sec)	7730 (3.65)	7850 (3.70)	8250 (3.89)	7943 (3.75)
Percent Isokinetic	98.0	101.4	102.7	100.7
Product Rate-ton lint cotton/hr-(M ton/hr)[5]	1.72 (1.56)	1.64 (1.49)	1.70 (1.54)	1.69 (1.53)
Duration of run - minutes	80	80	80	80
Particulates - probe, cyclone and filter catch				
mg	178.8	127.0	105.8	137.2
grains/DSCF[6]-(mg/Nm^3)	0.0392 (89.7)	0.0440 (101)	0.0345 (78.9)	0.0392 (89.9)
lb/hr-(Kg/hr)	2.40 (1.09)	2.85 (1.29)	2.34 (1.07)	2.54 (1.15)
lb/ton of lint cotton produced (kg/M ton of lint cotton produced)	1.40 (.699)	1.74 (.866)	1.38 (.695)	1.51 (.752)
Particulates - total catch				
mg	191.5	153.5	122.5	155.8
grains/DSCF[6]-(mg/Nm^3)	0.0420 (96.1)	0.0531 (122)	0.0400 (91.5)	0.0450 (103)
lb/hr-(Kg/hr)	2.57 (1.17)	3.44 (1.56)	2.71 (1.23)	2.91 (1.32)
lb/ton of lint cotton produced (Kg/M ton of lint cotton produced)	1.49 (.750)	2.10 (1.05)	1.59 (.799)	1.73 (.866)
percent impinger catch	6.63	17.3	13.6	12.5

[1]Dry Standard Cubic Feet @ 70°F, 29.92 in Hg
[2]Dry Standard Cubic Feet per Minute @ 70°F, 29.92 in Hg
[3]Actual Cubic Feed per Minute - Stack Conditions
[4]Normal Cubic Meters at 21.1°C, 760 mm Hg
[5]Metric Tons per Hour (1 metric ton = 1000 Kg)
[6]Grains per Dry Standard Cubic Feet

Table 13 - SUMMARY OF RESULTS - OUTLET OF TRASH HOPPER CYCLONE - POINT 7

Run Number:	7-1	7-2	Average
Date:	10-11-72	10-12-72	
Method Type:	EPA Method 5	EPA Method 5	
Volume of gas sampled-DSCF[1]-(Nm^3)[4]	45.7 (1.29)	44.0 (1.25)	44.9 (1.27)
Percent Moisture by Volume	0.72	1.05	0.885
Average Stack Temperature-°F-(°C)	98 (36.7)	105 (40.6)	102 (39.6)
Stack Volumetric Flow Rate-DSCFM[2]-(Nm^3/sec)	3040 (1.43)	2900 (1.37)	2970 (1.40)
Stack Volumetric Flow Rate-ACFM[3]-(m^3/sec)	3150 (1.49)	3060 (1.44)	3105 (1.47)
Percent Isokinetic	100.3	101.2	100.8
Product Rate-ton lint cotton/hr-(M ton/hr)[5]	1.93 (1.75)	2.44 (2.21)	2.19 (1.98)
Duration of run - minutes	64.0	64.0	64.0
<u>Particulates</u> - probe, cyclone and filter catch			
mg	108.7	138.9	123.8
grains/DSCF[6]-(mg/Nm^3)	0.0366 (83.8)	0.0486 (111)	0.0426 (97.4)
lb/hr-(Kg/hr)	0.954 (0.433)	1.21 (0.549)	1.082 (0.491)
lb/ton of lint cotton produced (kg/M ton of lint cotton produced)	.494 (.247)	.496 (.248)	.495 (.298)
<u>Particulates</u> - total catch			
mg	128.2	152.0	140.1
grains/DSCF[6]-(mg/Nm^3)	0.0432 (98.9)	0.0532 (122)	0.0482 (110)
lb/hr-(Kg/hr)	1.13 (0.513)	1.32 (0.599)	1.23 (0.556)
lb/ton of lint cotton produced (Kg/M ton of lint cotton produced)	.585 (.293)	.541 (.271)	.563 (.282)
percent impinger catch	15.2	8.6	11.9

[1] Dry Standard Cubic Feet @ 70°F, 29.92 in Hg
[2] Dry Standard Cubic Feet per Minute @ 70°F, 29.92 in Hg
[3] Actual Cubic Feed per Minute - Stack Conditions
[4] Normal Cubic Meters at 21.1°C, 760 mm Hg
[5] Metric Tons per Hour (1 metric ton = 1000 Kg)
[6] Grains per Dry Standard Cubic Feet

Table 14 - SUMMARY OF RESULTS - EPA 5 and HIGH VOLUME SAMPLERS COMPARISON - POINT 18

Run Number:	18-4	18-4-H
Date:	10-19-72	10-19-72
Method Type:	EPA Method 5 (modified for arsenic)	High Vol. Sampler
Volume of gas sampled-DSCF[1]-(Nm^3)[4]	26.1 (0.739)	837 (23.7)
Percent Moisture by Volume	0.87	0.86
Average Stack Temperature-°F-(°C)	82.0 (27.8)	82.0 (27.8)
Stack Volumetric Flow Rate-DSCFM[2]-(Nm^3/sec)	1660 (0.784)	1477 (0.697)
Stack Volumetric Flow Rate-ACFM[3]-(m^3/sec)	1700 (0.802)	1512 (0.714)
Percent Isokinetic	105.3	111
Product Rate-ton lint cotton/hr-(M ton/hr)[5]	2.15 (1.95)	2.15 (1.95)
Duration of run - minutes	64.0	64.0
<u>Particulates</u> - probe, cyclone and filter catch		
mg	71.2	5623.7
grains/DSCF[6]-(mg/Nm^3)	0.0420 (96.1)	0.104 (238.1)
lb/hr-(kg/hr)	0.597 (0.271)	1.32 (0.599)
lb/ton of lint cotton produced (Kg/M ton of lint cotton produced)	.278 (.139)	.614 (.307)

[1]Dry Standard Cubic Feet @ 70°F, 29.92 in Hg
[2]Dry Standard Cubic Feet per Minute @70°F, 29.92 in Hg
[3]Actual Cubic Feed per Minute - Stack Conditions
[4]Normal Cubic Meters at 21.1°C, 760 mm Hg
[5]Metric Tons per Hour (1 metric ton = 1000 Kg)
[6]Grains per Dry Standard Cubic Feet

SECTION III

PROCESS DESCRIPTION AND OPERATION

PROCESS DESCRIPTION

The following describes the process equipment and materials from which all emissions at subject plant are derived, and identifies each of those sources with the specific device being used to control emissions there from.

