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AP

Particleboard Production Facility Emission Test Report

Georgia-Pacific Corporation
Vienna, Georgia

EMISSION TEST REPORT

HAP EMISSION TESTING OF SELECTED SOURCES AT A PARTICLEBOARD PRODUCTION FACILITY

GEORGIA-PACIFIC CORPORATION
Vienna, Georgia

ETS Subcontract No. 4184
Contract No. 68D20029
Work Assignment No. 1-09

Prepared for:

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WESTON Work Order No. 10202-001-001
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SECTION 1
INTRODUCTION

1.1 BACKGROUND

The purpose of this test program was to assist EPA in the development of emission factors for selected hazardous air pollutants (HAPs) emitted from several processes associated with the wood products industry. Roy F. Weston, Inc. (WESTON) was contracted to conduct the air emissions testing at Georgia-Pacific Corporation (G-P) in Vienna, Georgia during January 18 to January 23, 1993. The processes that were tested include:

- Surface dryer and core dryer cyclones (Stacks 1 and 2, respectively);
- Particleboard press - 3 roof vents (Stacks 3, 4, and 5).

A detailed description of the processes is presented in Section 2. A summary of the emission results is presented in Section 3. Parameters and sampling locations are further discussed in Section 4. Descriptions of sampling and analytical methods are included in Section 5. Quality control measures employed during this program are described in Section 6. Appendices A-D contain information for verification of this report.

1.2 PROGRAM OBJECTIVES

The objectives of the test program were to:

- Collect valid, representative samples during normal process operation conditions of the sources to be evaluated.
- Measure the emissions of aldehyde/ketones, carbon monoxide, condensible particulate, nitrogen oxides, PM_{10}, semivolatile organics, total hydrocarbons, total particulate matter, and volatile organics, at two dryer cyclones.
- Measure aldehyde/ketones, condensible particulate, PM_{10}, and total hydrocarbon, emissions from the press vents (3 locations).
- Obtain sufficient process information to assess representative operating conditions.
- Document all data in a comprehensive report.

1.3 KEY PERSONNEL

Figure 1-1 presents the organization and major lines of communication for this test program.

1.4 OUTLINE OF TEST PROGRAM

The types of samples collected were dependent on the location being evaluated. Pollutants that were measured include:

- Aldehyde/ketones
- Carbon monoxide
- Condensible particulate
- Nitrogen Oxides (NO_x)
- PM_{10}
- Particulate matter
- Semivolatile organics
- Total hydrocarbons
- Volatile organics

Table 1-1 is a test log which presents the sampling locations, emissions measured, test dates, types of sampling, and run numbers.

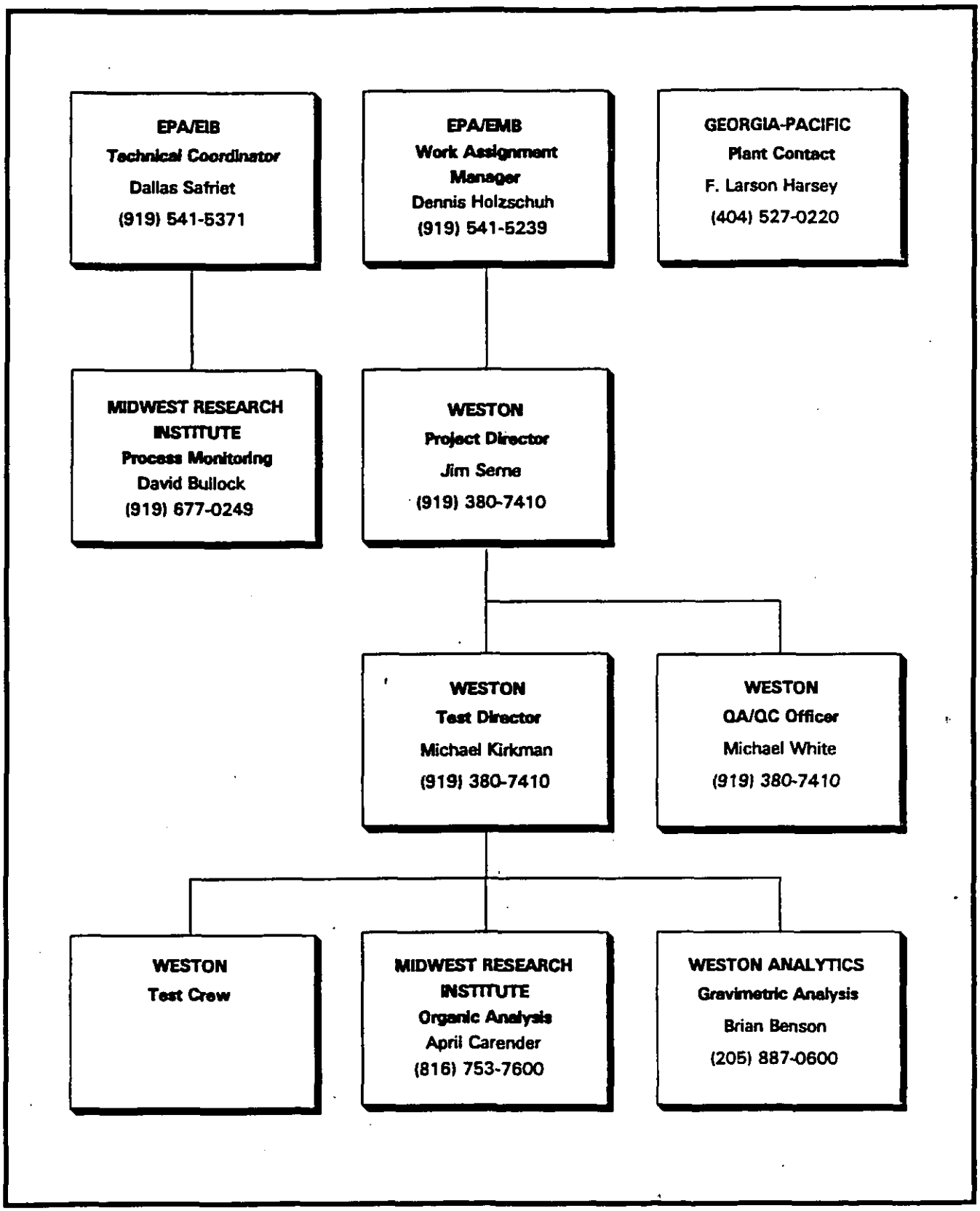


Figure 1-1
Test Program Organization Chart

FIG1-1.G-P

TABLE 1-1

Test Log

Sampling Location	Emissions Measured	Type of Sampling	Run Numbers\Test Date\Clock Time Repetition		
			1	2	3
Surface Dryer Cyclone Outlet (Stack 1)	Aldehydes/ Ketones	Method 0011	GP-S1-M0011-1 1/19 (1359-1522)	GP-S1-M0011-2 1/20 (840-950)	GP-S1-M0011-3 1/20 (1355-1500)
	Carbon Monoxide	Method 10	GP-S1-CEM-1 1/19 (830-1115)	GP-S1-CEM-2 1/19 (1135-1423)	GP-S1-CEM-3 1/19 (1450-1845)
	Nitrogen Oxides	Method 7E	GP-S1-CEM-1 1/19 (830-1115)	GP-S1-CEM-2 1/19 (1135-1423)	GP-S1-CEM-3 1/19 (1450-1845)
	Particulate & Condensibles	Method 5/202	GP-S1-M5/202-1 1/18 (1730-1854)	GP-S1-M5/202-2 1/19 (1520-1630)	GP-S1-M5/202-3 1/21 (857-1056)
	PM10	Method 201A	GP-S1-M201A-1 1/19 (1130-1304)	GP-S1-M201A-2 1/20 (1717-1817)	GP-S1-M201A-4 1/21 (855-1100)
	Semivolatile HAPs	Method 0010	GP-S1-M0010-1 1/19 (850-1225)	GP-S1-M0010-2 1/20 (928-1244)	GP-S1-M0010-3 1/20 (1605-1930)
	Total Hydrocarbons	Method 25A	GP-S1-CEM-1 1/19 (830-1115)	GP-S1-CEM-2 1/19 (1135-1423)	GP-S1-CEM-3 1/19 (1450-1845)
	Volatile HAPs	Method 0030	GP-S1-M0030-1 1/19 (947-1154)	GP-S1-M0030-2 1/20 (939-1119)	GP-S1-M0030-3 1/20 (1612-1749)
Core Dryer Cyclone Outlet (Stack 2)	Aldehydes/ Ketones	Method 0011	GP-S2-M0011-1 1/19 (1532-1644)	GP-S2-M0011-2 1/20 (853-952)	GP-S2-M0011-3 1/20 (1428-1627)
	Carbon Monoxide	Method 10	GP-S2-CEM-1 1/20 (830-1155)	GP-S2-CEM-2 1/20 (1215-1635)	GP-S2-CEM-3 1/20 (1700-2040)
	Nitrogen Oxides	Method 7E	GP-S2-CEM-1 1/20 (830-1155)	GP-S2-CEM-2 1/20 (1215-1635)	GP-S2-CEM-3 1/20 (1700-2040)
	Particulate & Condensibles	Method 5/202	GP-S2-M5/202-1 1/19 (1620-1740)	GP-S2-M5/202-2 1/19 (1732-1845)	GP-S2-M5/202-3 1/21 (855-1055)
	PM10	Method 201A	GP-S2-M201A-1 1/19 (1145-1308)	GP-S2-M201A-2 1/20 (1812-1901)	GP-S2-M201A-3 1/20 (1210-1427)
	Semivolatile HAPs	Method 0010	GP-S2-M0010-1 1/19 (850-1342)	GP-S2-M0010-2 1/20 (925-1302)	GP-S2-M0010-3 1/20 (1620-2022)
	Total Hydrocarbons	Method 25A	GP-S2-CEM-1 1/20 (830-1155)	GP-S2-CEM-2 1/20 (1215-1635)	GP-S2-CEM-3 1/20 (1700-2040)
	Volatile HAPs	Method 0030	GP-S2-M0030-1 1/19 (850-1049)	GP-S2-M0030-2 1/20 (928-1101)	GP-S2-M0030-3 1/20 (1624-1739)
Press Stack 3	Aldehydes/ Ketones	Method 0011	GP-S3-M0011-1 1/22 (1603-1836)	GP-S3-M0011-2 1/22 (1930-2058)	GP-S3-M0011-3 1/23 (845-1017)
	PM10 & Condensibles	Method 201A/202	GP-S3-M201A-1 1/22 (923-1301)		
	Total Hydrocarbons	Method 25A	GP-S3-M25A-2 1/22 (1440-1655)	GP-S3-M25A-3 1/22 (1930-2107)	GP-S3-M25A-4 1/23 (838-1030)
Press Stack 4	Aldehydes/ Ketones	Method 0011	GP-S4-M0011-1 1/22 (1603-1836)	GP-S4-M0011-2 1/22 (1930-2058)	GP-S4-M0011-3 1/23 (845-1017)
	PM10 & Condensibles	Method 201A/202	GP-S4-M201A-1 1/22 (923-1308)		
	Total Hydrocarbons	Method 25A	GP-S4-M25A-2 1/22 (1440-1655)	GP-S4-M25A-3 1/22 (1930-2107)	GP-S4-M25A-4 1/23 (838-1030)
Press Stack 5	Aldehydes/ Ketones	Method 0011	GP-S5-M0011-1 1/22 (1603-1836)	GP-S5-M0011-2 1/22 (1930-2058)	GP-S5-M0011-3 1/23 (845-1017)
	PM10 & Condensibles	Method 201A/202	GP-S5-M201A-1 1/22 (923-1445)		
	Total Hydrocarbons	Method 25A	GP-S5-M25A-2 1/22 (1440-1655)	GP-S5-M25A-3 1/22 (1930-2107)	GP-S5-M25A-4 1/23 (838-1030)

SECTION 2
PROCESS DESCRIPTION AND OPERATION

The following sections describe the particleboard manufacturing process and the process operation during testing at Georgia-Pacific. First, a description of the process is presented. Then, process operation during the test are described.

2.1 PROCESS DESCRIPTION AND OPERATION

Three grades of particleboard are produced at the plant, with the lowest grade being used for underlayment and decking, and the highest grade being used in the manufacture of furniture.

Figure 2-1 is a flow diagram of the particleboard manufacturing process at Facility C. Emission sources tested at the facility are indicated as S1, S2, S3, S4, and S5 on Figure 2-1. Planer shavings, plywood trim, sawdust, and whole tree chips are received at the plant by truck. The trucks empty the material onto a conveyor, and the newly arrived wood is screened to remove large pieces. An operator then positions a pivoting boom conveyor to pile the screened material according to moisture content, particle size, and wood type. Relatively dry material is piled under a three-sided enclosure. Material with a higher moisture content is piled outdoors. A front-end loader loads material from these piles onto a conveyor that leads to the milling and drying (M&D) building. The ratio of moisture contents and wood types are predetermined such that the front-end loader operator will take varying amounts of raw material from different piles to achieve an average moisture content (generally around 14 percent) and wood species mix (typically all pine, or six parts pine to one part hardwood).

When the material reaches the M&D area, it first passes through two screens that separate the wood into three cuts. The largest and middle size cuts are sent to the mills for further size reduction. The smallest cut (fines) bypasses the mills. The material that is to be reduced further is fed into either the Pallman mills or the Bauer mills, depending on the type of product being made at the time. The Pallman mills produce a coarser particle for lower grade boards or core material. The Bauer mills generate much finer particles for higher quality boards and face

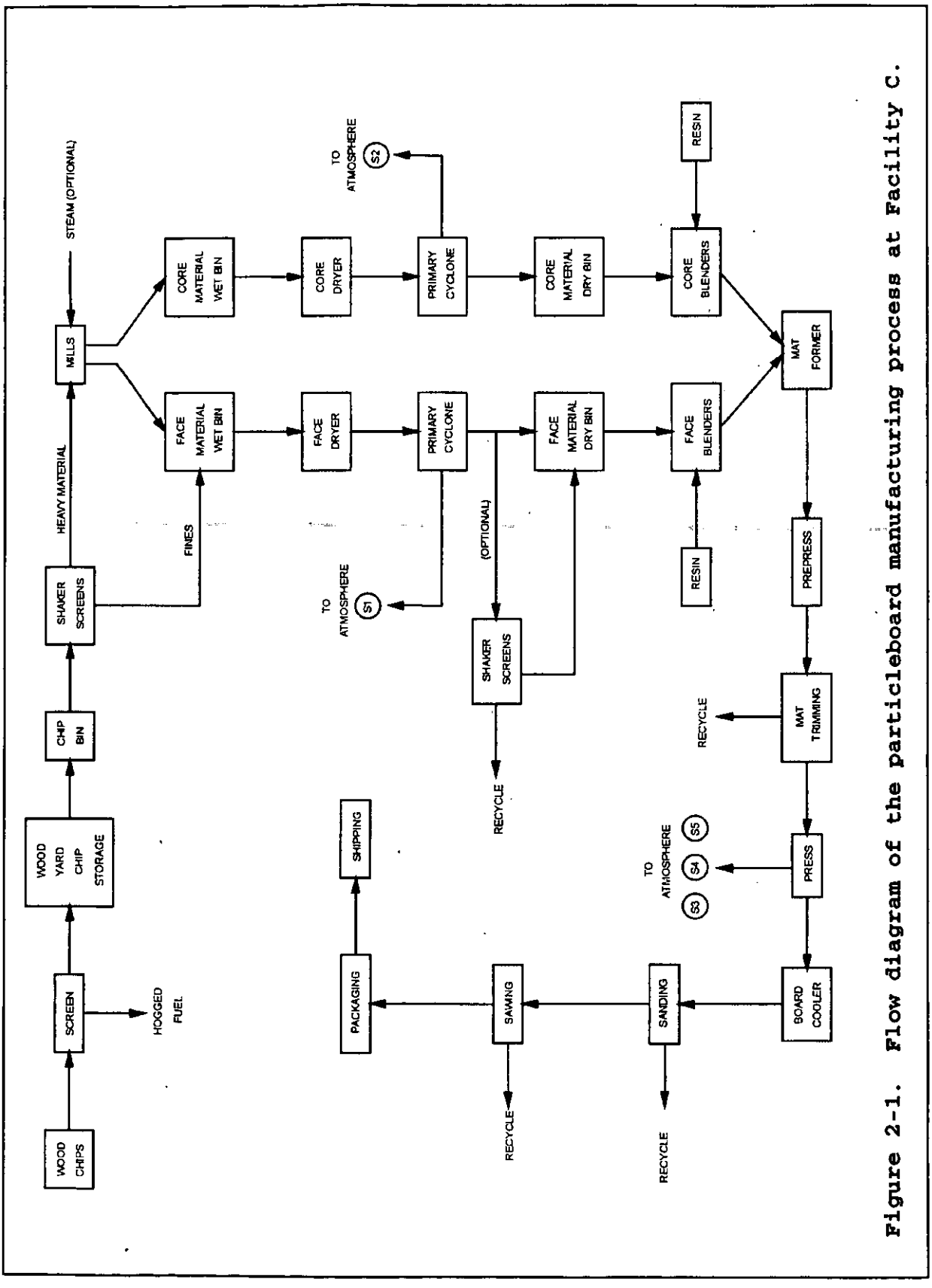


Figure 2-1. Flow diagram of the particleboard manufacturing process at Facility C.

material. Steam may be injected into either type of mill if a fibery, spongy material is needed. Steam is not added if a finer, more powdery product is desired.

The freshly milled face material, along with the fines from the screens, passes through a blowpipe to a cyclone that removes any remaining oversized material before the face material enters the face dryer. The oversized material is recycled to the mills. Similarly, the freshly milled core material passes through a cyclone prior to entering the core dryer. Both the face and core dryers are identical McConnell wood-fired triple-pass rotary dryers, located inside the M&D building. The moisture content of the material leaving the face dryer ranged from 6 to 9 percent, with an average of 7 percent during the test program. The moisture content of the material leaving the core dryer ranged from 4 to 8 percent, with an average of 6 percent during the test program.

The dried particles from each dryer are collected in a separate dedicated primary cyclone. Generally, the collected particles are then conveyed directly to the face material and core material dry storage bins in the blending and forming (B&F) building. However, when the mill is producing its highest-grade board, "microfine," the dried particles are screened once more before being conveyed to the dry bins.

From the dry bins, the face and core materials are conveyed to the two face blenders and the two core blenders, respectively, where they are mixed with the appropriate amounts of urea-formaldehyde resin, wax, and formaldehyde scavenger. The scavenger is added to help reduce formaldehyde emissions.

The resinated particles are then transferred to the two face and two core forming heads. The forming heads are arranged to produce a three-layer board with a core layer between two layers of face material. The forming heads lay down a continuous mat on the cauls moving below. Each caul is designed to carry a single mat that will fit into one of the press openings. The cauls are butted end to end as they pass under the forming heads. When the first caul passes from beneath the forming heads, it reaches a faster-moving conveyor that pulls the caul and its mat away from the next caul, thus separating the continuous mat into individual mats.

The newly separated mats then go to the prepress where they are compressed slightly at a temperature of 54°C (130°F) to consolidate the mats prior to trimming and final pressing. After the mats exit the prepress, first the sides and then the back and front ends of the mat are trimmed. After trimming, each mat measures approximately 135 cm x 757 cm (52.25 in. x 298 in). The trimmed material is recycled into the process.