Reference is made to the drawings showing the plant flow diagram Figure 2 and location of each emission control device Figure 3. Details on the individual items of process equipment, mentioned in this process description, may be found in the Handbook for Cotton Ginners, Agriculture Handbook No. 260 (USDA), 1964.

Seed Cotton Unloading

Seed cotton is unloaded from trailers by means of telescoping suction tubes. The resulting air stream, containing seed cotton, passes through ductwork to a rock trap, where heavy impurties such as rocks and green bolls are removed, then to the unloading separator, where air and seed cotton are separated. The air from the unloading separator (containing impurities such as dust derived from the seed cotton) is drawn through the unloading fan to Cyclone Sets Nos. 6 & 7 in parallel.

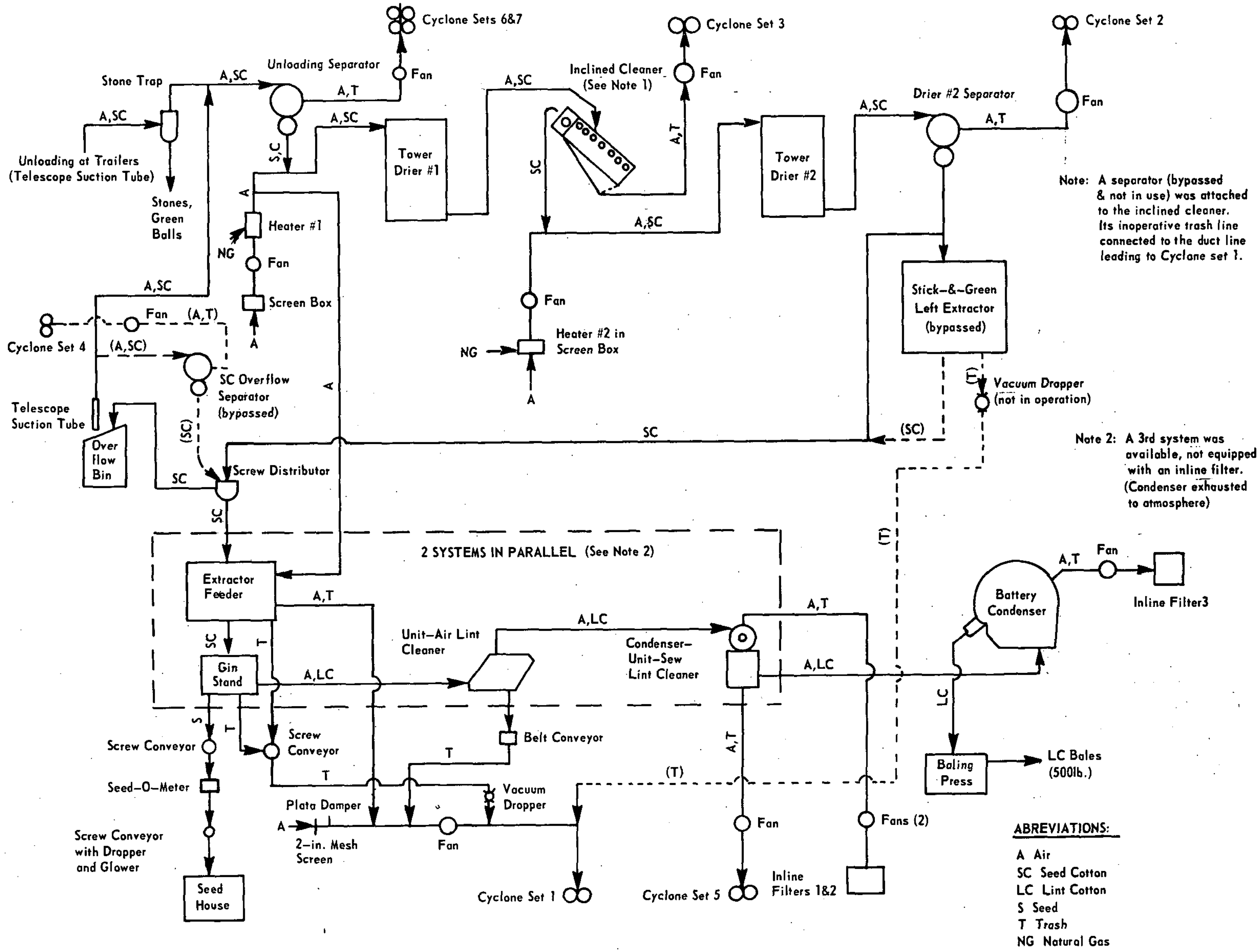

Figure 2. Plant Flow Diagram - Cotton Ginning Plant, Test No. 72-MM-23

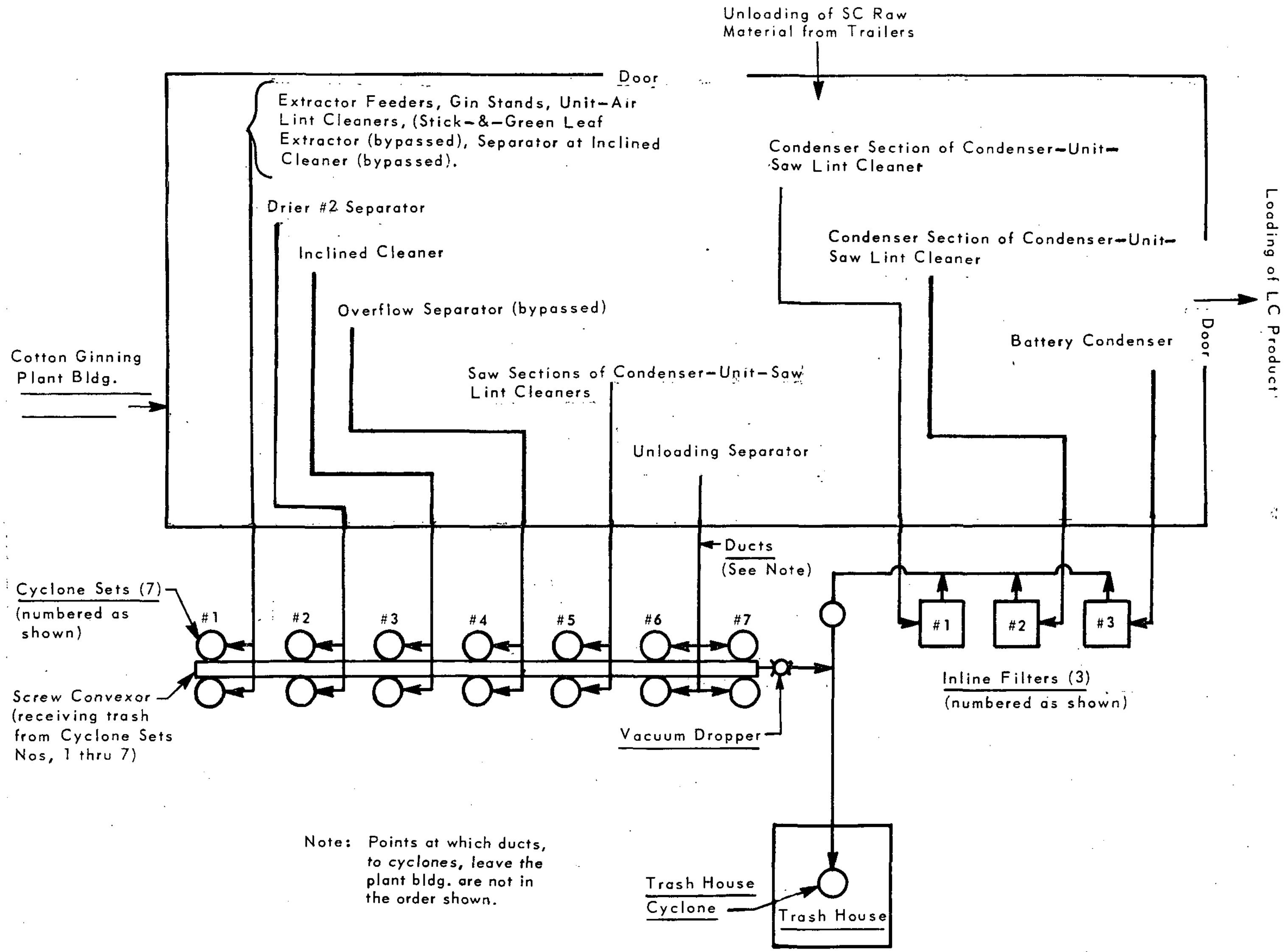

Figure 3. Location of Emission Control Devices - Cotton Ginning Plant, Test No. 72-MM-23

Seed Cotton Drying and Cleaning

A stream of hot gases is formed as a fan draws ambient air, from inside the plant, and forces it through Heater No. 1 where natural gas is burned and the resulting combustion products mix with the air stream.

Part of the hot gas mixture thus formed flows through a duct to the seed cotton outlet of the unloading separator, where the seed cotton is entrained and carried through Tower Drier No. 1 to the inclined cleaner. Gases, containing trash, are separated from the seed cotton in the inclined cleaner and are drawn through a fan to Cyclone Set No. 3

A stream of hot gases formed in Heater No. 2, similar to that formed in Heater No. 1, flows through a duct to the seed cotton outlet of the inclined cleaner, where the seed cotton is entrained and carried through Tower Drier No. 2 to the Drier No. 2 separator. Gases containing trash are separated from the seed cotton in that separator and are drawn through a fan to Cyclone Set No. 2. The seed cotton from that separator is channelled by gravity flow into the screw distributor, which carries it into the ginning system.

Ginning and Lint Cleaning

The screw distributor distributes seed cotton to two extractor feeders which, in turn, feed it to one gin stand each, at rates controlled to the gin stand capacity. When the flow of seed cotton from the screw distributor exceeds the total of the intake rates of the extractor feeders, the excess seed cotton flows into the overflow bin, from which it is picked up, at a suitable time, by a telescoping suction tube and routed again through the unloading separator and the seed cotton drying and cleaning system then back to the screw distributor.

Part of the hot gas mixture from Heater No. 1 flows into the two extractor feeders. Air, containing trash, is drawn from those extractor feeders into a duct having a vacuum, induced by a fan, wherein it is carried in a gas stream to Cyclone Set No. 1. The same gas stream receives trash from other sources which are shown in Figure 1, and which will be noted in the following paragraphs.

Additional trash from the extractor feeders and trash from the gin stands is carried by a screw conveyor to a vacuum dropper, thence into the duct carrying the gas stream to Cyclone Set No. 1.

Within the gin stands, lint cotton is separated from seed. The seed is removed to an elevated seed house by means of a screw conveyor, dropper, blower and ductwork. The lint cotton is carried in air streams through the unit-air lint cleaners (one for each gin stand), then through condenser-unit-saw lint cleaners (one for each gin stand), then to the battery condenser.

Trash from the unit-air lint cleaners is carried by belt conveyor to openings into the vacuum line to Cyclone Set No. 1. Air from the upper (condenser) section of each condenser-unit-saw lint cleaner (containing trash) flows through ducts to a fan, thence to an inline filter.

An additional system consisting of an extractor feeder, a gin stand, and lint cleaners (the same types as those just mentioned) was available and was put into operation during the last part of our test program. An inline filter was not available for this system; its condenser emissions were exhausted directly to atmosphere. Otherwise, this system operated in parallel and in the same way as the two similar, previously-operated systems.

Air streams from the saw units of the condenser-unit-saw lint cleaners (containing trash and motes) flow through a fan to Cyclone Set No. 5.

Air from the battery condenser (containing trash) flows through a fan to Inline Filter No. 3.

Lint cotton from the battery condenser flows into the baling press where the products, bales of lint cotton, are formed.

As shown in Figure 3, air and trash from inline Filters Nos. 1, 2 and 3 feed into a duct, thence through a fan to the outlet of the vacuum dropper removing trash from the screw conveyor under Cyclone Sets Nos. 1 through 7. Thus, trash from all inline filters and cyclones is entrained in a gas stream that carries it to the cyclone atop the trash house. The total trash is thus collected in the trash house which is elevated to facilitate periodic removal by dumping into a trailer or truck.