The trimmed mats then are fed into the press loader. The loader holds 14 mats, which are loaded into the 14-opening, steam-heated press simultaneously. The press cycle consists of five stages: (1) loading the mats, (2) closing the press, (3) raising the pressure to the prescribed maximum, (4) decompressing to a much lower pressure and holding it for a prescribed length of time, and (5) full decompression followed by opening of the press. During the decompression and opening of the press, a dense, blue-gray plume escapes and is exhausted through three vents above the press. Press cycle time varies to account for variations in board thickness, board density, moisture content, and resin content. However, the press generally operates at a temperature of 154°C (310°F), a maximum pressure of 16,200 kilopascals (kPa) (2,350 pounds per square inch [psi]), and a holding pressure of 3,450 kPa (500 psi) regardless of board thickness or other factors.

As the next press load is entering the press, the previous load exits onto the press unloader. The unloader accepts all 14 pressed boards simultaneously and releases them one-by-one to the board cooler. The fan-type board cooler accepts the hot boards and retains them in an upright position for five press loads (15 to 30 minutes or more depending on the press cycle and the continuity of the process). As a new board enters the cooler, the oldest board is released.

As boards are released from the cooler, they are conveyed to an automatic stacker that accumulates a specified number of boards and then releases the stack to be carried by forklift to a holding area. Later, the boards are finished by trimming, sanding on both sides, and cutting into sizes specified by the customer. The finished boards are then bundled and packaged for shipping.

2.2 PROCESS OPERATION DURING TESTING

The test program at Vienna consisted of taking emissions measurements from five emission points: the face particle dryer primary cyclone outlet, the core particle dryer primary cyclone outlet, and three particleboard press vents (designated as loader, press, and unloader).

Emissions from the two dryers and the press vents are uncontrolled. The primary cyclones serve as product recovery devices and are not considered to be add-on emission control devices. Emissions from the press are vented through three uncontrolled roof vents: one above the press loader, one above the press itself, and one above the press unloader. All three vents were sampled simultaneously to obtain the particleboard press emission rates. According to plant personnel, these three vents exhaust approximately 98 percent of the emissions from the press. Partitions in the rafters of the building serve as a hood above the press to aid in capturing the press emissions. However, some emissions from the press escape this hood and are released through other general building exhaust fans or doorways. The number and location of open doors and the prevailing wind direction would affect the capture efficiency of this hood arrangement.

2.2.1 Face Dryer

In general, the face dryer operated normally during the test. Only two test interruptions occurred, neither of which was due to a problem with the dryer. The nature of the interruptions and the test runs during which they occurred are provided in Table 2-1. According to plant personnel, the process interruptions cited in Table 2-1 are routine occurrences. The interruption on January 21 due to a thunderstorm did not affect the process; the dryer continued to run normally.

TABLE 2-1. FACE DRYER (S1) TEST INTERRUPTIONS

Day	Testing down time	Test runs affected	Reason for test interruption
1/19	09:00-09:14	M0010, Run 1	Side trim conveyor down; face material dry bin full; operator had to shut down face dryer
1/21	09:45-10:35	M5/202, Run 3 M201A, Run 4	Thunderstorm; test crew had to come down from stack; process not affected

The following parameters were monitored throughout the test and were logged at ten minute intervals:

Time;
Dryer inlet particle moisture content (%);
Dryer outlet particle moisture content (%);
Dryer inlet gas temperature (°F);
Dryer outlet gas temperature (°F);
Dryer particle throughput (lb/hr); and
Particle feed to the former (lb/hr).

Dryer process data log sheets and plant records containing the raw data can be found in Appendix E.

Table 2-2 summarizes the process rates and operating temperatures for each test run. The dryer throughput was measured using scales located on the conveyor belt that transferred the dried material to the B&F building. The dryer throughput rate was displayed on a digital readout that fluctuated rapidly, making it impractical to read a given value to more than the nearest thousand pounds. However, readings from the display were taken every ten minutes for the duration of each test run and averaged to obtain the average throughput for that run. According to plant personnel, the display fluctuates because the scales are small and material is not spread uniformly on the conveyor. The production rates do not include data taken during test interruptions. The average dryer inlet moisture content over all the dryer test runs was 17 percent. The average dryer outlet moisture content over all the dryer test runs was 7 percent.

2.2.2 Core Dryer

During testing of the core dryer there were five test interruptions, none of which was due to a problem with the dryer. The nature of the interruptions and the test runs during which they occurred are provided in Table 2-3. According to plant personnel, the process interruptions cited in Table 2-3 are routine occurrences. The interruption on January 21 due to a thunderstorm did not affect the process; the dryer continued to run normally.

TABLE 2-2. FACE DRYER (S1) PROCESS RATES DURING TESTING

Test method	Run No.	Date	Average temperature				Throughput[a]			
			Inlet		Outlet		Range		Average	
			C	F	C	F	lb/hr	kg/hr	lb/hr	kg/hr
M5/202	1	1/18	75.2	167	44.8	113	28,000-34,000	13,000-15,000	30,000	14,000
	2	1/19	120	248	53.6	128	21,000-39,000	10,000-18,000	32,000	15,000
	3	1/21	117	242	49.6	121	25,000-34,000	11,000-15,000	30,000	14,000
M0010	1	1/19	112	233	54.4	130	18,000-38,000	8,000-17,000	29,000	13,000
	2	1/20	118	244	49.7	121	16,000-32,000	7,000-15,000	29,000	13,000
	3	1/20	131	268	51.7	125	20,000-38,000	9,000-17,000	27,000	12,000
M0011	1	1/19	95.6	204	51.4	125	12,000-34,000	5,000-15,000	26,000	12,000
	2	1/20	109	228	48.8	120	16,000-36,000	7,000-16,000	28,000	13,000
	3	1/20	137	278	54.2	130	11,000-26,000	5,000-12,000	22,000	10,000
M0030	1	1/19	117	243	55.8	132	18,000-38,000	8,000-17,000	29,000	13,000
	2	1/20	127	260	50.4	123	23,000-32,000	10,000-15,000	29,000	13,000
	3	1/20	132	270	51.6	125	22,000-38,000	10,000-17,000	28,000	13,000
M201A	1	1/19	103	217	53.3	128	17,000-37,000	8,000-17,000	28,000	13,000
	2	1/20	124	256	50.9	124	20,000-38,000	9,000-17,000	29,000	13,000
	3	1/20	120	248	50.0	122	25,000-30,000	11,000-14,000	28,000	13,000
	4	1/21	105	222	51.4	124	25,000-34,000	11,000-15,000	30,000	14,000

[a]Throughputs are in pounds per hour (lb/hr) and in kilograms per hour (kg/hr) of dried particles from the dryer.

TABLE 2-3. CORE DRYER (S2) TEST INTERRUPTIONS

Day	Testing down time	Test runs affected	Reason for test interruption
1/19	09:00-09:14	M0010, Run 1 M0030, Run 1	Side trim conveyor down; core material dry bin full; operator had to shut down core dryer
	13:15-13:30	M0010, Run 1 M201A, Run 1	Hole in core material blowpipe; operator had to shut down core dryer in order for repair to be made
	14:09-14:25	M201A, Run 1	Hole in another core material blowpipe; operator had to shut down core dryer in order for repair to be made
1/20	14:50-15:30	M0011, Run 3	Press down for changeover to a different board thickness; core material dry bin full; operator had to shut down core dryer
1/21	09:45-10:35	M5/202, Run 3	Thunderstorm; test crew had to come down from stack; process not affected

The following parameters were monitored throughout the test and were logged at ten minute intervals:

Time;
Dryer inlet particle moisture content (%);
Dryer outlet particle moisture content (%);
Dryer inlet gas temperature (°F);
Dryer outlet gas temperature (°F);
Dryer particle throughput (lb/hr); and
Particle feed to the former (lb/hr).

Dryer process data log sheets and plant records containing the raw data can be found in Appendix E.

Table 2-4 summarizes the process rates and operating temperatures for each test run. The dryer throughput was measured using scales located on the conveyor belt that transferred the dried material to the B&F building. Like the face dryer throughput, the core dryer throughput rate was displayed on a digital readout that fluctuated rapidly, making it impractical to read a given value to more than the nearest thousand pounds. However, readings from the display were taken every ten minutes for the duration of each test run and averaged to obtain the average throughput for that run. According to plant personnel, the display fluctuates for the same reasons as the face dryer throughput reading, because the scales are small and material is not spread uniformly on the conveyor. The production rates do not include data taken during test interruptions. The average dryer inlet moisture content over all the dryer test runs was 17 percent. The average dryer outlet moisture content over all the dryer test runs was 6 percent.

2.2.3 Press

The press operated consistently and smoothly throughout the test program. There were no interruptions during any of the test runs. However, on several occasions, port changes were of unusually long duration because maintenance on various parts of the production line was performed. These maintenance activities stopped the press temporarily and delayed the start of the second traverse. The nature of the delays and the test runs during which they occurred are listed in Table 2-5.

TABLE 2-4. CORE DRYER (S2) PROCESS RATES DURING TESTING

Test method	Run No.	Date	Average temperature				Throughput[a]			
			Inlet		Outlet		Range		Average	
			C	F	C	F	lb/hr	kg/hr	lb/hr	kg/hr
M5/202	1	1/18	231	448	70.1	158	[b]	[b]	[b]	[b]
	2	1/19	233	452	69.8	158	8,000-29,000	4,000-13,000	19,000	8,600
	3	1/21	156	312	73.2	164	7,000-25,000	3,000-11,000	14,000	6,400
M0010	1	1/19	234	453	70.5	159	9,000-31,000	4,000-14,000	19,000	8,600
	2	1/20	251	484	67.0	153	12,000-28,000	5,000-13,000	18,000	8,200
	3	1/20	235	455	72.4	162	3,000-23,000	1,000-10,000	14,000	6,400
M0011	1	1/19	236	457	72.1	162	13,000-24,000	6,000-11,000	17,000	7,700
	2	1/20	226	439	64.7	148	8,000-23,000	4,000-10,000	16,000	7,300
	3	1/20	182	359	72.6	163	2,000-15,000	1,000-7,000	6,000	2,700
M0030	1	1/19	209	409	66.8	152	9,000-28,000	4,000-13,000	16,000	7,300
	2	1/20	251	483	65.7	150	14,000-28,000	6,000-13,000	19,000	8,600
	3	1/20	252	485	73.0	163	10,000-23,000	5,000-10,000	16,000	7,300
M201A	1	1/19	239	462	71.6	161	9,000-31,000	4,000-14,000	21,000	9,500
	2	1/20	153	307	70.3	159	6,000-21,000	3,000-10,000	12,000	5,400
	3	1/20	257	494	71.4	161	2,000-22,000	1,000-10,000	15,000	6,800

[a]Throughputs are in pounds per hour (lb/hr) and in kilograms per hour (kg/hr) of dried particles from the dryer.
[b]Process data were not taken for this test run due to a miscommunication between the test crew and the process monitor. Additionally, there was a problem with the sampling equipment that caused this test run to be invalid.

TABLE 2-5. PRESS (S3, S4, S5) TEST INTERRUPTIONS/DELAYS

Day	Testing Down Time	Test Runs Affected	Reason for Interruption/Delay
1/22	11:31-13:05	M201A, Run 1	Port change and delay due to mat edge trim problem
	16:40-18:00	M0011, Run 1	Port change and delay due to press changeover to a different board thickness
	20:25-20:28	M0011, Run 2	Port change
1/23	09:15-09:47	M0011, Run 3	Port change and delay due to a problem in Milling and Drying

The press operator maintains a log with the time of each press opening. This log was marked to indicate the beginning and end of each test run, as well as the beginning and end of port changes, and was used to determine the number of press openings during each test run. Periodically, the platen temperature, maximum pressure, and holding pressure were noted to ensure that the press was operating normally. Platen temperature remained constant at 154°C (310°F) throughout the test. Maximum pressure remained at 16,200 kPa (2,350 psi), and holding pressure was steady at 3,450 kPa (500 psi). The resin content of both the face and core material was also noted approximately every hour. The resin content of the face material ranged from 3.6 to 8.8 percent, with an average of 8.1 percent over all the press test runs. The resin content of the core material ranged from 6.3 to 9.9 percent, with an average of 7.5 percent over all the press test runs.

Press process data log sheets and plant records containing the raw data can be found in Appendix E.

Table 2-6 summarizes the process rates for each test run. Production rates were calculated by first calculating the volume of board in cubic feet (ft^3) produced per press load. The volume of board produced per press load was multiplied by the number of press openings during the test run to get the total volume of board produced during the test run. The total volume of board produced during the test run was then converted to total square feet (ft^2) of three-quarter inch board produced during the test run. This figure was divided by the time period of the test run to obtain a production rate in ft^2 per hour (ft^2/hr). Production rates do not include data taken during port changes. The average board density during the test program was 849 kilograms per cubic meter (kg/m^3) or 53 pounds per cubic foot (lb/ft^3).

TABLE 2-6. PRESS (S3, S4, S5) PROCESS RATES DURING TESTING

Test method	Date	Run No.	No. of press openings	Board thickness, in.	Board production, ft^2/hr^a
M0011	1/22	1	7 9	3/4 9/16	17,640
	1/22	2	10	9/16	10,512
	1/23	3	14	9/16	15,895
M201A	1/22	1	47	3/4	17,438

[a]Based on fourteen 135 cm x 757 cm (52.25 in x 298 in) boards per press opening

ft^2/hr = square feet of three-quarter inch thick board produced per hour.

SECTION 3
SUMMARY OF RESULTS

3.1 PRESENTATION

The tabulated results from all of the testing performed at G-P are presented in this section. The results are presented in tables which are organized by pollutant group. Refer to the "List of Tables and Figures" for a cross reference. Detailed results of all the testing can be found in Appendix A; field and analytical data are provided in Appendix B. The core and surface dryer sampling locations are referred to as stacks 1 and 2, respectively. The particleboard press sampling locations are referred to as stacks 3, 4, and 5.

Appendix A presents the raw data tables prepared for each location. They include all compounds reported by the laboratory with the results uncorrected for field and laboratory contamination and recovery efficiency. In order for a compound to be determined ***native*** to the source evaluated, and consequently be presented in the summary tables in this section, the following ***determination criteria*** was used:

- target compound concentration must be detected at a level 3 times the field bias blank and the laboratory blank concentration.
- target compound concentration must be detected at a level 5 times the method detection limit (MDL) of the analytical instrument.

In cases where a compound was detected, but was below the quantitation limit of the analytical instrument, the estimated value determined by the laboratory was used. In cases where one component of an average was reported as a non-detected value by the laboratory, 1/2 the MDL (method detection limit) was used for that fraction.

3.2 DISCUSSION

3.2.1 Stacks 1 and 2 - Abnormal Operation During Testing

In order to provide suitable sampling locations, stack extensions were installed at all five emission sources. Each stack extension included straightening vanes to reduce the possibility of cyclonic flow. It was noted by G-P personnel that the installation of the stacks on the cyclones

had affected the operation of the cyclones. They noted that there was an increase in the particulate emissions from stacks 1 and 2. Evidence of this increase was observed in unusually high particulate build-up around the cyclones, in lower than average product recovery (particulate) from the cyclones, and an increase in visible emissions from the cyclone stacks. In general, abnormal operation of the cyclones should not affect any gaseous pollutant emissions. The impact on the test results of any abnormal cyclone operation due to the modifications will be further discussed in the following sections.

3.2.2 Aldehyde/Ketones

Testing for aldehyde/ketone emissions was performed using EPA Method 0011 (M0011). Table 3-1 summarizes the average aldehyde/ketone emissions. Individual run summaries are presented in Tables 3-2 through 3-6.

Since the formaldehyde concentrations at most of the sources were high, the use of three impingers was needed to insure capture in the train. Each impinger reagent was analyzed separately to verify sample train collection efficiency. The formaldehyde catch in the third impinger was generally less than ten percent of the catch in the first impinger. Comparison of the individual impinger analyses demonstrates no significant breakthrough of any of the compounds of interest except acetone. Measured quantities of most compounds in the final impingers were near or at reported minimum detection limits. Acetone did not exhibit the same trend of impinger collection efficiency. It appears that EPA Method 0011 (M0011) may be inappropriate for quantifying acetone emissions from these sources. Acetone values from the EPA Method 0030 (VOST) runs for Stacks 1 and 2 averaged 0.0287 and 0.101 pounds per hour, respectively. Acetone values determined by M0011 averaged 0.144, and 0.254 pounds per hour at the same locations, respectively. Acetone is a common laboratory solvent and is also used to recover particulate and PM_{10} trains. M0011 has not been validated for acetone and previous sampling efforts under other EPA Work Assignments have reported problems with the use of M0011 to quantify acetone emissions. Although precautions were taken to prevent contamination, there is a possibility of field or laboratory contamination.