PROCESS OPERATION

The following list shows typical and peak process operation parameters for the sampled cotton gin.

Normal plant operating schedule:

10 hrs/day (1 shift)
5 days/week
12 weeks/year, plus a few days for remnants.
From October to December (ginning season).

Average plant operating capacity:

70 bales of lint cotton produced/day (2 gin stands)
90 bales of lint cotton produced/day (3 gin stands)

60,000 lbs of seed produced/day (2 gin stands)
70,000 lbs of seed produced/day (3 gin stands)

Capacity is based on one 10-hour shift per day; two hours downtime for maintenance; 9 bales per hour (2 gin stands operating); 11 bales per hour (3 gin stands operating); 800 lbs seed per bale lint cotton. Downtime periods range from a few minutes to several hours.

Peak plant operating capacity:*

140 bales of lint cotton produced/day (2 gin stands)
180 bales of lint cotton produced/day (3 gin stands)

120,000 lbs of seed produced/day (2 gin stands)
140,000 lbs of seed produced/day (3 gin stands)

* Based on two 10-hour shifts per day; other factors same as listed under "Average plant operating capacity."

The gin manager provided the following information on operation during sampling.[1] All seed cotton processed during sampling was machine-picked upland-type cotton. Weather prior to and during testing had been dry, causing the seed cotton entering the gin to be as dry as it ever was (estimated at 3% by the gin manager) in previous ginning seasons. Because of the dry conditions, the seed cotton contained more dust than usual. Production rate would have been about 30% higher had the moisture content been 8%. The natural gas-fired driers were in use during sampling; their

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[1] Extracted from "Trip Report-Bleckley Farm Service Company Cotton Ginning Plant", by William O. Herring; November 16, 1972.

purpose, however, was mostly to fluff the cotton to facilitate removing trash, rather than to reduce moisture content.

The ginning plant was originally designed by Lummus Cotton Gin Company in 1961. It was purchased used, moved to its present site, and operated for the first time by the present owners in 1972. Recorded production data show that when the gin operated smoothly, its production rate was about one 500-pound bale each seven minutes (9 bales per hour). Sampling was conducted from October 10 through October 19. From October 10 through 16 two gin stands were in use. On October 17 the third gin stand was put on line and was operated intermittently. The third gin stand was put to full use on October 18 and 19. Recorded data show that the production rate was not significantly changed by adding the third gin stand, indicating that production was limited by factors other than the number of operating gin stands.

Production data recorded by the EPA Project Engineer during sampling is summarized in Appendix B (Operation results) and the raw data is in the "Process and Production Data Sheets" in Appendix D (Operating Data Log).

SECTION IV

SAMPLING AND ANALYTICAL PROCEDURES

LOCATION OF SAMPLING POINTS

There are two types of emission control devices at the Bleckley Farm Service Company Cotton Gin; 3-42 inch in-line filters controlling emissions from the battery condenser and the lint cleaner condensers and 15-34" cyclones controlling emissions from the overflow separators, lint cleaners, unloading separator, dryer separators, extractor feeders, gin stands, and trash hopper.

The in-line filters were prepared for sampling by removing the rain shields and installing a 44" ID horizontal duct 166" long on both outlets of the filter. Sample ports were cut in the ducts for a horizontal sample traverse and a vertical upward traverse. The ports were located 133" (3.02 D) from the filter and 33" (.75 D) from the outside air, thus requiring 40 sampling points. The sample system was installed on the battery condenser (point No. 17, 17A) and on one of the lint cleaner condenser (points 14, 14A). The filter on the lint cleaner (14, 14A) was clogged and no samples were obtained at this site (or the corresponding inlet). The inlet to the battery condenser filter was 29" ID and sampling ports were cut 196" (6.75 D) from the building (beginning of straight run) and 70" (2.4 D) from the 90° elbow into the filter. This port location was a compromise between the sampling location and the available space for scaffolding. Twenty sampling points were required. A schematic of the in-line filter showing the sampling ducts and important dimensions are given in Figure 4.

The fifteen cyclones were approximately 34" in diameter with outlets ranging in size from 16 to 17". Each cyclone was equipped with a rain cap which had been adjusted to provide the proper back pressure for proper separation efficiency. The arrangement was not suitable for sampling as there was cyclonic flow from the device and no suitable straight length of pipe was available. To solve these problems, the rain cap was removed and replaced with an adapter to fit the top of the cyclone to a 16" ID 180° large radius sheet metal return bend with a bend radius of 2.5 D or 40 inches. The return bend was connected to a straightening vane and then to a length of 16" ID pipe. This arrangement directed the flow downward to allow sampling from lower scaffolding, and the straightening vane greatly reduced the cyclonic flow. The straight length of duct provided ample distance for the flow to be stabilized after the straightening vane. The candy cane as installed on the cyclone was estimated (without the contribution of the straightening vane) to be equal to at least 54 feet of straight pipe. This estimate is based on data in "Industrial Ventilation" published by the American Conference of Governmental Industrial Hygienists.

The straightening vanes were constructed of 20 gauge sheet metal following the honeycomb design suggested in "Fan Engineering" of the Buffalo Forge Company. The design criteria for the vane is to provide honeycomb squares of 7.5 to 15% of the diameter with the vane length to be three times the square size.

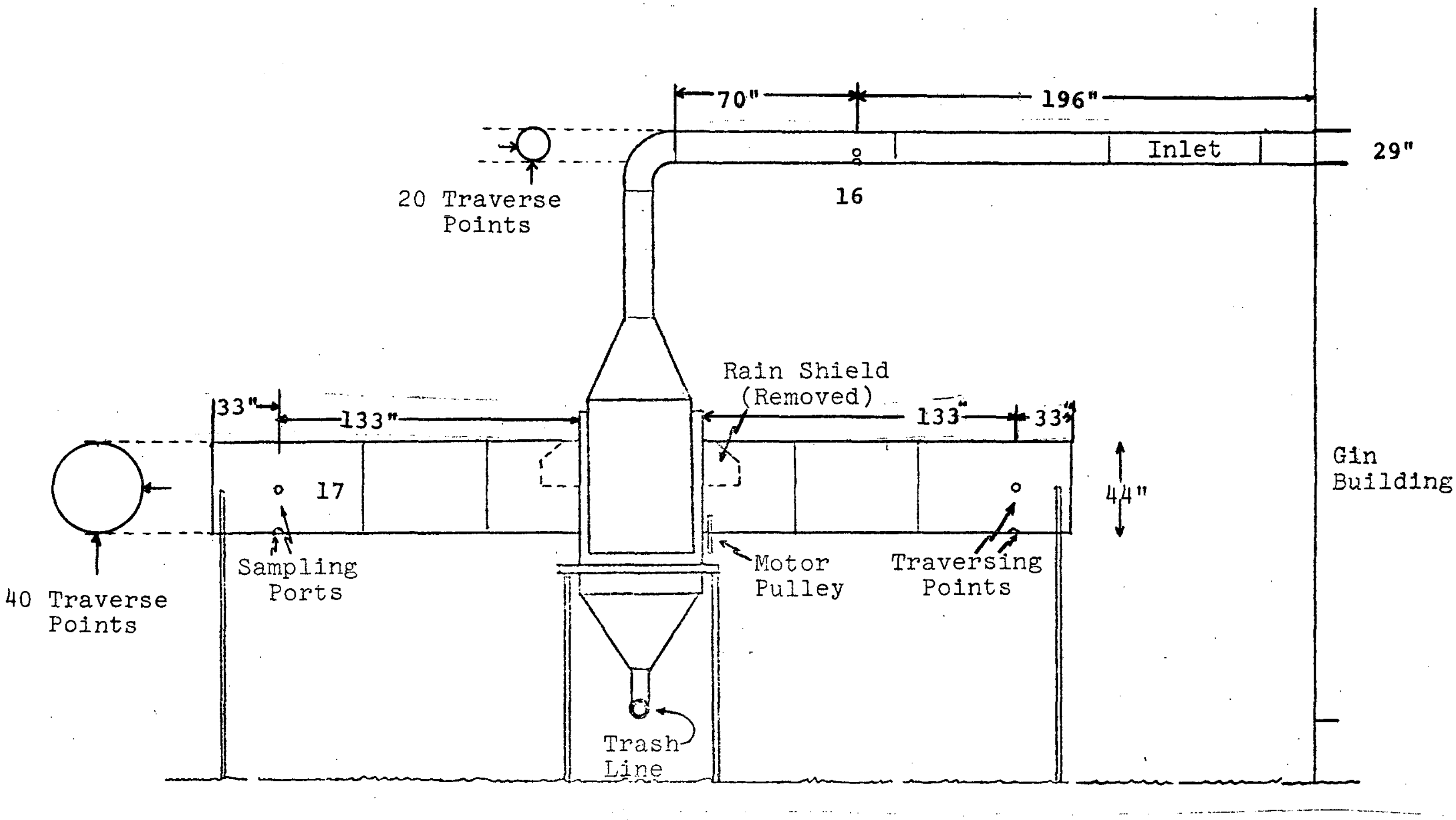

Figure 4. Schematic of In-Line Filter Showing Ducts and Sampling Ports

As a compromise between meeting the criteria and construction technique, the size of the squares in the honeycomb were 2.5" and the length of the vane 7.5". The final design of the vane is shown in Figure 5.

A total of five candy cane units were constructed, and these were moved from one cyclone bank to the next for sampling.

Different adapters were used depending on the size of the outlet of the cyclone. All adapter joints were sealed with furnace tape to assure a leak tight seal. The straight length of duct after the straightening vane was 194" long with 160" (10 D) from the vane to the ports and 34" (2.1 D) from the port to the atmosphere. As the duct has sufficient length, the minimum number of traverse point (12) can be used. This number was further reduced to 8 as the duct is less than two feet in diameter. No traverse points were chosen closer than 1 inch to the wall of the duct.

The inlets to the cyclones varied greatly in both diameter of duct and length of straight run available to meet sampling criteria. The pertinent data is as follows:

Point No.	Inlet from	Diameter of Duct (inches)	Upstream Distance (inches)	Downstream Distance (inches)	No. of Traverse Points
13	Unloading Separator	15	90 (6D)	15 (1D)	16
10	Inclined Cleaner	12	96 (8D)	72 (6D)	8
8	Extractor Feeders, etc.	12	96 (8D)	24 (2D)	8