Table 3-1

ALDEHYDES/KETONES AVERAGE EMISSIONS SUMMARY

ALDEHYDES/KETONES EMISSIONS	Stack 1	Stack 2	Stack 3	Stack 4	Stack 5
CONCENTRATION, µg/dscm*					
FORMALDEHYDE	1,700	2,638	10,021	19,408	15,908
ACETALDEHYDE	101	308	310	715	1,680
ACROLEIN	46.9	99.7	54.9	102	85.7
ACETONE	--	--	351	656	544
n-BUTYRALDEHYDE	74.2	229	73.2	122	94.1
METHYL ETHYL KETONE	--	--	--	--	--
BENZALDEHYDE	96.4	212	58.6	114	105
ISOVALERALDEHYDE	26.0	41.0	3.93	35.3	58.1
VALERALDEHYDE	145	278	110	216	225
m-TOLUALDEHYDE	9.63	13.5	--	--	--
p-TOLUALDEHYDE	--	--	--	14.5	16.4
HEXALDEHYDE	92.9	544	402	806	724
2,5-DIMETHYL BENZALDEHYDE	3.52	2.15	2.87	11.0	18.7
CONCENTRATION, ppb dry by volume					
FORMALDEHYDE	1,363	2,115	8,036	15,563	12,756
ACETALDEHYDE	88.3	168	169	390	916
ACROLEIN	20.1	42.7	23.5	43.6	36.7
ACETONE	--	--	146	272	226
n-BUTYRALDEHYDE	24.7	76.3	24.4	40.8	31.4
METHYL ETHYL KETONE	--	--	--	--	--
BENZALDEHYDE	21.9	48.1	13.3	25.8	23.7
ISOVALERALDEHYDE	7.27	11.5	1.10	9.87	16.2
VALERALDEHYDE	40.4	77.8	30.8	60.4	63.0
m-TOLUALDEHYDE	1.93	2.69	--	--	--
p-TOLUALDEHYDE	--	--	--	2.90	3.28
HEXALDEHYDE	22.3	131	96.5	194	174
2,5-DIMETHYL BENZALDEHYDE	0.632	0.386	0.515	1.97	3.36
EMISSION RATE, pounds/hour					
FORMALDEHYDE	0.209	0.312	1.60	2.84	2.43
ACETALDEHYDE	0.0202	0.0371	0.0493	0.102	0.263
ACROLEIN	0.00572	0.0119	0.00871	0.0149	0.0133
ACETONE	--	--	0.0560	0.0953	0.0833
n-BUTYRALDEHYDE	0.00909	0.0270	0.0116	0.0178	0.0144
METHYL ETHYL KETONE	--	--	--	--	--
BENZALDEHYDE	0.0119	0.0249	0.00930	0.0166	0.0160
ISOVALERALDEHYDE	0.00326	0.00480	0.000619	0.00514	0.00879
VALERALDEHYDE	0.0178	0.0332	0.0175	0.0315	0.0344
m-TOLUALDEHYDE	0.00123	0.00159	--	--	--
p-TOLUALDEHYDE	--	--	--	0.00222	0.00248
HEXALDEHYDE	0.0115	0.0652	0.0640	0.118	0.110
2,5-DIMETHYL BENZALDEHYDE	0.000446	0.000252	0.000464	0.00161	0.00282

Table 3-2

ALDEHYDES/KETONES TESTS SUMMARY

Stack 1

	GP-S1-M0011-1	GP-S1-M0011-2	GP-S1-M0011-3	Average
Test Date	1/19/93	1/20/93	1/20/93	N/A
Run Start Time	1359	840	1355	N/A
Run Finish Time	1522	950	1500	N/A
Test Train Parameters:				
Volume of Dry Gas Sampled, SCF*	44.192	39.839	39.988	N/A
Percent Isokenetic	102.4	98.7	96.4	N/A
Flue Gas Parameters:				
Temperature, Degrees F	127	123	128	126
Volumetric Air Flow Rates				
SCFM*, Dry	34,132	31,946	32,833	32,970
ACFM, Wet	39,573	36,628	37,695	37,965
ALDE./KETONES EMISSION RESULTS:				
FORMALDEHYDE				
µg per dry std. cubic meter*	1,678	2,274	1,148	1,700
ppb by volume, Dry	1,346	1,824	921	1,363
kilograms per hour	0.0973	0.123	0.0640	0.0949
pounds per hour	0.215	0.272	0.141	0.209
ACETALDEHYDE				
µg per dry std. cubic meter*	263 **	25.5 ****	15.5 ****	101
ppb by volume, Dry	144 **	13.9 ****	8.46 ****	55
kilograms per hour	0.0153 **	0.00138 ****	0.000863 ****	0.00509
pounds per hour	0.0337 **	0.00305 ****	0.00190 ****	0.0112
ACROLEIN				
µg per dry std. cubic meter*	24.5	77.6	38.6	46.9
ppb by volume, Dry	10.5	33.3	16.5	20.1
kilograms per hour	0.00142	0.00421	0.00215	0.00259
pounds per hour	0.00313	0.00928	0.00474	0.00572
n-BUTYRALDEHYDE				
µg per dry std. cubic meter*	49.0	104	69.5	74.2
ppb by volume, Dry	16.4	34.7	23.2	24.7
kilograms per hour	0.00284	0.00564	0.00388	0.00412
pounds per hour	0.00627	0.0124	0.00855	0.00909
BENZALDEHYDE				
µg per dry std. cubic meter*	118	100	70.5	96.4
ppb by volume, Dry	26.8	22.8	16.0	21.9
kilograms per hour	0.00686	0.00545	0.00393	0.00541
pounds per hour	0.0151	0.0120	0.00867	0.0119
ISOVALERALDEHYDE				
µg per dry std. cubic meter*	50.1 **	18.5 **	9.41 **	26.0
ppb by volume, Dry	14.0 **	5.18 **	2.63 **	7.27
kilograms per hour	0.00291 **	0.00101 **	0.000525 **	0.00148
pounds per hour	0.00641 **	0.00222 **	0.00116 **	0.00326
VALERALDEHYDE				
µg per dry std. cubic meter*	142	178	114	145
ppb by volume, Dry	39.6	49.7	31.8	40.4
kilograms per hour	0.00823	0.00966	0.00636	0.00808
pounds per hour	0.0181	0.0213	0.0140	0.0178
m-TOLUALDEHYDE				
µg per dry std. cubic meter*	27.0	0.966 ****	0.883 ****	9.63
ppb by volume, Dry	5.41	0.193 ****	0.177 ****	1.93
kilograms per hour	0.00157	0.0000524 ****	0.0000493 ****	0.000556
pounds per hour	0.00346	0.000116 ****	0.000109 ****	0.00123
HEXALDEHYDE				
µg per dry std. cubic meter*	120	88.6 ****	69.7 ****	92.9
ppb by volume, Dry	28.9	21.3 ****	16.7 ****	22.3
kilograms per hour	0.00699	0.00481 ****	0.00389 ****	0.00523
pounds per hour	0.0154	0.0106 ****	0.00857 ****	0.0115
2,5-DIMETHYL BENZALDEHYDE				
µg per dry std. cubic meter*	8.71	0.966 ***	0.883 ***	3.52
ppb by volume, Dry	1.56	0.173 ***	0.159 ***	0.632
kilograms per hour	0.000505	0.0000524 ***	0.0000493 ***	0.000202
pounds per hour	0.00111	0.000116 ***	0.000109 ***	0.000446

* 68 Deg. F (20 C) -- 29.92 In. Mercury

** Estimated results (i.e., the corresponding response was below calibration range, but above established detection limit)

*** Above calibration range by < 25%

**** Non-detectable results - 1/2 detection limit used in calculations

Table 3-3

ALDEHYDES/KETONES TESTS SUMMARY

Stack 2

	GP-S2-M0011-1	GP-S2-M0011-2	GP-S2-M0011-3	Average
Test Date	1/19/93	1/20/93	1/20/93	N/A
Run Start Time	1532	833	1428	N/A
Run Finish Time	1644	952	1627	N/A
Test Train Parameters:				
Volume of Dry Gas Sampled, SCF*	37.309	36.466	40.467	N/A
Percent Isokenetic	101.9	101.2	100.0	N/A
Flue Gas Parameters:				
Temperature, Degrees F	155	143	151	150
Volumetric Air Flow Rates				
SCFM*, Dry	30,870	30,381	34,090	31,780
ACFM, Wet	38,629	36,967	41,266	38,954
ALDE./KETONES EMISSION RESULTS:				
FORMALDEHYDE				
µg per dry std. cubic meter*	3,042	2,710	2,161	2,638
ppb by volume, Dry	2,439	2,173	1,732	2,115
kilograms per hour	0.160	0.140	0.125	0.142
pounds per hour	0.352	0.308	0.276	0.312
ACETALDEHYDE				
µg per dry std. cubic meter*	217 **	279 **	427 **	308
ppb by volume, Dry	118 **	152 **	233 **	168
kilograms per hour	0.0114 **	0.0144 **	0.0247 **	0.0168
pounds per hour	0.0251 **	0.0317 **	0.0546 **	0.0371
ACROLEIN				
µg per dry std. cubic meter*	42.2	154	103	99.7
ppb by volume, Dry	18.1	66.1	44.0	42.7
kilograms per hour	0.00221	0.00796	0.00594	0.00537
pounds per hour	0.00487	0.0176	0.0131	0.0119
n-BUTYRALDEHYDE				
µg per dry std. cubic meter*	252	254	179	229
ppb by volume, Dry	84.2	84.9	59.8	76.3
kilograms per hour	0.0132	0.0131	0.0104	0.0123
pounds per hour	0.0292	0.0290	0.0229	0.0270
BENZALDEHYDE				
µg per dry std. cubic meter*	265	255	117	212
ppb by volume, Dry	60.0	57.8	26.5	48.1
kilograms per hour	0.0139	0.0132	0.00676	0.0113
pounds per hour	0.0306	0.0290	0.0149	0.0249
ISOVALERALDEHYDE				
µg per dry std. cubic meter*	70.4	34.8	17.9	41.0
ppb by volume, Dry	19.7	9.72	5.01	11.5
kilograms per hour	0.00369	0.00180	0.00104	0.00218
pounds per hour	0.00814	0.00396	0.00229	0.00480
VALERALDEHYDE				
µg per dry std. cubic meter*	296 **	255 **	284 **	278
ppb by volume, Dry	82.7 **	71.2 **	79.4 **	77.8
kilograms per hour	0.0155 **	0.0132 **	0.0165 **	0.0150
pounds per hour	0.0342 **	0.0290 **	0.0363 **	0.0332
m-TOLUALDEHYDE				
µg per dry std. cubic meter*	35.4	0.968 ****	7.80	13.5
ppb by volume, Dry	7.08	0.194 ****	1.56	2.69
kilograms per hour	0.00186	0.0000500 ****	0.000452	0.000720
pounds per hour	0.00409	0.000110 ****	0.000996	0.00159
HEXALDEHYDE				
µg per dry std. cubic meter*	454	534	645	544
ppb by volume, Dry	109	128	155	131
kilograms per hour	0.0238	0.0275	0.0373	0.0296
pounds per hour	0.0525	0.0607	0.0823	0.0652
2,5-DIMETHYL BENZALDEHYDE				
µg per dry std. cubic meter*	4.61	0.968 ****	0.873 ****	2.15
ppb by volume, Dry	0.827	0.174 ****	0.157 ****	0.386
kilograms per hour	0.000242	0.0000500 ****	0.0000505 ****	0.000114
pounds per hour	0.000533	0.000110 ****	0.000111 ****	0.000252

* 68 Deg. F (20 C) -- 29.92 In. Mercury

** Estimated results (i.e., the corresponding response was below calibration range, but above established detection limit.)

*** Above calibration range by < 25%

**** Non-detectable results - 1/2 detection limit used in calculations

Table 3-4

ALDEHYDES/KETONES TESTS SUMMARY

Stack 3

	GP-S3-M0011-1	GP-S3-M0011-2	GP-S3-M0011-3	Average
Test Date	1/22/93	1/22/93	1/23/93	N/A
Run Start Time	1605	1950	845	N/A
Run Finish Time	1836	2056	1017	N/A
Test Train Parameters:				
Volume of Dry Gas Sampled, SCF*	54.412	47.743	47.037	N/A
Percent Isokenetic	98.2	98.4	101.8	N/A
Flue Gas Parameters:				
Temperature, Degrees F	83	78	66	76
Volumetric Air Flow Rates				
SCFM*, Dry	41,927	44,066	41,966	42,653
ACFM, Wet	43,331	45,392	41,824	43,516
ALDE./KETONES EMISSION RESULTS:				
FORMALDEHYDE				
µg per dry std. cubic meter*	10,667	9,756	9,641	10,021
ppb by volume, Dry	8,553	7,823	7,731	8,036
kilograms per hour	0.760	0.731	0.688	0.726
pounds per hour	1.68	1.61	1.52	1.60
ACETALDEHYDE				
µg per dry std. cubic meter*	348 **	257 **	324 **	310
ppb by volume, Dry	190 **	140 **	177 **	169
kilograms per hour	0.0248 **	0.0192 **	0.0231 **	0.0224
pounds per hour	0.0547 **	0.0424 **	0.0509 **	0.0493
ACROLEIN				
µg per dry std. cubic meter*	63.4 **	33.7 **	67.6	54.9
ppb by volume, Dry	27.2 **	14.4 **	29.0	23.5
kilograms per hour	0.00451 **	0.00252 **	0.00482	0.00395
pounds per hour	0.00995 **	0.00556 **	0.0106	0.00871
ACETONE				
µg per dry std. cubic meter*	352	331	371	351
ppb by volume, Dry	146	137	154	146
kilograms per hour	0.0251	0.0247	0.0264	0.0254
pounds per hour	0.0553	0.0546	0.0583	0.0560
n-BUTYRALDEHYDE				
µg per dry std. cubic meter*	119	41.5	59.6	73.2
ppb by volume, Dry	39.6	13.8	19.9	24.4
kilograms per hour	0.00845	0.00311	0.00425	0.00527
pounds per hour	0.0186	0.00685	0.00937	0.0116
BENZALDEHYDE				
µg per dry std. cubic meter*	75.5	38.6	61.6 **	58.6
ppb by volume, Dry	17.1	8.74	14.0 **	13.3
kilograms per hour	0.00538	0.00289	0.00439 **	0.00422
pounds per hour	0.0119	0.00636	0.00968 **	0.00930
ISOVALERALDEHYDE				
µg per dry std. cubic meter*	7.68 **	0.769 ***	3.33 **	3.93
ppb by volume, Dry	2.15 **	0.215 ***	0.929 **	1.10
kilograms per hour	0.000547 **	0.0000576 ***	0.000237 **	0.000281
pounds per hour	0.00121 **	0.000127 ***	0.000523 **	0.000619
VALERALDEHYDE				
µg per dry std. cubic meter*	149	75.1	107	110
ppb by volume, Dry	41.5	21.0	29.9	30.8
kilograms per hour	0.0106	0.00563	0.00763	0.00795
pounds per hour	0.0233	0.0124	0.0168	0.0175
HEXALDEHYDE				
µg per dry std. cubic meter*	486	328	390	402
ppb by volume, Dry	117	78.9	93.8	96.5
kilograms per hour	0.0346	0.0246	0.0278	0.0290
pounds per hour	0.0764	0.0542	0.0614	0.0640
2,5-DIMETHYL BENZALDEHYDE				
µg per dry std. cubic meter*	0.646 ***	4.98	2.98	2.87
ppb by volume, Dry	0.116 ***	0.894	0.535	0.515
kilograms per hour	0.0000460 ***	0.000373	0.000213	0.000210
pounds per hour	0.000101 ***	0.000822	0.000469	0.000464

* 68 Deg. F (20 C) -- 29.92 In. Mercury

** Estimated results (i.e., the corresponding response was below calibration range, but above established detection limit.)

*** Non-detectable results - 1/2 detection limit used in calculations

Table 3-5
ALDEHYDES/KETONES TESTS SUMMARY

Stack 4

	GP-S4-M0011-1	GP-S4-M0011-2	GP-S4-M0011-3	Average
Test Date	1/22/93	1/22/93	1/23/93	N/A
Run Start Time	1605	1950	845	N/A
Run Finish Time	1836	2056	1017	N/A
Test Train Parameters:				
Volume of Dry Gas Sampled, SCF*	58.687	51.154	52.929	N/A
Percent Isokenetic	101.6	102.4	100.2	N/A
Flue Gas Parameters:				
Temperature, Degrees F	86	82	69	79
Volumetric Air Flow Rates				
SCFM*, Dry	37,355	38,780	40,982	39,039
ACFM, Wet	38,867	40,175	41,164	40,069
ALDE./KETONES EMISSION RESULTS:				
FORMALDEHYDE				
µg per dry std. cubic meter*	19,579	18,397	20,248	19,408
ppb by volume, Dry	15,700	14,752	16,236	15,563
kilograms per hour	1.24	1.21	1.41	1.29
pounds per hour	2.74	2.67	3.11	2.84
ACETALDEHYDE				
µg per dry std. cubic meter*	1,346 **	418	379	715
ppb by volume, Dry	734 **	228	207	390
kilograms per hour	0.0854 **	0.0276	0.0264	0.0465
pounds per hour	0.188 **	0.0608	0.0583	0.102
ACROLEIN				
µg per dry std. cubic meter*	119	59.6 **	127	102
ppb by volume, Dry	50.9	25.5 **	54.4	43.6
kilograms per hour	0.00753	0.00393 **	0.00884	0.00677
pounds per hour	0.0166	0.00866 **	0.0195	0.0149
ACETONE				
µg per dry std. cubic meter*	730 **	737 ***	500	656
ppb by volume, Dry	303 **	305 ***	207	272
kilograms per hour	0.0463 **	0.0485 ***	0.0348	0.0432
pounds per hour	0.102 **	0.107 ***	0.0768	0.0953
n-BUTYRALDEHYDE				
µg per dry std. cubic meter*	144	108	115	122
ppb by volume, Dry	48.0	36.1	38.4	40.8
kilograms per hour	0.00913	0.00713	0.00802	0.00809
pounds per hour	0.0201	0.0157	0.0177	0.0178
BENZALDEHYDE				
µg per dry std. cubic meter*	129	95.4	118	114
ppb by volume, Dry	29.2	21.6	26.7	25.8
kilograms per hour	0.00817	0.00629	0.00819	0.00755
pounds per hour	0.0180	0.0139	0.0181	0.0166
ISOVALERALDEHYDE				
µg per dry std. cubic meter*	58.5 **	7.50	40.0 **	35.3
ppb by volume, Dry	16.3 **	2.10	11.2 **	9.87
kilograms per hour	0.00371 **	0.000494	0.00279 **	0.00233
pounds per hour	0.00818 **	0.00109	0.00615 **	0.00514
VALERALDEHYDE				
µg per dry std. cubic meter*	276	169	204	216
ppb by volume, Dry	77.1	47.2	56.9	60.4
kilograms per hour	0.0175	0.0111	0.0142	0.0143
pounds per hour	0.0386	0.0245	0.0313	0.0315
p-TOLUALDEHYDE				
µg per dry std. cubic meter*	0.614 ****	1.41	41.5	14.5
ppb by volume, Dry	0.123 ****	0.282	8.30	2.90
kilograms per hour	0.0000390 ****	0.0000928	0.00289	0.00101
pounds per hour	0.0000859 ****	0.000205	0.00637	0.00222
HEXALDEHYDE				
µg per dry std. cubic meter*	909	655	854	806
ppb by volume, Dry	218	157	205	194
kilograms per hour	0.0577	0.0432	0.0595	0.0534
pounds per hour	0.127	0.0951	0.131	0.118
2,5-DIMETHYL BENZALDEHYDE				
µg per dry std. cubic meter*	12.7	5.55	14.6	11.0
ppb by volume, Dry	2.28	0.996	2.62	1.97
kilograms per hour	0.000808	0.000366	0.00102	0.000730
pounds per hour	0.00178	0.000806	0.00224	0.00161

* 68 Deg. F (20 C) – 29.92 In. Mercury
** Estimated results (i.e., the corresponding response was below calibration range, but above detection limit.)
*** Above calibration range by < 25%
**** Non-detectable results - 1/2 detection limit used in calculations

Table 3-6

ALDEHYDES/KETONES TESTS SUMMARY

Stack 5

	GP-S5-M0011-1	GP-S5-M0011-2	GP-S5-M0011-3	Average
Test Date	1/22/93	1/22/93	1/23/93	N/A
Run Start Time	1605	1950	845	N/A
Run Finish Time	1836	2058	1017	N/A
Test Train Parameters:				
Volume of Dry Gas Sampled, SCF*	51.875	47.508	46.694	N/A
Percent Isokenetic	99.1	100.4	98.8	N/A
Flue Gas Parameters:				
Temperature, Degrees F	84	80	67	77
Volumetric Air Flow Rates				
SCFM*, Dry	38,715	42,005	41,920	40,880
ACFM, Wet	40,175	43,308	42,036	41,840
ALDE./KETONES EMISSION RESULTS:				
FORMALDEHYDE				
µg per dry std. cubic meter*	16,769	14,438	16,517	15,908
ppb by volume, Dry	13,447	11,577	13,245	12,756
kilograms per hour	1.10	1.03	1.18	1.10
pounds per hour	2.43	2.27	2.59	2.43
ACETALDEHYDE				
µg per dry std. cubic meter*	400 **	4,250 **	389 **	1,680
ppb by volume, Dry	218 **	2,318 **	212 **	916
kilograms per hour	0.0263 **	0.303 **	0.0277 **	0.119
pounds per hour	0.0580 **	0.669 **	0.0611 **	0.263
ACROLEIN				
µg per dry std. cubic meter*	48.6 **	80.9 **	127.4	85.7
ppb by volume, Dry	20.8 **	34.7 **	54.6	36.7
kilograms per hour	0.00320 **	0.00578 **	0.00908	0.00602
pounds per hour	0.00705 **	0.0127 **	0.0200	0.0133
ACETONE				
µg per dry std. cubic meter*	551	538	544	544
ppb by volume, Dry	229	223	226	226
kilograms per hour	0.0363	0.0384	0.0388	0.0378
pounds per hour	0.0800	0.0846	0.0855	0.0833
n-BUTYRALDEHYDE				
µg per dry std. cubic meter*	99.8	98.9	83.6	94.1
ppb by volume, Dry	33.3	33.0	27.9	31.4
kilograms per hour	0.00656	0.00706	0.00596	0.00653
pounds per hour	0.0145	0.0156	0.0131	0.0144
BENZALDEHYDE				
µg per dry std. cubic meter*	110	109	94.8 **	105
ppb by volume, Dry	24.9	24.7	21.5 **	23.7
kilograms per hour	0.00723	0.00777	0.00675 **	0.00725
pounds per hour	0.0159	0.0171	0.0149 **	0.0160
ISOVALERALDEHYDE				
µg per dry std. cubic meter*	83.6 **	16.0 **	74.7 **	58.1
ppb by volume, Dry	23.4 **	4.47 **	20.9 **	16.2
kilograms per hour	0.00550 **	0.00114 **	0.00532 **	0.00399
pounds per hour	0.0121 **	0.00252 **	0.0117 **	0.00879
VALERALDEHYDE				
µg per dry std. cubic meter*	254	230	192	225
ppb by volume, Dry	71.0	64.2	53.7	63.0
kilograms per hour	0.0167	0.0164	0.0137	0.0156
pounds per hour	0.0368	0.0362	0.0302	0.0344
p-TOLUALDEHYDE				
µg per dry std. cubic meter*	23.6	0.743 ***	24.9	16.4
ppb by volume, Dry	4.71	0.149 ***	4.98	3.28
kilograms per hour	0.00155	0.0000531 ***	0.00177	0.00113
pounds per hour	0.00342	0.000117 ***	0.00391	0.00248
HEXALDEHYDE				
µg per dry std. cubic meter*	855	573	743	724
ppb by volume, Dry	205	138	178	174
kilograms per hour	0.0562	0.0409	0.0529	0.0500
pounds per hour	0.124	0.0901	0.117	0.110
2,5-DIMETHYL BENZALDEHYDE				
µg per dry std. cubic meter*	30.4	11.8	13.9	18.7
ppb by volume, Dry	5.46	2.11	2.50	3.36
kilograms per hour	0.00200	0.000839	0.000990	0.00128
pounds per hour	0.00441	0.00185	0.00218	0.00282

* 68 Deg. F (20 C) – 29.92 In. Mercury

** Estimated results (i.e., the corresponding response was below calibration range, but above detection limit.)

*** Non-detectable results - 1/2 detection limit used in calculations

The sample volume for the M0011 runs performed at stacks 1 and 2 were less than the minimum of 45 cubic feet required in the method. This sample volume requirement is intended to ensure the capture of enough sample for detection of target analytes. Most analytes measured at stacks 1 and 2 were greater than the detection limits and those compounds that were below detection limits were not detected in the samples taken at stacks 3, 4, and 5. Based on the laboratory results, this reduced sample volume had no negative impact on the data quality. All sample volumes for stacks 3, 4, and 5 were at least 45 cubic feet.

Since the aldehyde/ketone compounds are primarily gaseous, abnormal operation of the cyclones should not have had any significant effect on the M0011 test results. The results are judged to be correct as reported.

3.2.3 Particulate and Condensibles

An EPA Method 5/202 (M5/202) sample train was used to determine the particulate and condensible particulate emissions at stack 1 and stack 2 sampling locations. The average particulate and condensible particulate emissions are summarized in Table 3-7. Tables 3-8 and 3-9 summarize the individual runs.

The abnormal operation of the cyclone during the particulate tests would bias the results high. *Quantifying the bias of the results is impossible without further study.*

The particulate emission rate for Run GP-S1-M5/202 performed at the stack 1 sampling location should be identified as an outlier. The emission rate is 15 times higher than the other two runs performed. The increase can be attributed to abnormal operation of the cyclone. The cyclone was operating at a high excess air rate. Air was entering the cyclone through the fire dump duct. This problem was corrected prior to all other runs performed at stacks 1 and 2. The fire dump duct was temporarily sealed with cardboard and duct tape after the first test run. Condensible particulate emissions should not be affected and are judged correct as reported.

Table 3-7

PM10 & TOTAL PARTICULATE AVERAGE EMISSIONS SUMMARY

SAMPLING LOCATION	FILTERABLE				FILTERABLE (PM10) + NON-EXTRACTABLE CONDENSIBLES		FILTERABLE (PM10) + EXTRACTABLE & NON-EXTRACTABLE CONDENSIBLES		TOTAL PARTICULATE (Includes PM10)	
	Grains/DSCF*		Pound/Hr		Grains/DSCF*	Pound/Hr	Grains/DSCF*	Pound/Hr	Grains/DSCF*	Pound/Hr
	PM10	Method 5	PM10	Method 5						
Stack 1**	0.0104	0.0701 ***	2.94	20.0 ***	0.0112	3.17	0.0122	3.45	0.0712 ***	20.3 ***
Stack 2**	0.0283	0.109	7.60	31.5	0.0292	7.87	0.0310	8.38	0.111	32.3
Stack 3***	0.000647		0.227		0.000750	0.263	0.000750	0.263	0.00182	0.640
Stack 4****	0.000416		0.146		0.000705	0.248	0.00112	0.394	0.00304	1.07
Stack 5***	0.00112		0.357		0.00124	0.396	0.00147	0.472	0.00267	0.853

* 68 Degrees F -- 29.92 Inches of Mercury (Hg).
** Condensible Particulate & Total Particulate from M5/202 Sampling Train
*** Average of Two Runs
**** One Run Only

Table 3-8

PARTICULATE & CONDENSIBLE PARTICULATE TESTS SUMMARY

Stack 1

	GP-S1-M5/202-1	GP-S1-M5/202-2	GP-S1-M5/202-3	Average
Test Date	1/18/93	1/19/93	1/21/93	N/A
Run Start Time	1750	1520	857	N/A
Run Finish Time	1854	1630	1056	N/A
Test Train Parameters:				
Volume of Dry Gas Sampled, SCF*	33.347	40.276	38.448	N/A
Percent Isokenetic	91.7	101.9	99.1	N/A
Flue Gas Parameters:				
Temperature, Degrees F	115	128	128	124
Volumetric Air Flow Rates				
SCFM*, Dry	31,933	33,570	32,976	32,826
ACFM, Wet	35,643	39,255	37,880	37,593
PARTICULATE RESULTS:				
Filterable				
Concentration, grains/DSCF*	1.12 **	0.0714	0.0688	0.0701 ***
Emission Rate, kilograms/hour	139 **	9.32	8.82	9.07 ***
Emission Rate, pounds/hour	306 **	20.6	19.4	20.0 ***
Extractable Condensibles				
Concentration, grains/DSCF*	0.00222	0.000651	0.000201	0.00103
Emission Rate, kilograms/hour	0.276	0.0850	0.0257	0.129
Emission Rate, pounds/hour	0.608	0.187	0.0567	0.285
Non-Extractable Condensibles				
Concentration, grains/DSCF*	0.00111	0.000421	0.000923	0.000811
Emission Rate, kilograms/hour	0.138	0.0550	0.118	0.103
Emission Rate, pounds/hour	0.304	0.121	0.261	0.228
Total Particulate				
Concentration, grains/DSCF*	1.12 **	0.0725	0.0699	0.0712 ***
Emission Rate, kilograms/hour	139 **	9.46	8.96	9.21 ***
Emission Rate, pounds/hour	307 **	20.9	19.8	20.3 ***

* 68 Deg. F (20 C) -- 29.92 In. Mercury
** Outlier
*** Average of Runs 2 & 3

TABLE 3-9

PARTICULATE & CONDENSIBLE PARTICULATE TESTS SUMMARY

Stack 2

	GP-S2-M5/202-1	GP-S2-M5/202-2	GP-S2-M5/202-3	Average
Test Date	1/19/93	1/20/93	1/21/93	N/A
Run Start Time	1620	1732	855	N/A
Run Finish Time	1740	1843	1055	N/A
Test Train Parameters:				
Volume of Dry Gas Sampled, SCF*	37.942	39.542	40.23	N/A
Percent Isokenetic	95.7	100.2	101.0	N/A
Flue Gas Parameters:				
Temperature, Degrees F	159	153	152	155
Volumetric Air Flow Rates				
SCFM*, Dry	33,672	34,079	33,838	33,863
ACFM, Wet	41,933	41,317	40,886	41,379
PARTICULATE RESULTS:				
Filterable				
Concentration, grains/DSCF*	0.0681	0.1017	0.156	0.109
Emission Rate, kilograms/hour	8.92	13.5	20.5	14.3
Emission Rate, pounds/hour	19.7	29.7	45.2	31.5
Extractable Condensibles				
Concentration, grains/DSCF*	0.00110	0.00137	0.00276	0.00174
Emission Rate, kilograms/hour	0.144	0.181	0.363	0.229
Emission Rate, pounds/hour	0.317	0.399	0.801	0.506
Non-Extractable Condensibles				
Concentration, grains/DSCF*	0.00106	0.00109	0.000614	0.000921
Emission Rate, kilograms/hour	0.138	0.145	0.0807	0.121
Emission Rate, pounds/hour	0.305	0.319	0.178	0.268
Total Particulate				
Concentration, grains/DSCF*	0.0703	0.104	0.159	0.111
Emission Rate, kilograms/hour	9.20	13.8	20.9	14.6
Emission Rate, pounds/hour	20.3	30.4	46.2	32.3

* 68 Deg. F (20 C) -- 29.92 In. Mercury

3.2.4 PM_{10}

The PM_{10} emissions from stacks 1 and 2 were determined using an EPA Method 201A constant rate sample train. The PM_{10} and condensible particulate emissions from stacks 3, 4, and 5 were determined using an EPA Method 201A/202 sample train. The average PM_{10} emissions from stacks 1 through 5 and condensible particulate emissions from stacks 3, 4, and 5 are summarized in Table 3-7. Individual run summaries are presented in Tables 3-10 through 3-12. The sample train from run GP-S1-M201A-3 did not meet acceptable post-test leak check requirements. An additional run was performed to replace this unacceptable run.

PM_{10} emissions, in general, would be less affected by abnormal cyclone operation than total suspended particulate emissions. Particles less than 2 μm will tend to behave like gaseous emissions, while particles between 2 and 10 μm will behave more like the TSP. Since the actual size(s) of the measured PM_{10} emissions can not be determined the reported values should be considered estimates due to the abnormal operation at the cyclones.

3.2.5 Semivolatile Organics

Semivolatile organic samples were collected at the stack 1 and 2 sampling locations using EPA Method 0010 (M0010). Pinenes were the most abundant compounds detected. The average semivolatile organics emissions are summarized in Table 3-13. Tables 3-14 and 3-15 summarize the individual runs.

Benzyl chloride could not be detected on the GC due to early elution from the column. For stacks 1 and 2, the α-pinene, β-pinene and α-terpineol were above the high point of the calibration curve and so the results were estimated. The p-cymene results for stack 2 were above the calibration curve and, therefore, were estimated.

Based on previous data at a similar facility where separate analyses were done on the front half catch (filter and probe rinse) and the back half (XAD and condensate), less than 5% of the total semivolatile catch was in the front half. Since >95% of semivolatile emissions are gaseous, an increase in particulate emissions due to abnormal cyclone operation should not have a significant effect on the semivolatile emissions.

Table 3-10

PM10 TESTS SUMMARY

Stack 1

	GP-S1-M201A-1	GP-S1-M201A-2	GP-S1-M201A-3	Average
Test Date	1/19/93	1/20/93	1/21/93	N/A
Run Start Time	1150	1717	855	N/A
Run Finish Time	1304	1817	1100	N/A
Test Train Parameters:				
Volume of Dry Gas Sampled, SCF*	26.269	23.668	25.417	N/A
Percent Isokenetic	91.5	114.6	95.6	N/A
Flue Gas Parameters:				
Temperature, Degrees F	128	126	123	126
Volumetric Air Flow Rates				
SCFM*, Dry	33,062	30,495	35,722	33,093
ACFM, Wet	38,649	35,243	41,009	38,300
Dia. of Particles in Cyclone, Microns	9.54	9.84	10.25	9.88
PM10 EMISSION RESULTS:				
Concentration, grains/DSCF*	0.0105	0.0114	0.00935	0.0104
Emission Rate, kilograms/hour	1.35	1.35	1.30	1.33
Emission Rate, pounds/hour	2.98	2.98	2.86	2.94
TOTAL PARTICULATE EMISSIONS (Includes PM10):				
Concentration, grains/DSCF*	0.0827	0.0549	0.0601	0.0659
Emission Rate, kilograms/hour	10.6	6.51	8.35	8.49
Emission Rate, pounds/hour	23.4	14.4	18.4	18.7
PARTICULATE FRACTIONATION:				
> PM10, %	87.3	79.2	84.4	84
< PM10, %	12.7	20.8	15.6	16

* 68 Deg. F (20 C) -- 29.92 In. Mercury

Table 3-11

PM10 TESTS SUMMARY

Stack 2

	GP-S2-M201A-1	GP-S2-M201A-2	GP-S2-M201A-3	Average
Test Date	1/19/93	1/20/93	1/21/93	N/A
Run Start Time	1145	1717	855	N/A
Run Finish Time	1508	1817	1100	N/A
Test Train Parameters:				
Volume of Dry Gas Sampled, SCF*	25.447	19.991	29.075	N/A
Percent Isokenetic	122.4	122.8	100.4	N/A
Flue Gas Parameters:				
Temperature, Degrees F	156	152	152	153
Volumetric Air Flow Rates				
SCFM*, Dry	30,153	26,871	34,240	30,421
ACFM, Wet	37,829	32,500	42,281	37,537
Dia. of Particles in Cyclone, Microns	9.00	10.2	10.3	9.82
PM10 EMISSION RESULTS:				
Concentration, grains/DSCF*	0.0372	0.0127	0.0350	0.0283
Emission Rate, kilograms/hour	4.37	1.32	4.66	3.45
Emission Rate, pounds/hour	9.62	2.92	10.3	7.60
TOTAL PARTICULATE EMISSIONS (Includes PM10):				
Concentration, grains/DSCF*	0.162	0.0892	0.111	0.121
Emission Rate, kilograms/hour	19.0	9.32	14.7	14.3
Emission Rate, pounds/hour	41.8	20.6	32.5	31.6
PARTICULATE FRACTIONATION:				
> PM10, %	77.0	85.8	68.4	77
< PM10, %	23.0	14.2	31.6	23

* 68 Deg. F (20 C) -- 29.92 In. Mercury

Table 3-12

PM10 TESTS SUMMARY

Stacks 3, 4, & 5

	GP-S3-M201A-1	GP-S4-M201A-1	GP-S5-M201A-1	Average
Test Date	1/22/93	1/22/93	1/22/93	N/A
Run Start Time	925	925	925	N/A
Run Finish Time	1501	1508	1455	N/A
Test Train Parameters:				
Volume of Dry Gas Sampled, SCF*	104.882	122.533	103.584	N/A
Percent Isokenetic	98.8	103.0	112.3	N/A
Flue Gas Parameters:				
Temperature, Degrees F	79	82	80	80
Volumetric Air Flow Rates				
SCFM*, Dry	40,953	41,029	37,322	39,768
ACFM, Wet	42,307	41,777	37,572	40,552
Dia. of Particles in Cyclone, Microns	9.94	9.70	9.88	9.84
PM10 EMISSION RESULTS:				
Including extractable/non-extractable condensibles				
Concentration, grains/DSCF	0.000750	0.00112	0.00147	0.00112
Emission Rate, kilograms/hour	0.119	0.179	0.214	0.171
Emission Rate, pounds/hour	0.263	0.394	0.472	0.377
Including only non-extractable condensibles				
Concentration, grains/DSCF*	0.000750	0.000705	0.001237	0.000897
Emission Rate, kilograms/hour	0.119	0.113	0.179	0.137
Emission Rate, pounds/hour	0.263	0.248	0.396	0.302
Without condensibles (filterable)				
Concentration, grains/DSCF*	0.000647	0.000416	0.00112	0.000727
Emission Rate, kilograms/hour	0.103	0.0663	0.162	0.111
Emission Rate, pounds/hour	0.227	0.146	0.357	0.244
TOTAL PARTICULATE EMISSIONS (Includes PM10):				
Concentration, grains/DSCF*	0.00182	0.00304	0.00267	0.00251
Emission Rate, kilograms/hour	0.300	0.484	0.387	0.390
Emission Rate, pounds/hour	0.640	1.07	0.853	0.854
PARTICULATE FRACTIONATION:				
> PM10, %	58.9	63.1	44.7	55.5
< PM10, %	41.1	36.9	55.3	44.5

* 68 Deg. F (20 C) – 29.92 In. Mercury

Table 3-13

SEMIVOLATILE ORGANICS AVERAGE EMISSIONS SUMMARY

SEMIVOLATILE ORGANICS EMISSIONS	STACK 1	STACK 2
A-PINENE		
µg per dry std. cubic meter*	1,924	5,551
ppb by volume, Dry	340	980
pounds per hour	0.220	0.647
B-PINENE		
µg per dry std. cubic meter*	1,160	3,141
ppb by volume, Dry	205	555
pounds per hour	0.132	0.366
P-CYMENE		
µg per dry std. cubic meter*	123	636
ppb by volume, Dry	22.0	114
pounds per hour	0.0140	0.0741
A-TERPINEOL		
µg per dry std. cubic meter*	3,613	7,242
ppb by volume, Dry	563	1,129
pounds per hour	0.410	0.842

Table 3-14

SEMIVOLATILE ORGANICS TESTS SUMMARY

Stack 1

	GP-S1-M0010-1	GP-S1-M0010-2	GP-S1-M0010-3	Average
Test Date	1-19-93	1-20-93	1-20-93	N/A
Run Start Time	850	928	1605	N/A
Run Finish Time	1223	1241	1930	N/A
Test Train Parameters:				
Volume of Dry Gas Sampled, SCF*	113.11	102.462	117.451	N/A
Percent Isokenetic	100.5	103.5	101.1	N/A
Flue Gas Parameters:				
Temperature, Degrees F	132	123	125	127
Volumetric Air Flow Rates				
SCFM*, Dry	31,870	28,024	30,832	30,242
ACFM, Wet	37,511	31,939	35,469	34,973
EMISSION RESULTS:				
A-PINENE				
µg per dry std. cubic meter*	1,725 **	1,449 **	2,599 **	1,924
ppb by volume, Dry	305 **	256 **	459 **	340
kilograms per hour	0.0935 **	0.0690 **	0.1363 **	0.100
pounds per hour	0.206 **	0.152 **	0.300 **	0.220
B-PINENE				
µg per dry std. cubic meter*	1,012 **	904 **	1,565 **	1,160
ppb by volume, Dry	179 **	160 **	276 **	205
kilograms per hour	0.0549 **	0.0430 **	0.0821 **	0.0600
pounds per hour	0.121 **	0.0948 **	0.181 **	0.132
P-CYMENE				
µg per dry std. cubic meter*	120	87.9	160	123
ppb by volume, Dry	21.5	15.8	28.7	22.0
kilograms per hour	0.00650	0.00418	0.00840	0.00636
pounds per hour	0.0143	0.00922	0.0185	0.0140
A-TERPINEOL				
µg per dry std. cubic meter*	3,731 **	3,484 **	3,624 **	3,613
ppb by volume, Dry	582 **	543 **	565 **	563
kilograms per hour	0.202 **	0.166 **	0.190 **	0.186
pounds per hour	0.446 **	0.366 **	0.419 **	0.410

* 68 Deg. F (20 C) -- 29.92 In. Mercury
** Estimated (i.e., value exceeded calibration range.)