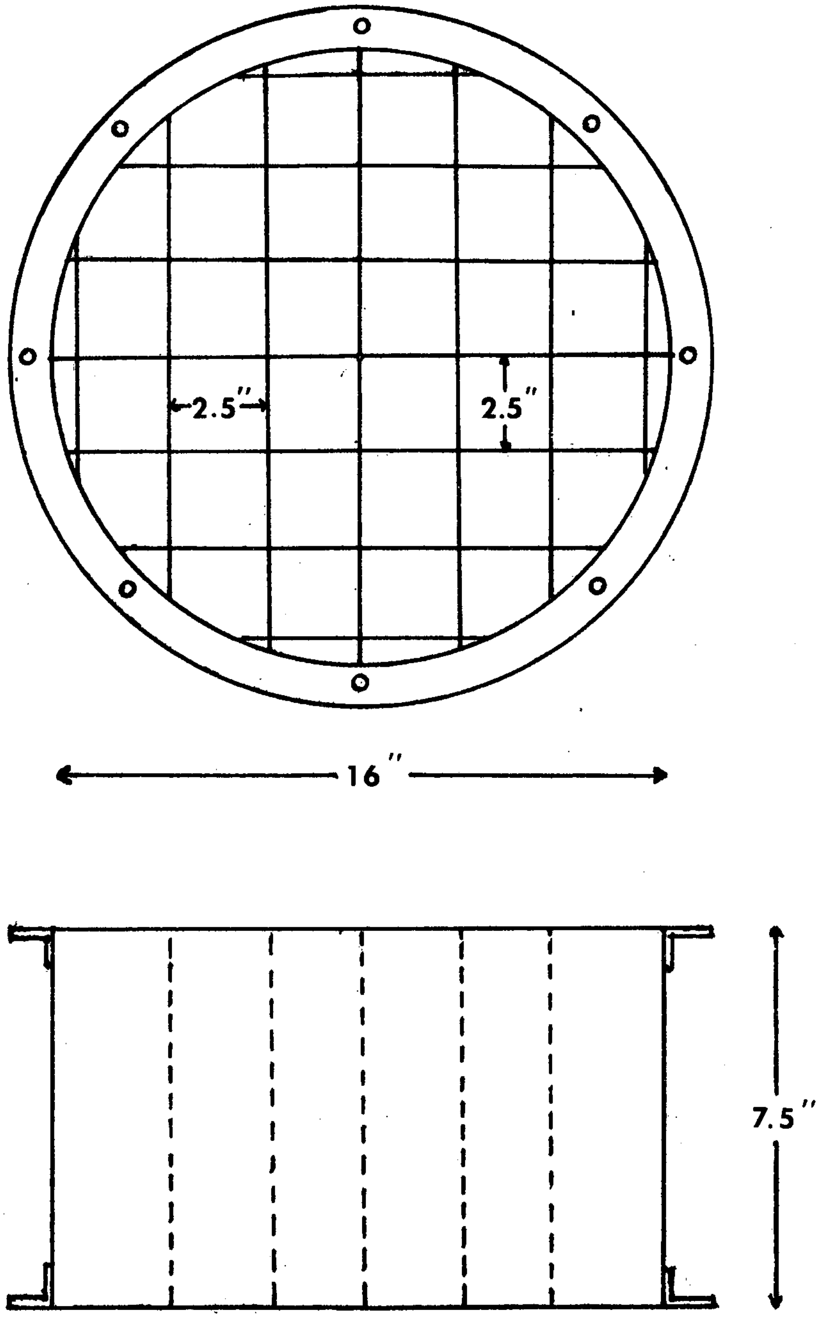

Figure 5. Diagram of Straightening Vane Construction

The schematic diagram of the inlets and outlet of the cyclone banks is given in Figures 6, 7, and 8.

During the testing program, it was found that blockage in the bottom end of the cyclone would cause larger trash to exit through the top of the cyclone, and quickly close off the passages in the straightening vane, forcing the gin to shut down. Inspection ports were cut into the 180° bend just above the vane for checking and clean-out. These ports were closed by sheet metal bonds during test runs.

Approximately one month prior to the beginning of the sampling program a subcontract was let to Snead's Sheet Metal Shop in Macon, Georgia, to construct the ducts, elbows, and straightening vanes. These were transported to the gin along with the necessary scaffolding and lumber. Prior to the first day of sampling, the ducts were erected in the in-line filters and on several of the cyclones. Men and a boom truck were supplied by Snead's to move the ducting from one cyclone to the next during the sampling program.

Sufficient electrical power was not available at this cotton gin. Ward's Electrical Service of Hawkensville, Georgia, installed a 60 amp transformer to convert the 440 V gin voltage to 110 V, 60 hertz service required by the sampling equipment.

SAMPLING PROCEDURES

The outlets from all of the control devices at the cotton gin were sampled generally in accordance with the Methods given in the August 17, 1971, Federal Register. One exception was the use of the wet bulb-dry bulb technique to