Table 3-15

SEMIVOLATILE ORGANIC HAPS TESTS SUMMARY

Stack 2

	GP-S2-M0010-1	GP-S2-M0010-2	GP-S2-M0010-3	Average
Test Date	1-19-93	1-20-93	1-20-93	N/A
Run Start Time	850	925	1620	N/A
Run Finish Time	1342	1302	2022	N/A
Test Train Parameters:				
Volume of Dry Gas Sampled, SCF*	116.768	120.528	117.024	N/A
Percent Isokenetic	100.2	101.2	101.5	N/A
Flue Gas Parameters:				
Temperature, Degrees F	152	145	155	151
Volumetric Air Flow Rates				
SCFM*, Dry	30,948	31,610	30,620	31,059
ACFM, Wet	38,229	39,019	38,188	38,479
EMISSION RESULTS:				
A-PINENE				
µg per dry std. cubic meter*	5,180 **	5,607 **	5,866 **	5,551
ppb by volume, Dry	915 **	990 **	1,036 **	980
kilograms per hour	0.273 **	0.302 **	0.306 **	0.293
pounds per hour	0.601 **	0.665 **	0.674 **	0.647
B-PINENE				
µg per dry std. cubic meter*	2,905 **	3,242 **	3,277 **	3,141
ppb by volume, Dry	513 **	573 **	579 **	555
kilograms per hour	0.153 **	0.174 **	0.171 **	0.166
pounds per hour	0.337 **	0.384 **	0.376 **	0.366
P-CYMENE				
µg per dry std. cubic meter*	653 **	743 **	511 **	636
ppb by volume, Dry	117 **	133 **	91.7 **	114
kilograms per hour	0.0344 **	0.0400 **	0.0266 **	0.0337
pounds per hour	0.0758 **	0.0879 **	0.0587 **	0.0741
A-TERPINEOL				
µg per dry std. cubic meter*	7,413 **	6,428 **	7,886 **	7,242
ppb by volume, Dry	1,156 **	1,002 **	1,229 **	1,129
kilograms per hour	0.390 **	0.346 **	0.411 **	0.382
pounds per hour	0.859 **	0.762 **	0.906 **	0.842

* 68 Deg. F (20 C) – 29.92 In. Mercury
** Estimated (i.e., value exceeded calibration range)

3.2.6 Continuous Emissions Measurement (CEM)

The carbon monoxide (CO), nitrogen oxides (NOx), and total hydrocarbon (THC) emissions were determined using EPA Methods 10, 7E, and 25A, respectively. The average CO, NOx and THC emissions are summarized in Table 3-16. Tables 3-17 through 3-21 summarize the individual runs.

Run 1 performed at stack 4 did not meet the bias requirement of EPA Method 25A. An additional run was performed at stacks 3, 4, and 5 (run 4) to replace the unacceptable run.

3.2.7 Volatile Organics

EPA Method 0030 (VOST) was used to determine the volatile organics emissions at the stacks 1 and 2 sampling locations. The volumetric flow rates used to report emission rates were obtained from concurrent isokinetic sample runs. Table 3-22 summarizes the average volatile organics emissions. The individual runs are summarized in Tables 3-23 and 3-24.

Each VOST run consisted of four pairs of adsorbent tubes. Three of the four pairs were analyzed with the fourth pair archived as a backup. Each pair consisted of a Tenax trap, followed by a Tenax Charcoal trap. The traps were analyzed individually. The sample flow rate and total gas volume were based on the total hydrocarbon (THC) concentrations measured in the field using Method 25A (flame ionization detector). Any locations with high concentrations of THC were sampled at an appropriately lower flow rate, thus yielding a smaller volume of sample. Despite adjustments in the sample volume, there were instances when the amount of analyte detected exceeded the effective calibration range. This problem necessitated modification of the analytical procedures as discussed in Section 5.4.6.

The most abundant compounds detected were α-pinene and β-pinene. During analysis of the initial VOST tubes from both stacks 1 and 2 the pinene compounds were detected at levels above the upper calibration range. The analytical strategy was modified to quantify these compounds. The archived tubes for stacks 1 and 2 were analyzed and quantifiable pinene data was obtained. The reported quantities for other compounds of interest were well within calibration range except for toluene and methylene chloride for stack 2 runs 1a and 2a.

Table 3-16

AVERAGE CARBON MONOXIDE, NITROGEN OXIDES, AND TOTAL HYDROCARBONS EMISSIONS SUMMARY

SAMPLING LOCATION & POLLUTANT	CONCENTRATION			Emission Rate, Pound/Hr
	Parts Per Million		Milligrams Per Dry Std. Cu. Meter*	
	Wet	Dry		
Total Hydrocarbons**				
Stack 1	2.65	2.81	5.15	0.627
Stack 2	23.4	25.3	46.4	5.59
Stack 3	12.7	12.9	23.6	3.79
Stack 4	35.7	36.2	66.4	9.82
Stack 5	27.5	27.9	51.1	7.93
Carbon Monoxide				
Stack 1		7.53	8.77	1.07
Stack 2		19.3	22.5	2.74
Nitrogen Oxides				
Stack 1		4.85	9.27	1.12
Stack 2		27.8	53.1	6.42

* 68 Degrees F -- 29.92 Inches of Mercury (Hg).

** As Propane

Table 3-17

CARBON MONOXIDE, NITROGEN OXIDES, AND TOTAL HYDROCARBONS TEST SUMMARY

Stack 1

	GP-S1-CEM-1	GP-S1-CEM-2	GP-S1-CEM-3	Average
Test Date	1/19/93	1/19/93	1/19/93	N/A
Run Start Time	850	1135	1450	N/A
Run Finish Time	1115	1423	1845	N/A
Dry Mole Fraction*	0.942	0.945	0.945	0.944
Air Flow Rate, SCFM, Dry*	31,896	33,614	33,869	33,126
CEM RESULTS:				
Carbon Monoxide				
Concentration				
parts per million, dry	15.5	4.10	3.00	7.53
milligrams / dry std. m_3**	18.0	4.77	3.49	8.77
Emission Rate				
Pounds per Hour	2.16	0.601	0.443	1.07
Kilograms per Hour	0.978	0.273	0.201	0.484
Nitrogen Oxides as NO_2				
Concentration				
parts per million, dry	11.5	1.41	1.64	4.85
milligrams / dry std. m_3**	22.0	2.70	3.14	9.27
Emission Rate				
Pounds per Hour	2.63	0.34	0.40	1.12
Kilograms per Hour	1.19	0.154	0.180	0.509
Total Hydrocarbons***				
Concentration				
parts per million, wet	5.36	1.18	1.41	2.65
parts per million, dry	5.69	1.25	1.49	2.81
milligrams / dry std. m_3**	10.43	2.29	2.74	5.15
Emission Rate				
Pounds per Hour	1.25	0.288	0.347	0.627
Kilograms per Hour	0.565	0.131	0.157	0.285

* From Concurrent Isokinetic Testing

** 68 Degrees F -- 29.92 Inches Of Mercury (Hg)

*** As Propane

Table 3-18

CARBON MONOXIDE, NITROGEN OXIDES, AND TOTAL HYDROCARBONS TEST SUMMARY

Stack 2

	GP-S2-CEM-1	GP-S2-CEM-2	GP-S2-CEM-3	Average
Test Date	1/20/93	1/20/93	1/20/93	N/A
Run Start Time	830	1215	1700	N/A
Run Finish Time	1155	1635	2040	N/A
Dry Mole Fraction*	0.922	0.937	0.927	0.945
Air Flow Rate, SCFM, Dry*	31,660	34,212	30,653	33,614
CEM RESULTS:				
Carbon Monoxide				
Concentration				
parts per million, dry	29.6	20.7	7.7	19.3
milligrams / dry std. m_3**	34.5	24.1	9.0	22.5
Emission Rate				
Pounds per Hour	4.09	3.09	1.03	2.74
Kilograms per Hour	1.85	1.40	0.47	1.24
Nitrogen Oxides as NO_2				
Concentration				
parts per million, dry	41.4	26.4	15.5	27.8
milligrams / dry std. m_3**	79.2	50.5	29.6	53.1
Emission Rate				
Pounds per Hour	9.39	6.47	3.40	6.42
Kilograms per Hour	4.26	2.93	1.54	2.91
Total Hydrocarbons***				
Concentration				
parts per million, wet	45.7	17.0	7.60	23.4
parts per million, dry	49.6	18.2	8.20	25.3
milligrams / dry std. m_3**	90.9	33.3	15.0	46.4
Emission Rate				
Pounds per Hour	10.78	4.26	1.73	5.59
Kilograms per Hour	4.89	1.93	0.783	2.54

* From Concurrent Isokinetic Testing

** 68 Degrees F -- 29.92 Inches Of Mercury (Hg)

*** As Propane

Table 3-19

TOTAL HYDROCARBONS SUMMARY

Stack 3

	GP-S3-M25A-2	GP-S3-M25A-3	GP-S3-M25A-4	Average
Test Date	1/22/93	1/22/93	1/23/93	N/A
Run Start Time	1807	1950	838	N/A
Run Finish Time	1926	2107	1050	N/A
Dry Mole Fraction*	0.986	0.983	0.991	0.987
Air Flow Rate, SCFM*, Dry	42,997	44,066	41,966	43,010
CEM RESULTS:				
Total Hydrocarbons**				
Concentration				
parts per million, wet	13.2	8.56	16.4	12.7
parts per million, dry	13.4	8.71	16.5	12.9
milligrams / dry std. m3***	24.6	16.0	30.3	23.6
Emission Rate				
Pounds per Hour	3.95	2.64	4.77	3.79
Kilograms per Hour	1.79	1.20	2.16	1.72

* From Concurrent Isokinetic Testing

** As Propane

*** 68 Degrees F -- 29.92 Inches Of Mercury (Hg)

Table 3-20

TOTAL HYDROCARBONS SUMMARY

Stack 4

	GP-S4-M25A-2	GP-S4-M25A-3	GP-S4-M25A-4	Average
Test Date	1/22/93	1/22/93	1/23/93	N/A
Run Start Time	1807	1950	838	N/A
Run Finish Time	1926	2107	1050	N/A
Dry Mole Fraction*	0.985	0.984	0.988	0.986
Air Flow Rate, SCFM*, Dry	38,068	38,780	40,982	39,277
CEM RESULTS:				
Total Hydrocarbons**				
Concentration				
parts per million, wet	34.1	27.3	45.7	35.7
parts per million, dry	34.6	27.7	46.3	36.2
milligrams / dry std. m3***	63.5	50.9	84.8	66.4
Emission Rate				
Pounds per Hour	9.05	7.39	13.0	9.82
Kilograms per Hour	4.11	3.35	5.90	4.45

* From Concurrent Isokinetic Testing

** As Propane

*** 68 Degrees F -- 29.92 Inches Of Mercury (Hg)

Table 3-21

TOTAL HYDROCARBONS SUMMARY

Stack 5

	GP-S5-M25A-2	GP-S5-M25A-3	GP-S5-M25A-4	Average
Test Date	1/22/93	1/22/93	1/23/93	N/A
Run Start Time	1807	1950	838	N/A
Run Finish Time	1926	2107	1050	N/A
Dry Mole Fraction*	0.985	0.984	0.987	0.985
Air Flow Rate, SCFM*, Dry	40,360	42,005	41,920	41,428
CEM RESULTS:				
Total Hydrocarbons**				
Concentration				
parts per million, wet	26.7	20.3	35.4	27.5
parts per million, dry	27.1	20.6	35.9	27.9
milligrams / dry std. m3***	49.7	37.8	65.8	51.1
Emission Rate				
Pounds per Hour	7.51	5.95	10.3	7.93
Kilograms per Hour	3.41	2.70	4.68	3.60

* From Concurrent Isokinetic Testing

** As Propane

*** 68 Degrees F -- 29.92 Inches Of Mercury (Hg)

Table 3-22

VOLATILE ORGANICS AVERAGE EMISSIONS SUMMARY

VOLATILE ORGANICS EMISSIONS	STACK 1	STACK 2
CONCENTRATION, µg/dscm*		
Chloromethane	6.14	14.2
Acetone	264	872
Methylene Chloride	94.7	44.4
Methyl Ethyl Ketone	25.7	223
Benzene	15.7	26.0
Toluene	42.3	234
4-Methyl-2-Pentanone	4.58	6.82
m,p-Xylene	11.3	11.6
Styrene	--	8.88
A-Pinene*	12,490	113,683
B-Pinene*	3,272	32,376
P-Cymene*	271	989
Acrolein*	247	675
Acrylonitrile*	6.14	10.2
CONCENTRATION, ppb by volume, Dry		
Chloromethane	2.92	6.76
Acetone	127	419
Methylene Chloride	26.8	12.6
Methyl Ethyl Ketone	8.57	74.5
Benzene	4.85	8.00
Toluene	11.0	61.1
4-Methyl-2-Pentanone	1.10	1.67
m,p-Xylene	2.55	2.64
Styrene	--	2.05
A-Pinene*	2,205	20,073
B-Pinene*	578	5,717
P-Cymene*	48.5	177
Acrolein*	106	290
Acrylonitrile*	2.78	4.61
EMISSION RATE, Lb/Hr		
Chloromethane	0.000697	0.00165
Acetone	0.0287	0.101
Methylene Chloride	0.0108	0.00513
Methyl Ethyl Ketone	0.00275	0.0256
Benzene	0.00177	0.00303
Toluene	0.00479	0.0272
4-Methyl-2-Pentanone	0.000516	0.000788
m,p-Xylene	0.00125	0.00136
Styrene	--	0.00103
A-Pinene*	1.39	13.1
B-Pinene*	0.364	3.76
P-Cymene*	0.0304	0.115
Acrolein*	0.0270	0.0795
Acrylonitrile*	0.000675	0.00118

* Compound not listed in SW-846 Method 5041 and is considered semi-quantitative due to lack of acceptance criteria.

Table 3-23

VOLATILE ORGANICS EMISSIONS SUMMARY

Stack 1

	GP-S1-M0030-1	GP-S1-M0030-2	GP-S1-M0030-3	Average
Test Date	1-19-93	1-20-93	1-20-93	
Run Start-Finish Time	1033-1154	939-1053	1612-1724	
Volumetric Air Flow Rates, SCFM*	31,870	28,024	30,832	30,242
TEST RESULTS:				
Chloromethane				
µg per dry std. cubic meter*	5.31	5.34	7.77	6.14
ppb by volume, Dry	2.53	2.55	3.70	2.92
kiligrams per hour	0.000287	0.000255	0.000407	0.000316
pounds per hour	0.000634	0.000561	0.000897	0.000697
Acetone				
µg per dry std. cubic meter*	68.6	540	183	264
ppb by volume, Dry	33.0	259	87.7	127
kiligrams per hour	0.00372	0.0257	0.00957	0.0130
pounds per hour	0.00819	0.0567	0.0211	0.0287
Methylene Chloride				
µg per dry std. cubic meter*	139	78.7	67.0	94.7
ppb by volume, Dry	39.3	22.3	19.0	26.8
kiligrams per hour	0.00750	0.00375	0.00351	0.00492
pounds per hour	0.0165	0.00826	0.00774	0.0108
Methyl Ethyl Ketone				
µg per dry std. cubic meter*	4.80	64.2	8.06	25.7
ppb by volume, Dry	1.60	21.4	2.69	8.57
kiligrams per hour	0.000260	0.00306	0.000422	0.00125
pounds per hour	0.000573	0.00674	0.000931	0.00275
Benzene				
µg per dry std. cubic meter*	7.82	16.6	22.9	15.7
ppb by volume, Dry	2.41	5.10	7.04	4.85
kiligrams per hour	0.000423	0.000788	0.00120	0.000803
pounds per hour	0.000933	0.00174	0.00264	0.00177
Toluene				
µg per dry std. cubic meter*	42.1	41.7	43.0	42.3
ppb by volume, Dry	11.0	10.9	11.2	11.0
kiligrams per hour	0.00228	0.00199	0.00225	0.00217
pounds per hour	0.00502	0.00438	0.00497	0.00479
4-Methyl-2-Pentanone				
µg per dry std. cubic meter*	4.06	4.98	4.69	4.58
ppb by volume, Dry	0.975	1.20	1.13	1.10
kiligrams per hour	0.000220	0.000237	0.000245	0.000234
pounds per hour	0.000485	0.000523	0.000541	0.000516
m,p-Xylene				
µg per dry std. cubic meter*	5.79	16.4	11.6	11.3
ppb by volume, Dry	1.31	3.72	2.63	2.55
kiligrams per hour	0.000314	0.000781	0.000608	0.000568
pounds per hour	0.000692	0.00172	0.00134	0.00125
A-Pinene**				
µg per dry std. cubic meter*	9734 (a)	9638	15,342	12490
ppb by volume, Dry	1719	1702	2,709	2205
kiligrams per hour	0.527	0.459	0.804	0.631
pounds per hour	1.16	1.01	1.77	1.39
B-Pinene**				
µg per dry std. cubic meter*	1881 (a)	2,698	3,846	3272
ppb by volume, Dry	332	476	679	578
kiligrams per hour	0.102	0.128	0.202	0.165
pounds per hour	0.225	0.283	0.444	0.364
P-Cymene**				
µg per dry std. cubic meter*	178	314	320	271
ppb by volume, Dry	31.9	56.2	57.4	48.5
kiligrams per hour	0.00964	0.0149	0.0168	0.01378
pounds per hour	0.0212	0.0329	0.0370	0.0304
Acrolein**				
µg per dry std. cubic meter*	41.2	467	234	247
ppb by volume, Dry	17.7	200	101	106
kiligrams per hour	0.00223	0.0222	0.0123	0.0122
pounds per hour	0.00492	0.0490	0.0271	0.0270
Acrylonitrile**				
µg per dry std. cubic meter*	1.03	9.69	7.7	6.14
ppb by volume, Dry	0.467	4.39	3.47	2.78
kiligrams per hour	0.0000558	0.000461	0.000401	0.000306
pounds per hour	0.000123	0.00102	0.000885	0.000675

* 68 Deg. F (20 C) -- 29.92 In. Mercury

** Compound not listed in SW-846 Method 5041 and is considered semi-quantitative due to lack of acceptance criteria

(a)--Results were obtained from one (archived) tube pair only, and have not been included in the averages.

Table 3-24

VOLATILE ORGANICS EMISSIONS SUMMARY

Stack 2

	GP-S2-M0030-1	GP-S2-M0030-2	GP-S2-M0030-3	Average
Test Date	1-19-93	1-20-93	1-20-93	
Run Start-Finish Time	850-1003	928-1101	1624-1734	
Volumetric Air Flow Rates, SCFM*	30,948	31,610	30,620	31,059
TEST RESULTS:				
Chloromethane				
µg per dry std. cubic meter*	14.3	14.4	13.9	14.2
ppb by volume, Dry	6.79	6.87	6.61	6.76
kilograms per hour	0.000749	0.000774	0.000721	0.000748
pounds per hour	0.00165	0.00171	0.00159	0.00165
Acetone				
µg per dry std. cubic meter*	184	942	1,489	872
ppb by volume, Dry	88.5	453	715	419
kilograms per hour	0.00969	0.0506	0.0775	0.0459
pounds per hour	0.0214	0.112	0.171	0.101
Methylene Chloride				
µg per dry std. cubic meter*	66.9	--	21.9	44.4
ppb by volume, Dry	18.9	--	6.20	12.6
kilograms per hour	0.00352	--	0.00114	0.00233
pounds per hour	0.00775	--	0.00251	0.00513
Methyl Ethyl Ketone				
µg per dry std. cubic meter*	8.78	12.6	648.5	223
ppb by volume, Dry	2.93	4.21	216	74.5
kilograms per hour	0.000462	0.000678	0.0337	0.0116
pounds per hour	0.00102	0.00150	0.0744	0.0256
Benzene				
µg per dry std. cubic meter*	30.6	31.4	15.9	26.0
ppb by volume, Dry	9.43	9.69	4.88	8.00
kilograms per hour	0.00161	0.00169	0.000825	0.00137
pounds per hour	0.00355	0.00372	0.00182	0.00303
Toluene				
µg per dry std. cubic meter*	119	263	321	234
ppb by volume, Dry	30.9	68.7	83.8	61.1
kilograms per hour	0.00623	0.0141	0.0167	0.0124
pounds per hour	0.0137	0.0312	0.0368	0.0272
4-Methyl-2-Pentanone				
µg per dry std. cubic meter*	6.37	11.7	11.6	6.82
ppb by volume, Dry	1.53	2.82	2.79	1.67
kilograms per hour	0.000335	0.000631	0.000604	0.000357
pounds per hour	0.000738	0.00139	0.00133	0.000788
m,p-Xylene				
µg per dry std. cubic meter*	11.5	14.3	9.20	11.6
ppb by volume, Dry	2.59	3.23	2.08	2.64
kilograms per hour	0.000602	0.000767	0.000479	0.000616
pounds per hour	0.00133	0.00169	0.00106	0.00136
Styrene				
µg per dry std. cubic meter*	14.3	7.38	4.92	8.88
ppb by volume, Dry	3.31	1.70	1.14	2.05
kilograms per hour	0.000754	0.000396	0.000256	0.000469
pounds per hour	0.00166	0.000874	0.000564	0.00103
A-Pinene**				
µg per dry std. cubic meter*	146588 (a)	57,690	169,676	113,683
ppb by volume, Dry	25883	10,186	29,960	20,073
kilograms per hour	7.71	3.10	8.83	5.96
pounds per hour	17.0	6.83	19.5	13.1
B-Pinene**				
µg per dry std. cubic meter*	67818 (a)	25,265	39,487	32,376
ppb by volume, Dry	11975	4,461	6,972	5,717
kilograms per hour	3.57	1.36	2.05	1.71
pounds per hour	7.86	2.99	4.53	3.76
P-Cymene**				
µg per dry std. cubic meter*	159	925	1,882	989
ppb by volume, Dry	28.6	166	337	177
kilograms per hour	0.00838	0.0497	0.0979	0.0520
pounds per hour	0.0185	0.110	0.216	0.115
Acrolein**				
µg per dry std. cubic meter*	276	1,508	242	675
ppb by volume, Dry	118	647	104	290
kilograms per hour	0.0145	0.0810	0.0126	0.0360
pounds per hour	0.0320	0.179	0.0277	0.0795
Acrylonitrile**				
µg per dry std. cubic meter*	8.98	7.97	13.5	10.2
ppb by volume, Dry	4.07	3.62	6.14	4.61
kilograms per hour	0.000472	0.000428	0.000704	0.000535
pounds per hour	0.00104	0.000944	0.00155	0.00118

* 68 Deg. F (20 C) – 29.92 In. Mercury

** Compound not listed in SW-846 5041 and is considered semi-quantitative due to lack of acceptance criteria.

(a)--Results were obtained from one (archived) tube pair only, and have not been included in the averages.

For the acrolein results, there were large variabilities from run to run. Acrolein was detected in the lab and field blanks but the amounts detected in the samples were significantly greater than the blanks. Individual tube analysis demonstrated there was no breakthrough of any compounds detected at significant levels.

For pinene emissions, the VOST results were approximately 6 to 26 times higher than the semivolatile results. The semivolatile results for these compounds were estimated based on data that was higher than the calibration curves. Based on test results obtained at a similar facility, the VOST data should be considered more accurate for quantifying pinene compounds. The trapping efficiency (recovery) of the VOST method may be greater and, therefore, more accurate than the semivolatile method, which involves extraction and concentration steps with possible losses. Since no labeled standards for the pinenes and cymene were used in either the VOST or semivolatile method, no direct comparisons can be made to isotopically labeled surrogate or internal standard compounds in each analysis. While the VOST data appear to be more accurate than the semivolatile data, they are to be considered semiquantitative for the pinenes and cymene.

The bromofluorobenzene surrogate recovery for the field bias blank for stack 1 was 220 percent. This is the only sample that was not within method requirements.

The lab was unable to procure standards for cumene, 1,3-butadiene, and vinyl bromide. Analysis for these compounds therefore was not done.

Approximately one third of the samples were analyzed outside the recommended 14 day holding time. This is due to the modification of the analytical scheme required to quantify the terpene compounds. Since the terpene compounds were the primary analytes detected and because they typically have higher boiling points, this extended hold time should have no effect on the data quality.

SECTION 4
SAMPLING LOCATIONS

4.1 GENERAL

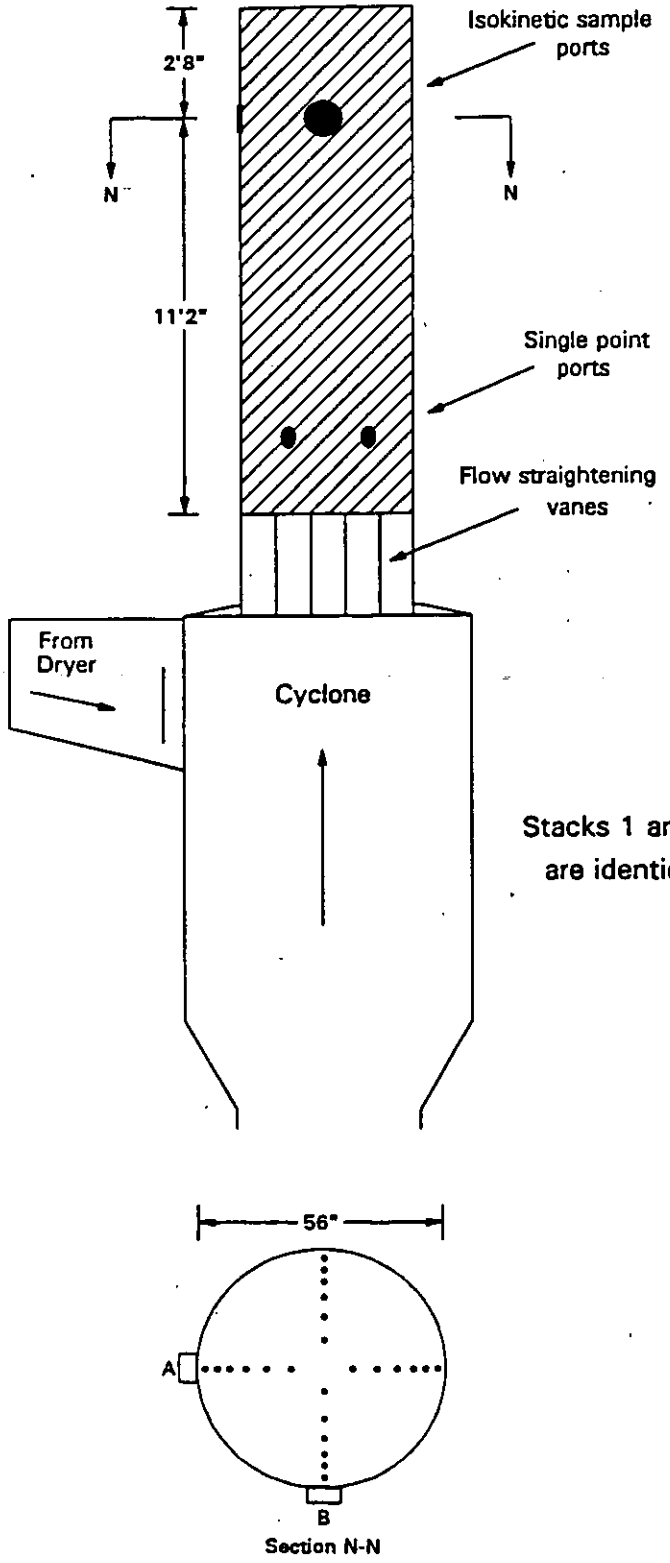
Emissions sampling was conducted at the two dryer cyclones (stacks 1 and 2) and three roof vents (stacks 3, 4, and 5) on the particleboard press exhaust. Schematics are presented for each of the locations sampled. The test program focused primarily on flue gas sampling. There was no requirement for any process stream sample collection during the program.

4.2 SAMPLING LOCATIONS DESCRIPTIONS

All of the exhaust ducts and vents required installation of specially designed and constructed stack extensions. The stack extensions were built and installed by a local contractor under the supervision of Georgia-Pacific and WESTON. Due to the presence of cyclonic flow, straightening vanes were installed on the stack extensions to provide suitable sampling locations. All sampling locations met all of the EPA Method 1 criteria for velocity determination. Each of the stack extensions had two ports for isokinetic sampling and two ports for single point sampling. The single point sampling ports are not required to meet Method 1 criteria.

4.2.1 Dryers

There are two particle dryers, each with cyclones, to process dried material. The dryer stacks (#1 and #2) are located approximately 75 feet above grade. The test ports for isokinetic sampling were located 2.4 diameters downstream from a flow disturbance (flow straightening vanes) and 0.6 duct diameters upstream from a flow disturbance (stack outlet to atmosphere). For isokinetic sampling, these measurements require that 12 points per port be tested, resulting in a total of 24 points per test run. Figure 4-1 presents a schematic of the sampling locations.



Stacks 1 and 2 are identical

ISOKINETIC SAMPLING TRAIN	
TRAVERSE POINT NUMBER	DISTANCE FROM INSIDE NEAR WALL (INCHES)
1	1 1/4
2	3 3/4
3	6 5/8
4	9 7/8
5	14
6	19 7/8
7	36
8	42
9	46
10	49 3/8
11	52 1/2
12	54 3/4

PM 10 SAMPLING TRAIN	
TRAVERSE POINT NUMBER	DISTANCE FROM INSIDE NEAR WALL (INCHES)
1	2 1/2
2	8 1/8
3	16 1/2
4	39 1/2
5	47 1/8
6	53 1/2

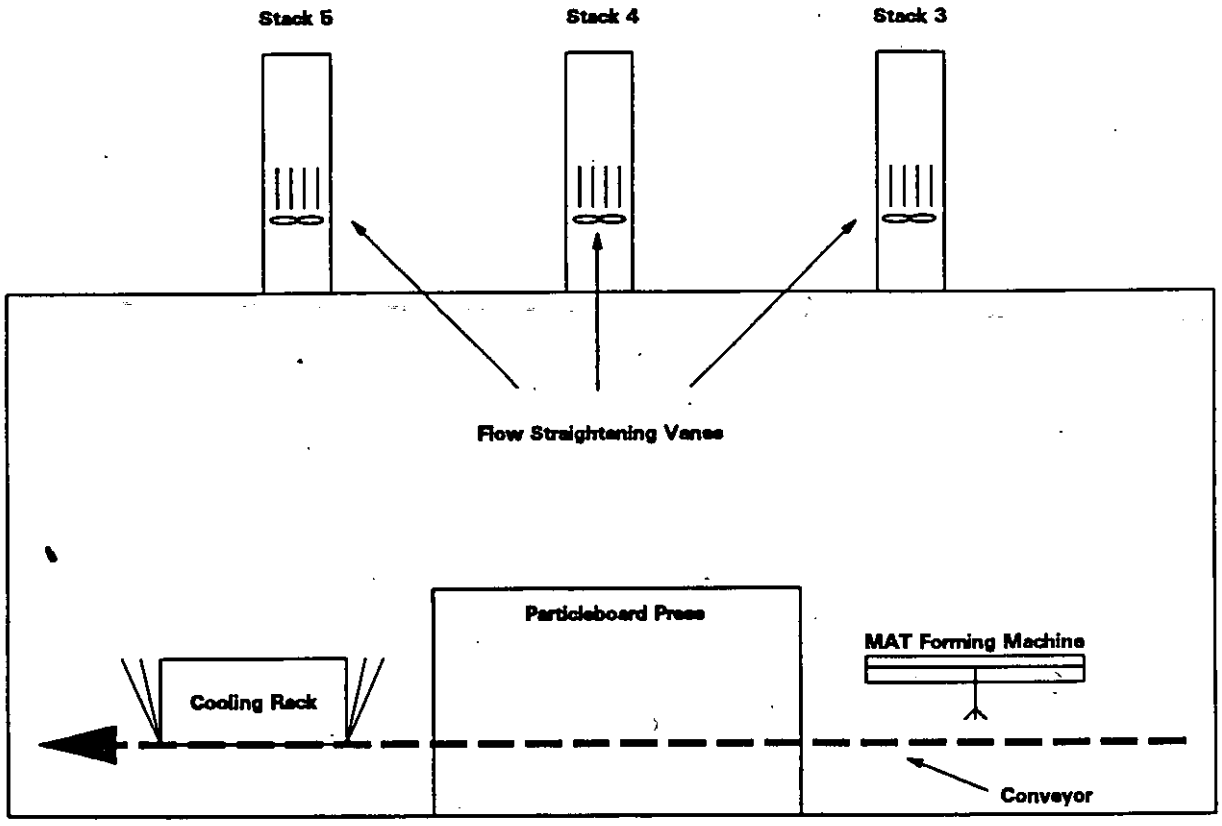
Drawing Not to Scale

Figure 4-1
Stacks 1 & 2 Sampling Location

FIG4-1.G-P

4.2.2 Particleboard Press Exhausts

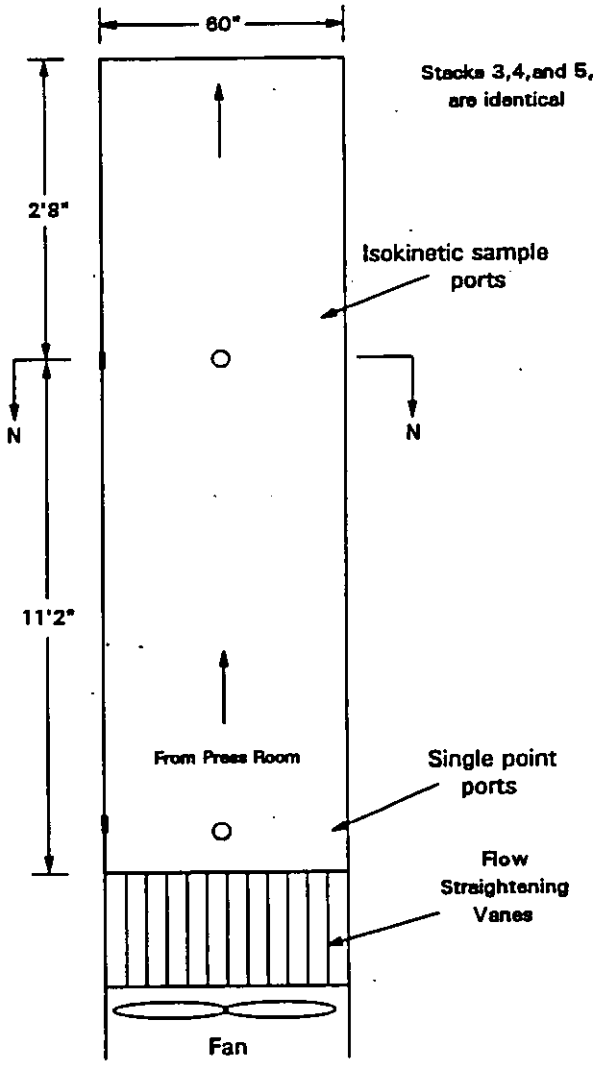
As shown in Figure 4-2, there are a total of three exhausts (stacks #3 - #5) for the press area located on a roof that is slightly pitched. The stacks are identical and a schematic is shown in Figure 4-3. The stacks run vertically approximately 15 feet above the roof level. For isokinetic sampling, the test ports were located 3.1 diameters downstream from the flow straightening vanes and 0.6 diameters upstream from the stack outlet to atmosphere. These measurements dictate that 12 points per port be tested for a total of 24 points per test run.

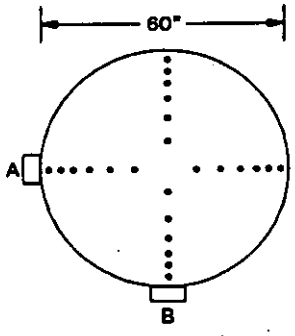


Drawing not to scale

Figure 4-2
Particleboard Press Building

RG4-2.G-P





Section N-N

(Isokinetic Sampling Train Points)

ISOKINETIC SAMPLING TRAIN	
TRAVERSE POINT NUMBER	DISTANCE FROM INSIDE NEAR WALL (INCHES)
1	1 1/2
2	4 1/4
3	7 3/8
4	10 7/8
5	15 1/4
6	21 5/8
7	38 7/8
8	45 1/4
9	49 5/8
10	53 1/4
11	56 1/4
12	59

PM 10 SAMPLING TRAIN	
TRAVERSE POINT NUMBER	DISTANCE FROM INSIDE NEAR WALL (INCHES)
1	2 5/8
2	8 3/4
3	17 3/4
4	42 1/4
5	51 1/4
6	57 3/8

Drawing Not to Scale

Figure 4-3
Press Stack Sampling Location

R04-3.0-P

SECTION 5
SAMPLING AND ANALYTICAL PROCEDURES

5.1 OVERVIEW OF FLUE GAS SAMPLING AND ANALYSIS PROCEDURES

Aldehyde/ketone, condensible particulate, PM_{10}, particulate, semivolatile organic, and volatile organic samples were recovered on-site at the field laboratory. Carbon monoxide, total hydrocarbon, and nitrogen oxide concentrations were monitored continuously during each test repetition using WESTON's on-site CEMs instrumentation trailer. Appendix C contains the reference methods and a complete description of equipment and procedures (extracted from 40 CFR 60).

5.2 SAMPLING POINTS

EPA Method 1 criteria was used to determine the number and location of the sampling points.

5.3 VOLUMETRIC FLOW RATES

5.3.1 Flue Gas Velocity

EPA Method 2 was utilized to obtain the velocity measurements during the traverses of the stack cross sections.