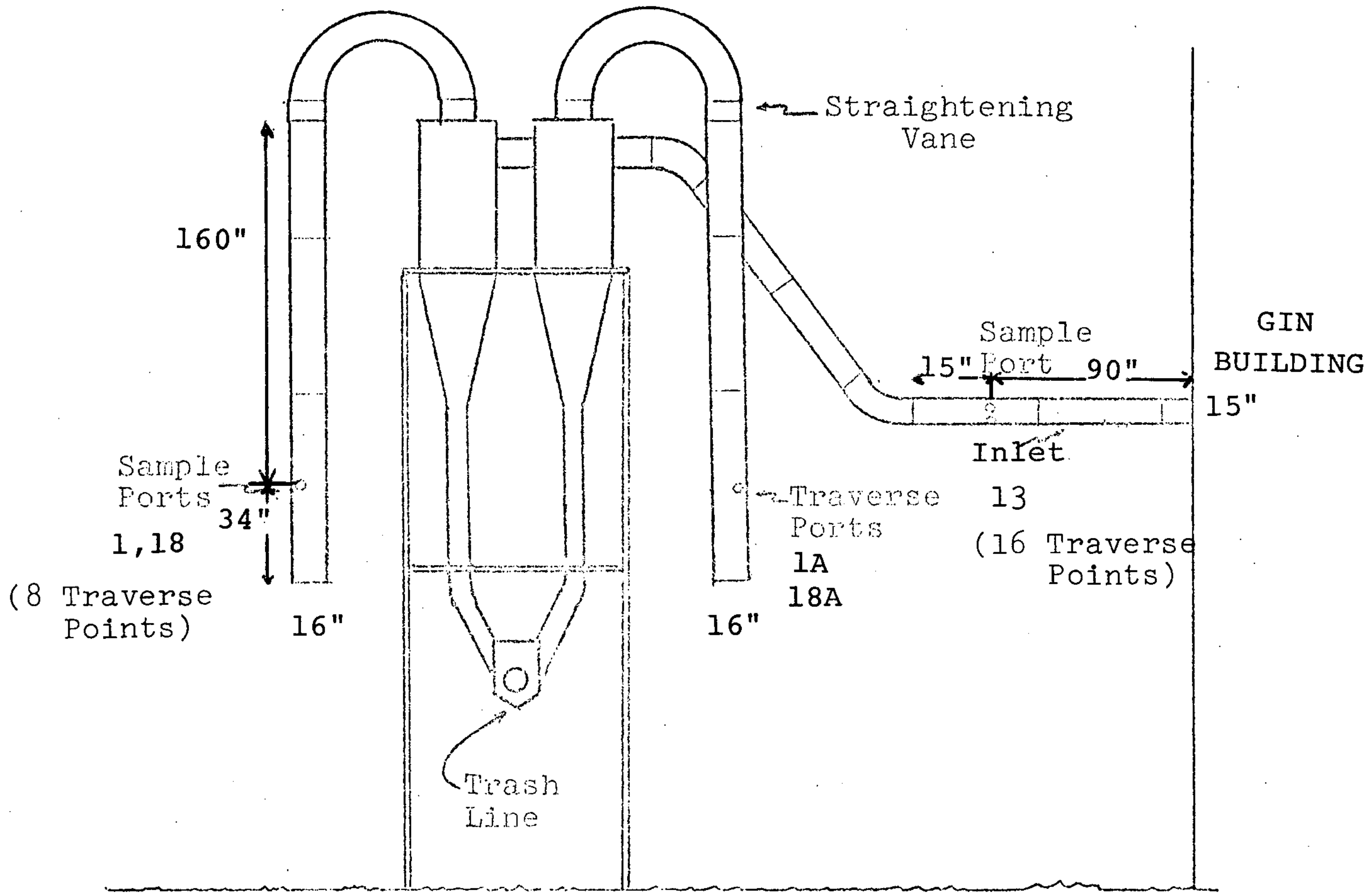

Figure 6. Schematic Diagram of Outlet Ducts, 1, 18, 1A, 18A, and Inlet Duct 13

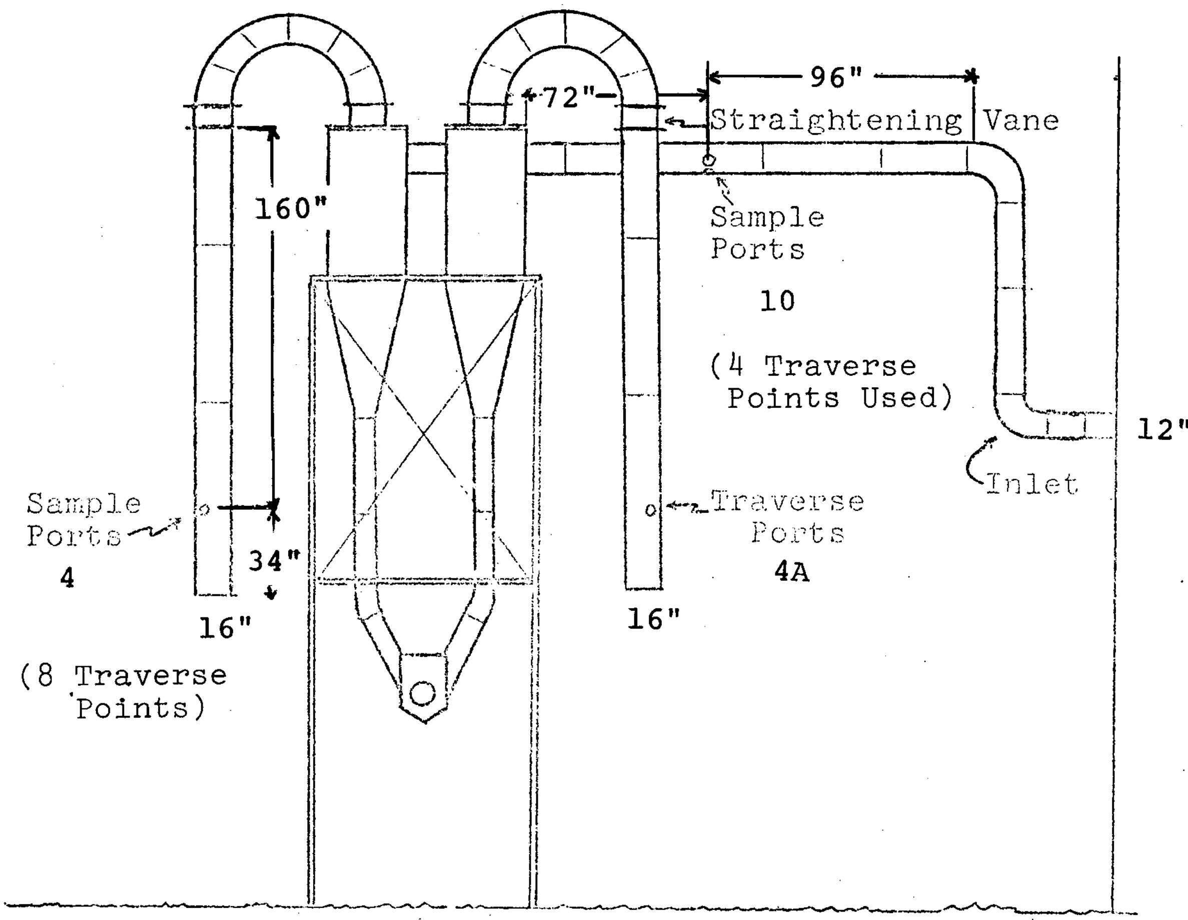

Figure 7. Schematic Diagram of Outlet Ducts 4 and 4A, and Inlet Duct 10

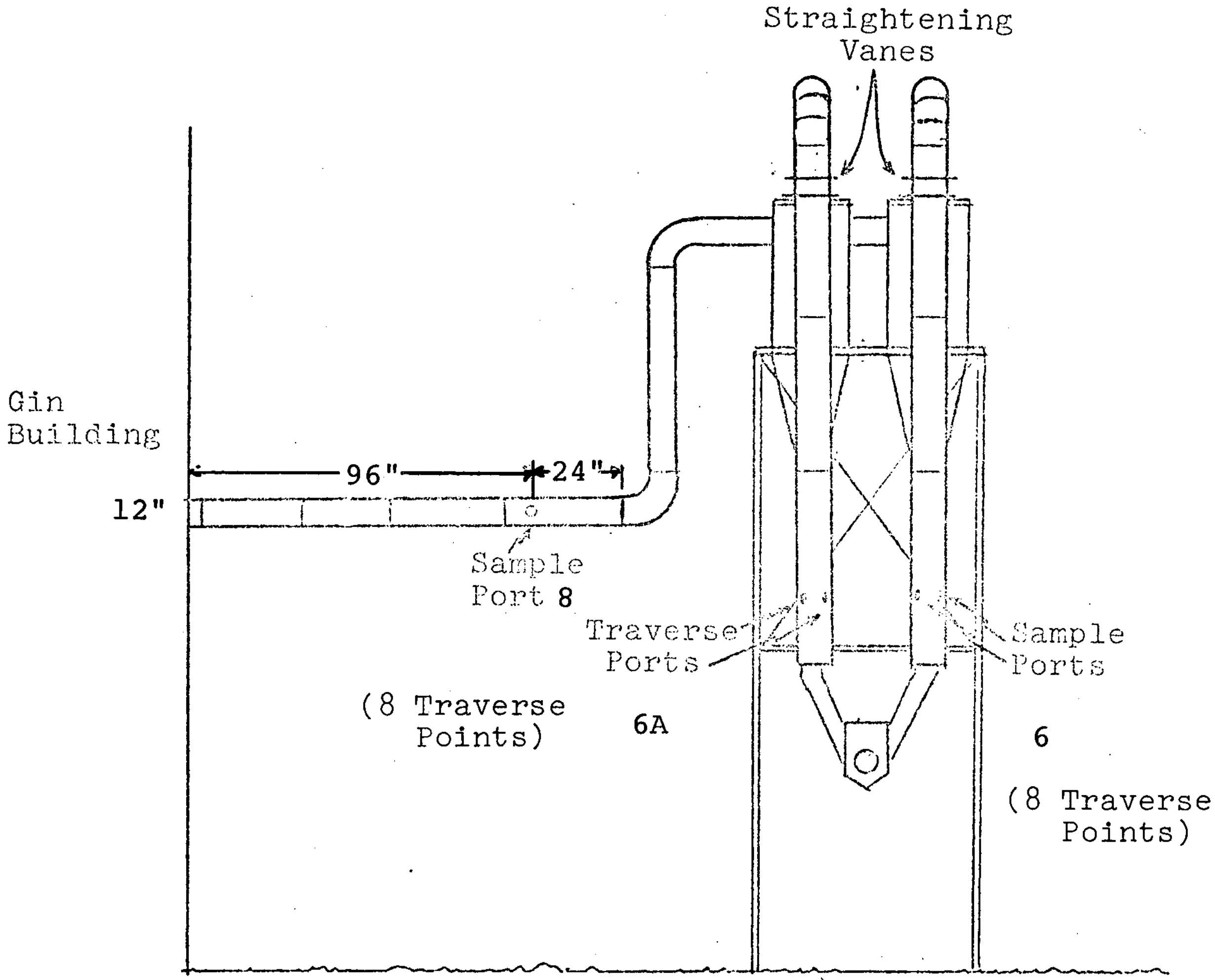

Figure 8. Schematic Diagram of Inlet Duct 8, and Outlet Ducts 6 and 6A

obtain initial moisture levels, rather than Method 4, Determination of Moisture in Stack Gases. The low moisture levels (1-4%) and low stack temperatures (below 212°F) permitted the use of this deviation.

Method 5 of the Federal Register Methods was used to obtain the emission rate of all sampled outlets. During these sample runs, any unsampled outlets in the same cyclone bank or connected to the same control device were traversed to obtain the velocity profile and stock temperature following Method 2. If it is assumed that the loading in grains/standard cubic foot is the same at all outlets of the control devices in one unit, the emission rate in lb/hr would be a function of the differences in velocity at the outlets. The loading in grains/cubic foot were obtained from the Method 5 data, and from the velocity traverse of the unsampled ducts, the emission rate in lb/hr can be calculated for each individual outlet.

Run 18-4 was designed to accomplish two objectives. First, the water in the second impinger was replaced with 100 ml of 2% NaOH. The combination of water in the first impinger and sodium hydroxide in the second was to trap arsenic acid. The sampling train was operated in a normal manner. The second objective of this run was to provide a comparison of data obtained by Method 5 apparatus with the High Volume sampler. Run 18-4H, the High Volume run, was conducted simultaneously with run 18-4.

No conditions were encountered during this sampling program that were beyond the normal operating parameters of the Method 5 sampling apparatus. The sampling runs were stopped however when portions of the gin ceased operation of if unusual conditions occurred in the gin. The runs were restarted when normal operation resumed.

A High Volume sampler designed and constructed by EPA was used on the inlets to the control devices. These inlets usually contained large quantities of relatively large size particulate matter. In addition, the velocities in these ducts were quite high. Both of these factors made it impractical to attempt to sample the inlets with a Method 5 sampling train.

The High Volume sampler consisted of a 1-1/2 inch stainless steel probe and nozzle, a cyclone collector, a 8-1/8 x 10-1/2 inch filter holder for a 8-1/2 x 11 fiberglass filter (MSA 1106 B), a Roots meter, flow orfice, and the necessary pump and control devices. Details of the sampler and the equations relating to its use are given in Appendix E.