5.3.2 Flue Gas Composition

The flue gas molecular weight was determined by EPA Method 3 at stacks 1 and 2. At stacks 3, 4, and 5, the flue gas composition was assumed to be that of ambient air. Ambient concentration was verified by Fyrite analysis.

5.3.3 Flue Gas Moisture Content

Moisture content was determined by analyzing the sampling train impinger contents according to the procedures outlined in the respective EPA Methods.

5.4 POLLUTANT EMISSIONS DETERMINATIONS

5.4.1 Aldehyde/Ketones

The aldehyde and ketone emissions from all sampling locations were determined by EPA Method 0011. The sampling train, as shown in Figure 5-1, consisted of the following components connected in a series:

- A calibrated borosilicate nozzle attached to a borosilicate probe.
- A rigid borosilicate connector to join the outlet of the sample probe to the inlet of the impinger train.
- An impinger train consisting of four impingers. The first three impingers contained 100 ml of cleaned 2,4-dinitrophenylhydrazine (DNPH) solution. The fourth impinger contained 300 grams of the dry preweighed silica gel. The second impinger was a Greenburg-Smith type; all other impingers were of a modified design. All impingers were maintained in a crushed ice bath.
- A vacuum line (umbilical cord) with adapter to connect the outlet of the impinger train to a control module.
- A control module containing a 3-cfm carbon vane vacuum pump (sample gas mover), a calibrated dry gas meter (sample gas volume measurement device), a calibrated orifice (sample gas flow rate monitor) and inclined manometers (orifice and gas stream pressure indicators).
- A switchable calibrated digital pyrometer to monitor flue and sample gas temperatures.

The preparation, sampling, and recovery procedures used for determination of formaldehyde, aldehydes, and ketones are shown in Figure 5-2, 5-3 and 5-4, respectively. Each test was 60 to 72 minutes in duration. All runs were isokinetic ± 10 percent. The analytical procedures for the quantification of aldehydes and ketones were performed as specified in EPA Methods 0011 and 0011A utilizing high-performance liquid chromatography (HPLC). The Method 0011A analysis steps for the determination of aldehydes and ketones are summarized in Figure 5-5.

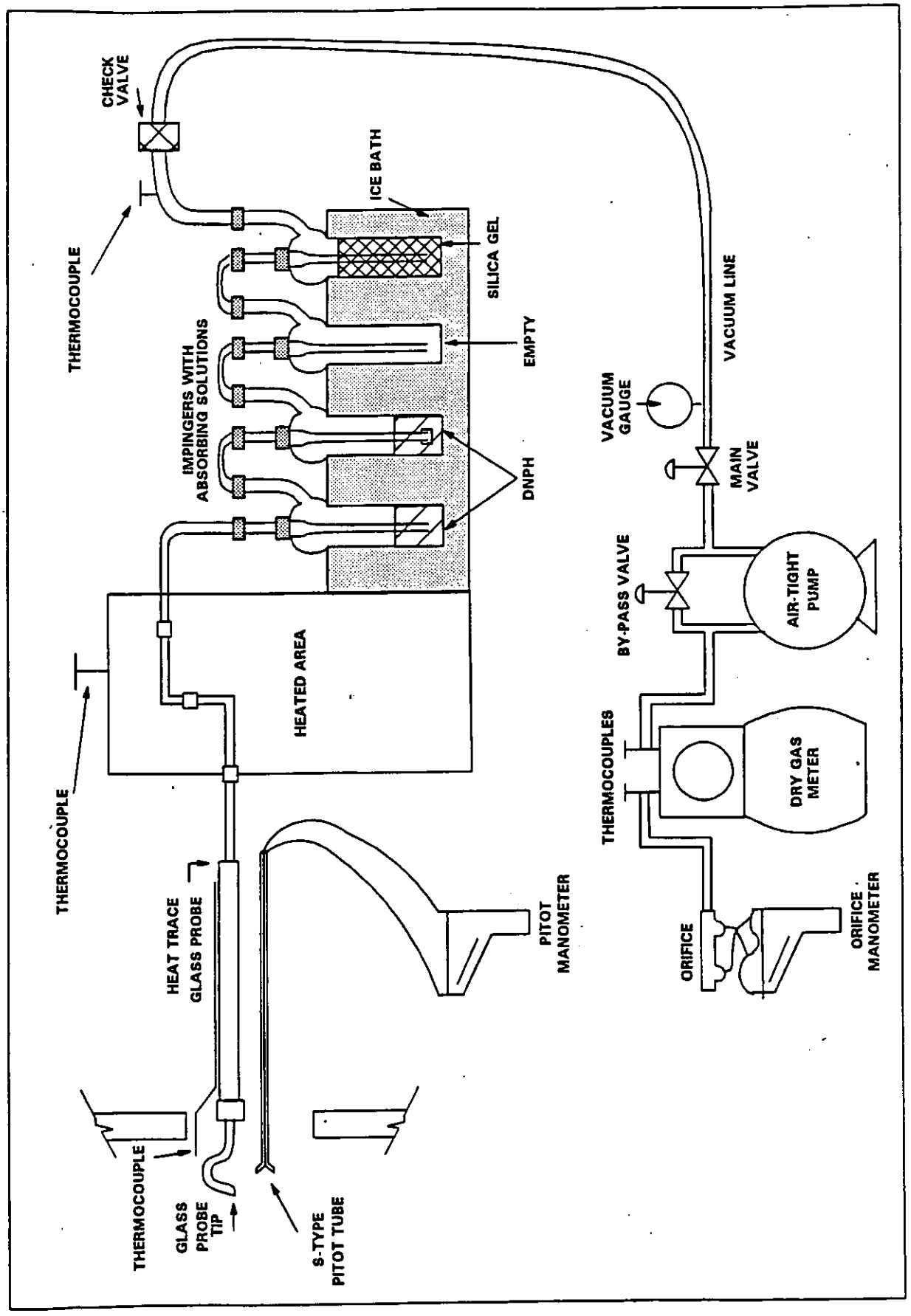


FIGURE 5-1
EPA METHOD 0011
ALDEHYDE/KETONE SAMPLING TRAIN

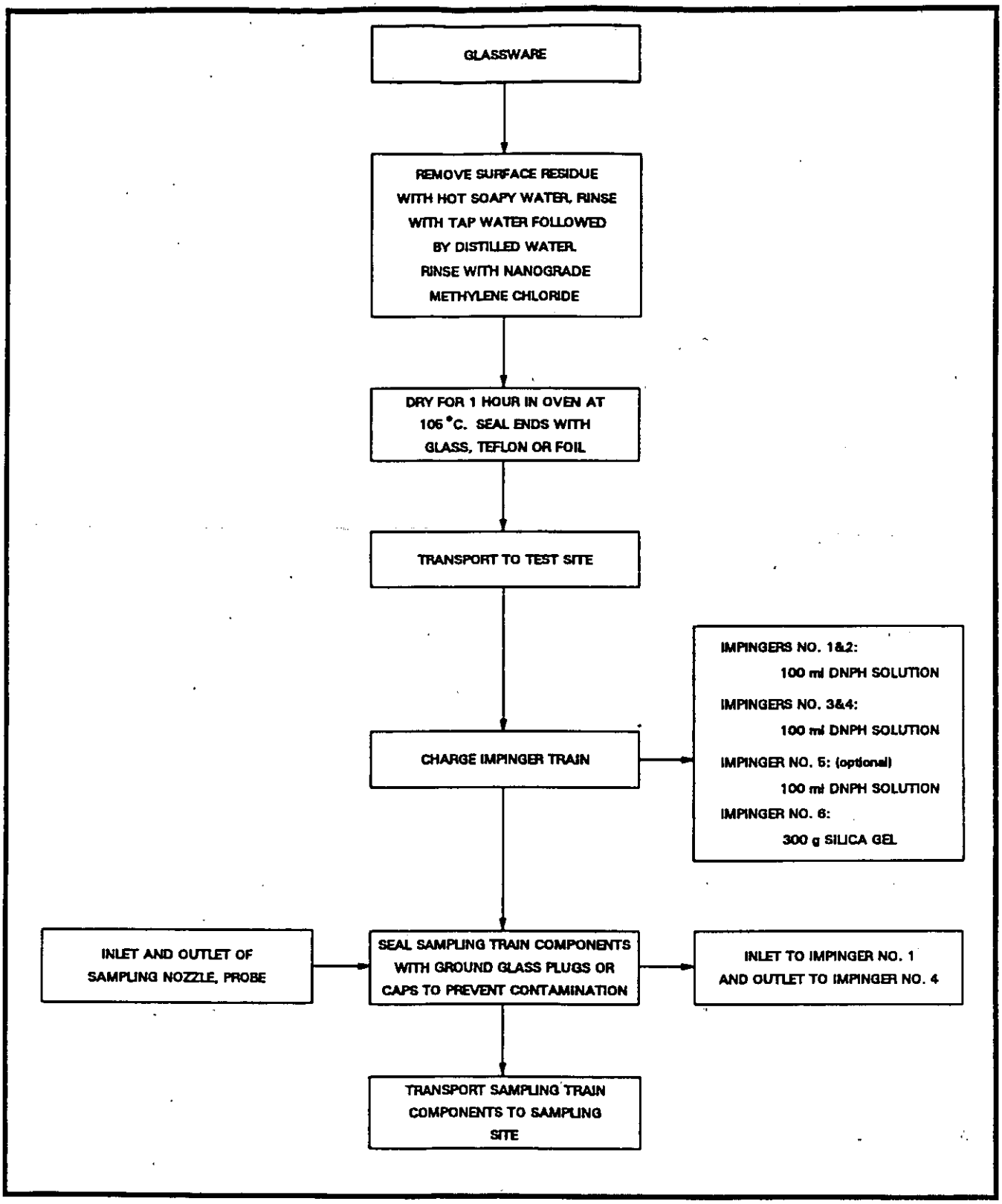


FIGURE 5-2
PREPARATION PROCEDURES FOR
ALDEHYDE/KETONE SAMPLING TRAIN

PRP-ALDE

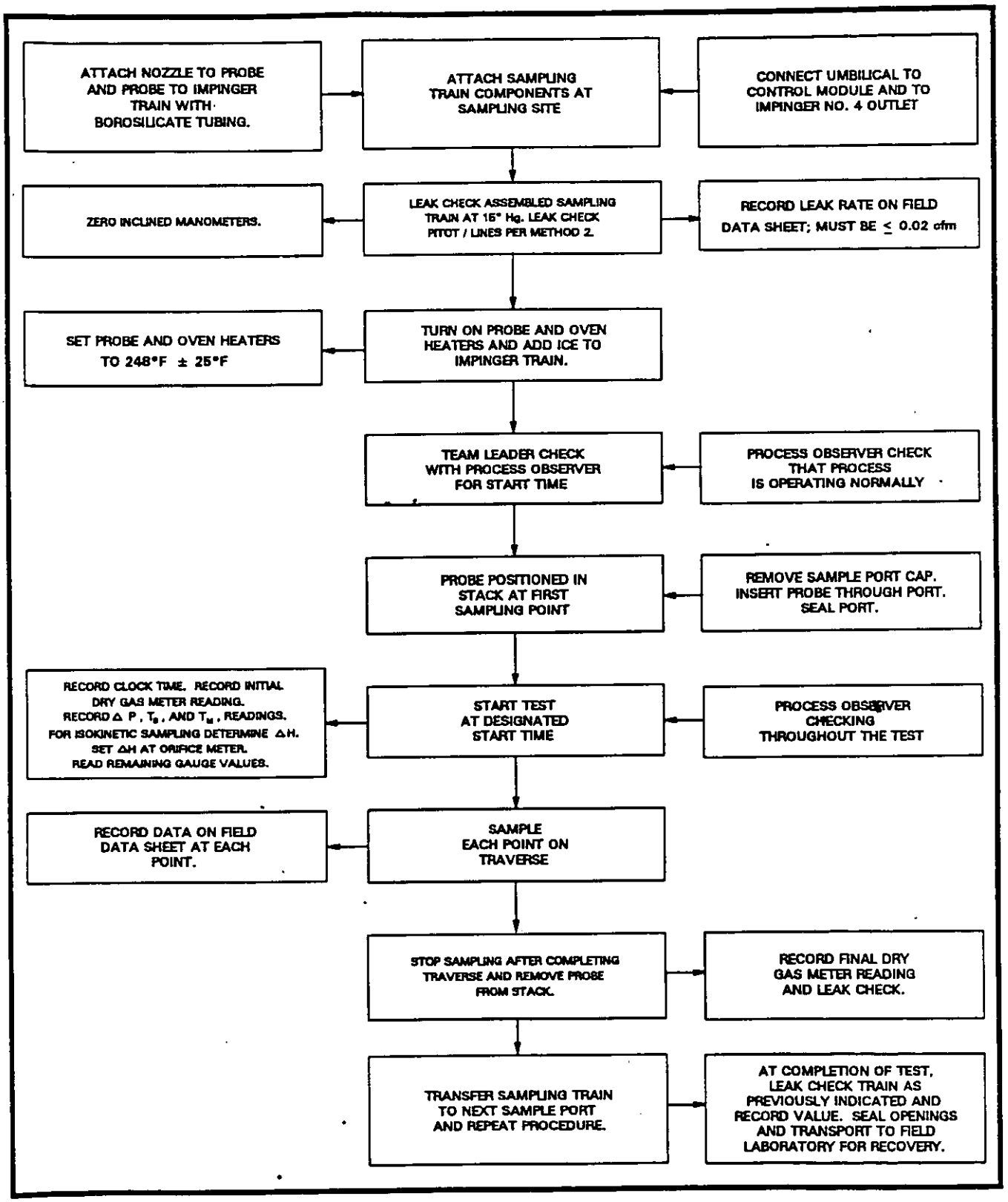


FIGURE 5-3
SAMPLING PROCEDURES FOR
ALDEHYDE/KETONE SAMPLING TRAIN

SMP-ALDE

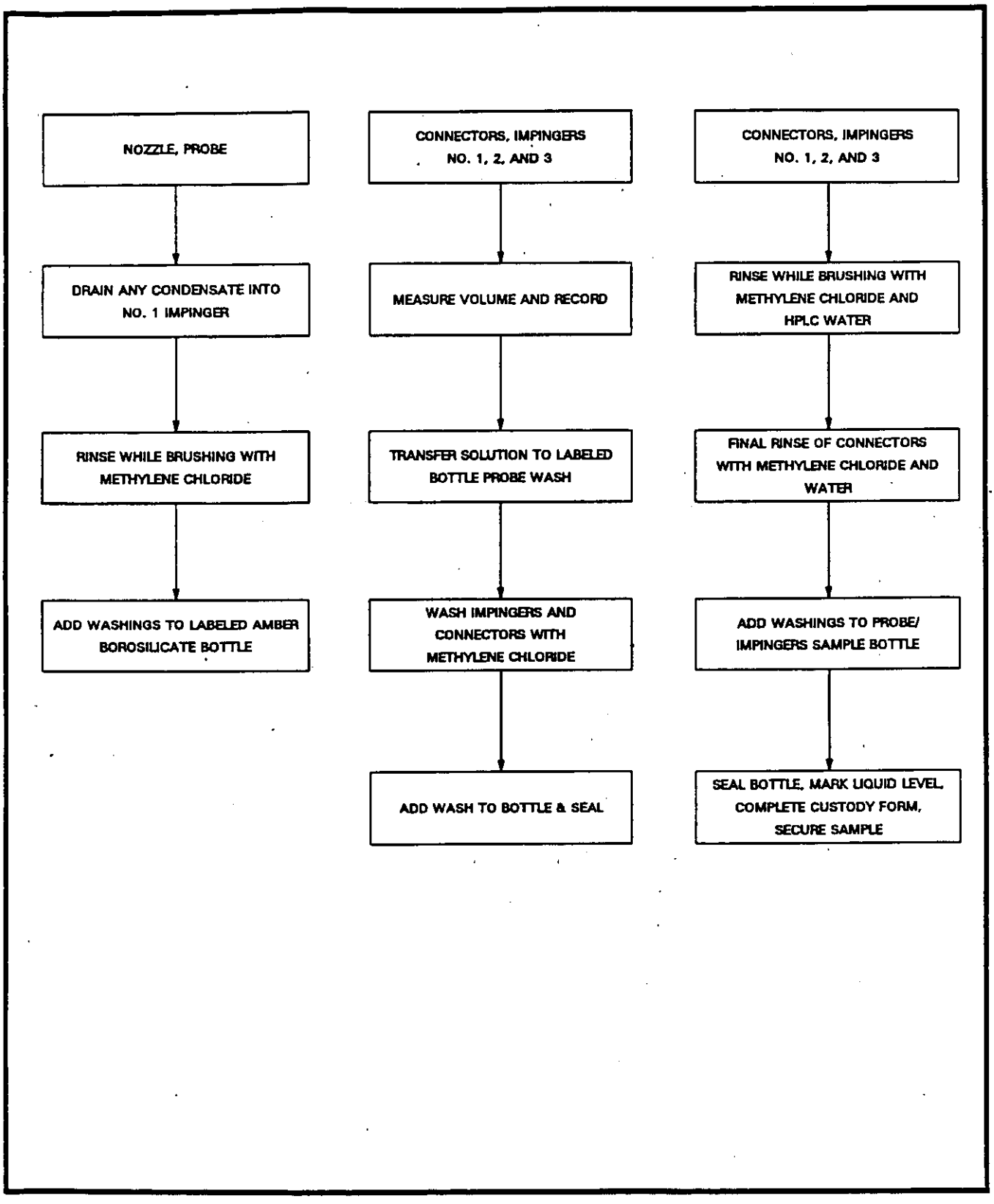


FIGURE 5-4
SAMPLE RECOVERY PROCEDURES FOR ALDEHYDE/KETONE SAMPLING TRAIN

REC-ALDE

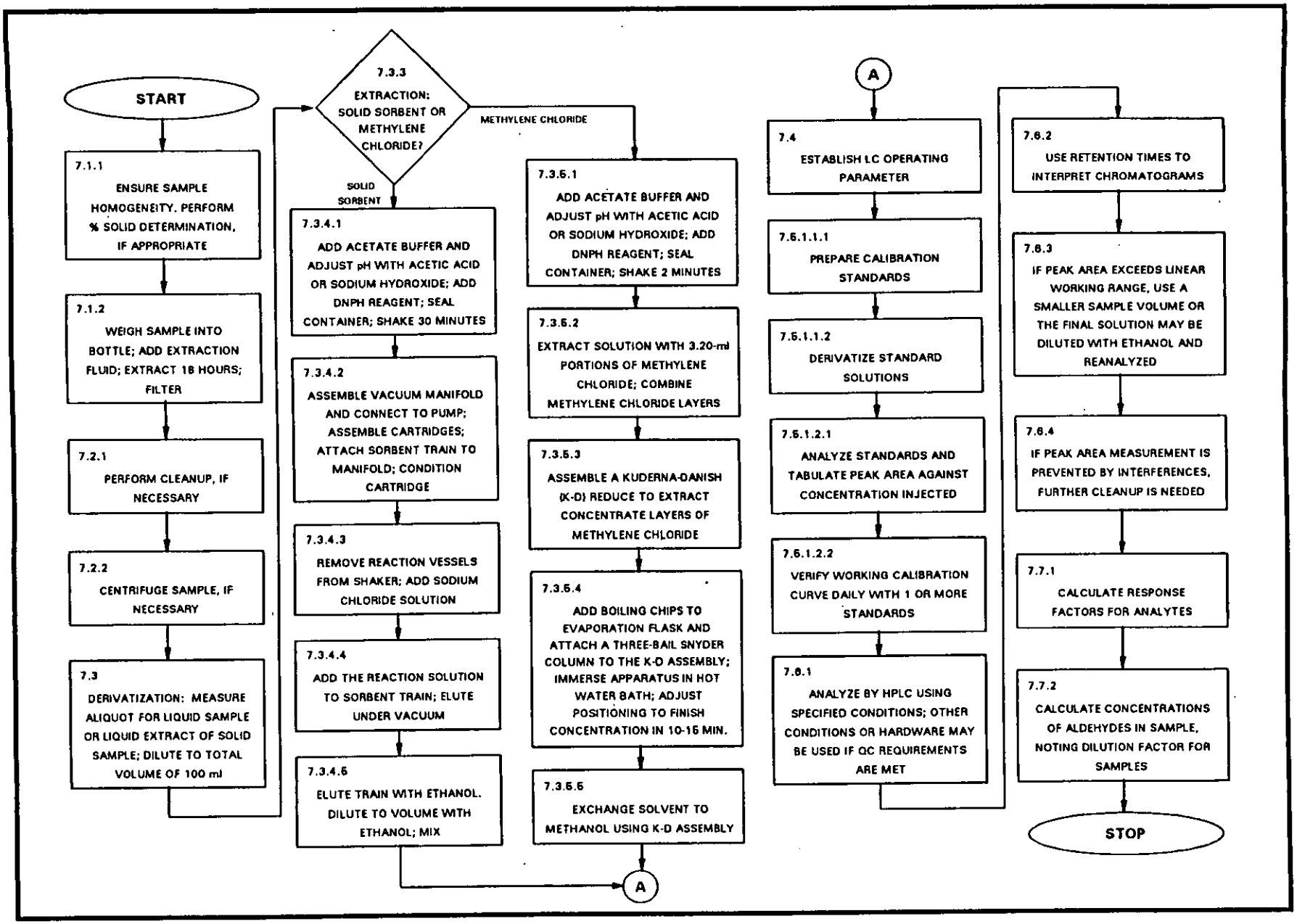


FIGURE 5-5
ANALYTICAL SCHEME FOR ALDEHYDES/KETONES

REC-ALDE

5.4.2 Carbon Monoxide, Nitrogen Oxides, and Total Hydrocarbons

The WESTON portable CEM system was used to continuously monitor the concentrations of carbon monoxide, nitrogen oxides and total hydrocarbons at stacks 1 and 2. Only total hydrocarbon emissions were measured at the press stacks.