Sampling of the inlets with the High Volume apparatus was conducted simultaneously with Method 5 sampling on the outlets to permit the calculation of efficiency data on the control devices. Sampling at Point 13, inlet to the unloading separator cyclone and Point 16, inlet to the battery condenser filter, were of the same time duration as the corresponding outlets. However, on Points 8, inlet to the extractor feeder, gin stand cyclones, and 10, inlet to the inclined cleaner cyclones, only very short runs were possible due to the extremely high loading levels in the inlet. In these ducts, sampling times were made as long as possible without completely filling the cyclone and filter.

ANALYTICAL PROCEDURES

Samples from the Method 5 sampling trains were recovered as outlined in the August 17, 1971, Federal Register. After removal of the filter, all sample exposed surfaces were washed with reagent grade acetone or distilled water as specified. All sample bottles for liquid samples were obtained from Wheaton Scientific, Catalogue No. 219630. Each of these bottles and the petri dishes for sample filters were acid soaked with 1:1 HNO_3 for one day, rinsed with distilled water and soaked with distilled water for one day.

Sample recovered from the High Volume sampler included removal of the filter and placing it in a large mouth bottle, removal of the cyclone bottle and sealing it, and washing of all exposed surfaces of the train with acetone. Acetone washings were placed in acid washed Wheaton bottles.

Analytical procedures for the Method 5 samples follow the Federal Register guidelines, with one exception. Container No. 3 as indicated in the method contains water from the impingers and washing of the glassware of the train. The solution was extracted with chloroform and ether, and then the extracted portion was dried to constant weight, as specified. In addition, the remaining water after extraction was evaporated to dryness at 212 °F to constant weight. Both weights were included in the total mass of particulate.

Sample weight from the Method 5 samplers were reported as "front half" (probe washings and filter collection weights) and "total" (front half plus water, chloroform-ether extract and impinger acetone washing weights).

The analytical procedure for the High Volume sampler is similar to the front half of the Method 5 procedure. The filter is dried to constant weight as is the dry cyclone catch. The acetone washing of the probe and all surfaces up to the filter were evaporated and dried to constant weight. The total particulate mass is the sum of the weight of the three parts.

All dried samples from the runs were submitted to the EPA. Specific samples were analyzed pesticides, arsenic, and trace metals. The results are summarized in Appendicies H, I, and J.