The portable CEM system consisted of an instrument rack, a data acquisition system, and a microcomputer. The instrument rack contained continuous emission analyzers, conditioning units, recorders, and a data acquisition system. The following parameters were determined in accordance with U.S. EPA methodology:

- Carbon monoxide (EPA Method 10).
- Nitrogen oxides (EPA Method 7E).
- Total hydrocarbons (EPA Method 25A).

Stack samples were collected through a heated stainless steel probe and heated Teflon line and sent to the portable CEM. The total hydrocarbon sample was drawn directly from this heated line. Heated sample line pressure was monitored and the sampling rate was controlled by a needle valve on the pump outlet in order to maintain excess conditioned sample flow. The excess sample was released to the atmosphere to maintain a constant sample pressure.

The data from the CEM train was processed through a Molytek Model 2702 chart recorder. This unit has the capacity to handle up to 32 channels of data from instruments, thermocouples, and other process instrumentation. All active channels can be displayed on a single strip chart. The Model 2702 also scales and converts the analog input signals to digital (ASCII) format, and transmits the data to a computer for data logging. The WESTON data logging program reads the digital output from the Molytek 2702 approximately once per second. The speed varies depending upon the number of active channels, microprocessor speed, and the baud rate for transmission. The data logger calculates a 1-minute average from the instantaneous readings and stores this average on a hard disk. The data logger displays the instantaneous channel values in real time, with updates every 5 seconds. The 1-minute average and a rolling 60-minute average values are also displayed.

At the close of each test period, the CEM data was stored on the hard disk drive and downloaded to a Lotus 1-2-3 spreadsheet to calculate discreet time periods and to correct for calibration drift.

The analyzers used for this evaluation of the emissions were the following:

Parameter	Manufacturer and Model	Detection Method
CO	Thermo Electron Model 48	NDIR
NO_X	Thermo Electron Model 10A	Chemiluminescent Detector
THC	J.U.M. Model VE-7	FID (heated)

The analyzers were calibrated at the start and end of each test day and/or test series. Analyses of calibration gases from NIST traceable cylinders were performed along with zero checks. Three-point calibrations (low, mid, and high range) were performed directly for each analyzer. Bias checks were performed by introducing the calibration standard that is closest to the observed concentration in the sample gas at a three-way valve on the probe. Bias checks performed at the intervals between each test repetition were averaged to correct for instrument drift. The bias calibration gases are sent to the probe valve through a separate Teflon line and back through the heated sample line and sample conditioning system to the instrument to determine the entire sampling system calibration bias. Bias calibration gas flow is regulated to maintain sample line pressure. All calibrations, zero and calibration drift tests, and QA procedures followed the specific requirements in the EPA reference methods. The calibration drift correction described in EPA Method 6C was used for all analyzers.

5.4.3 Particulate and Condensible Particulate

Particulate and condensible particulate emissions were withdrawn isokinetically from the gas streams of stacks 1 and 2 using an EPA Method 5/202 sampling train. A schematic of the sampling train is shown in Figure 5-6. This sampling train consisted of the following components:

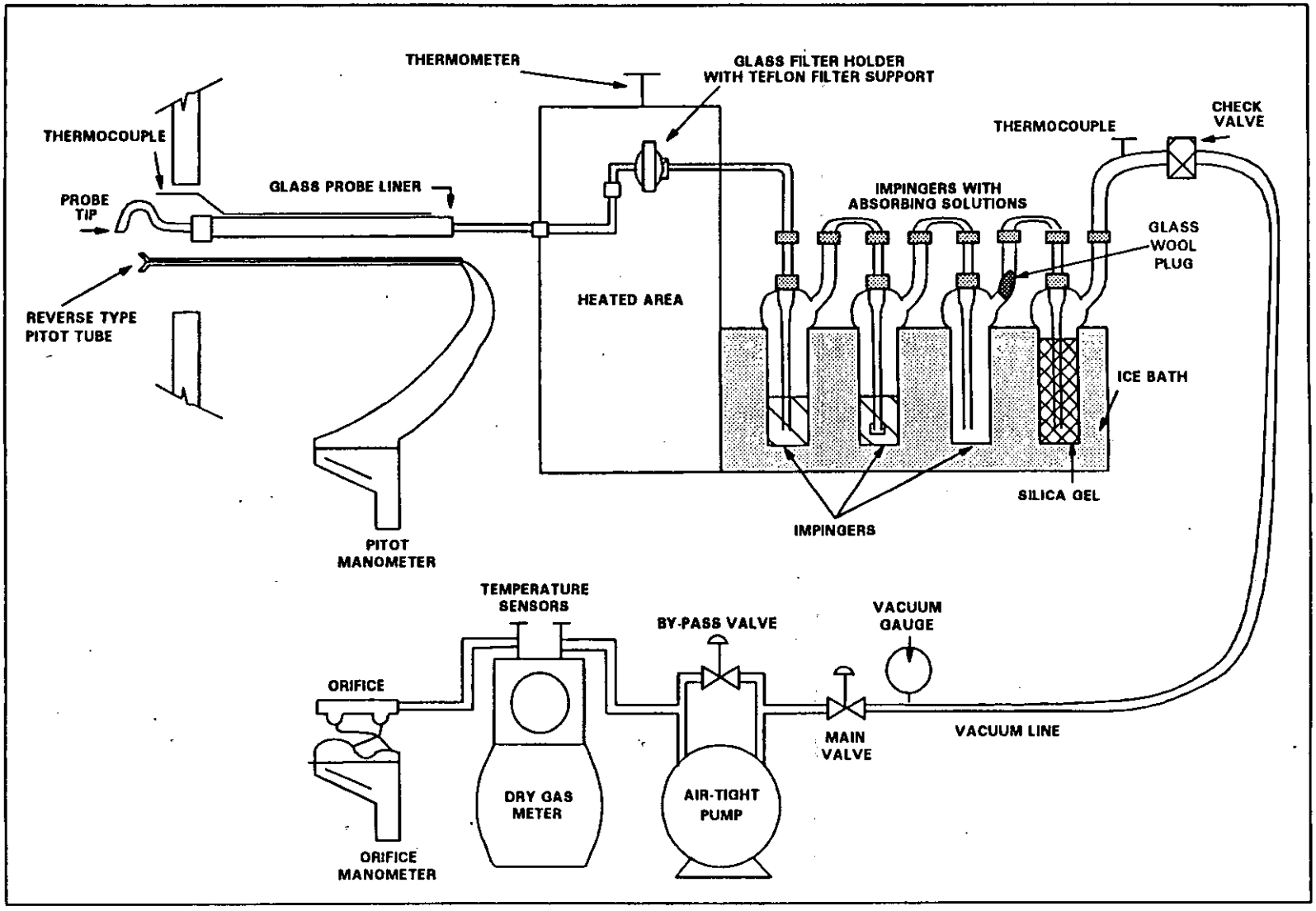


FIGURE 5-6
EPA METHOD 5/202
PARTICULATE AND CONDENSIBLE PARTICULATE SAMPLING TRAIN

SCH-COND

- A stainless steel or glass nozzle with an inside diameter sized to sample isokinetically.

- A heated, (248 ± 25 °F) borosilicate-lined probe, approximately 5 ft long, equipped with a calibrated thermocouple to measure flue gas temperature and a calibrated S-type pitot tube to measure flue gas velocity pressure.

- A heated oven containing a section of borosilicate tubing followed by a borosilicate filter holder with a preweighed glass fiber filter.

- Borosilicate tubing to connect the outlet of the filter holder to the first impinger.

- An impinger train containing four impingers (No. 1 - 100 ml DI H_2O; No. 2 - 100 ml DI H_2O; No. 3 - dry; No. 4 - 300 gm silica gel).

- A vacuum hose with adapter to connect the outlet of the impinger train to a control module.

- A control module containing a 3-cfm carbon vane vacuum pump (sample gas mover), a calibrated dry gas meter (sample gas volume measurement device), a calibrated orifice (sample gas flow rate monitor), and inclined manometers (orifice and gas stream pressure indicators).

- A switchable calibrated digital pyrometer to monitor flue and sample gas temperatures.

Preparation, testing, and sample recovery techniques, as shown in Figures 5-7, 5-8, and 5-9, respectively, conformed to those specified in Section 4 of EPA Method 5 and Section 3.2 of EPA Method 202. Each test was 60 minutes in length and consisted of at least 30 dry standard cubic feet of flue gas. All runs were isokinetic ±10 percent.

Analytical procedures and calculations for particulate determination were performed as specified in Sections 4 and 6 of Method 5, and Section 5 of Method 202. The analytical procedure is described below:

- The filter and any loose fragments were desiccated for 24 hours and weighed on a calibrated analytical balance to the nearest 0.1 mg to a constant weight. "Constant weight" means a difference of no more than 0.5 mg or 1% of total weight less tare weight, whichever is greater, between 2 consecutive weighings, with no less than six hours of desiccation time between weighings.

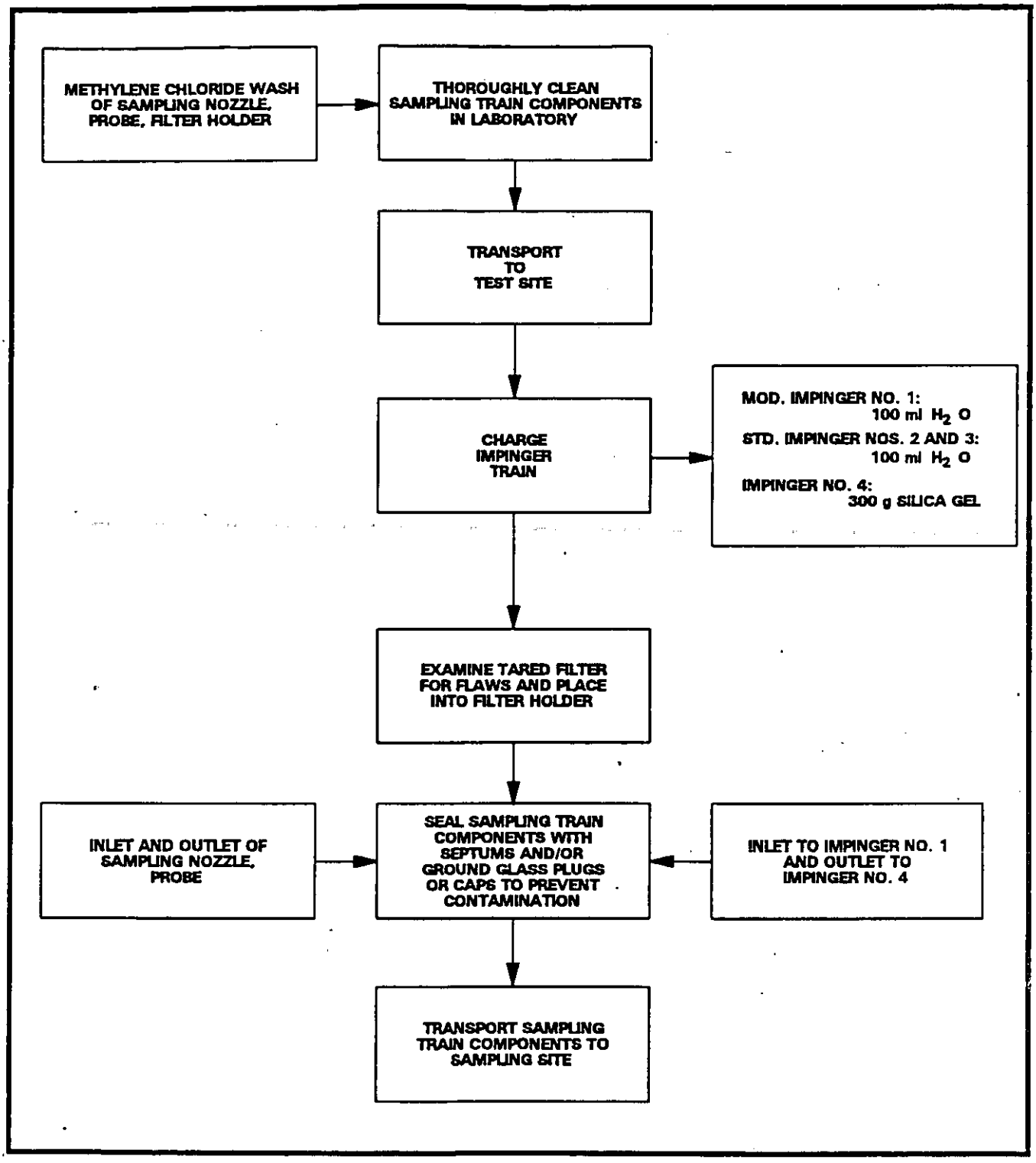


FIGURE 5-7
PREPARATION PROCEDURES FOR
PARTICULATE AND CONDENSIBLE PARTICULATE SAMPLING TRAIN

PRP-COND

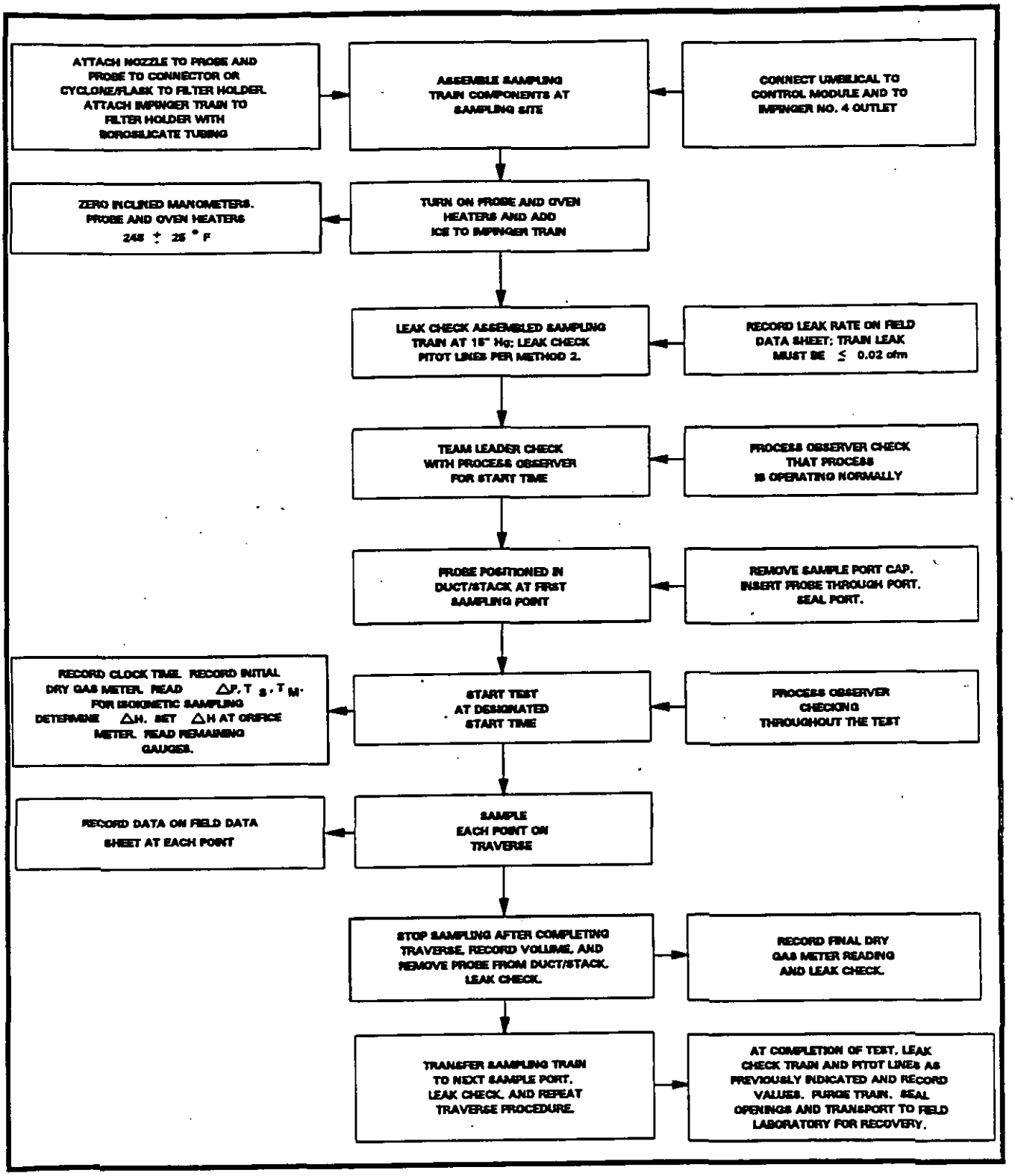


FIGURE 5-8
SAMPLING PROCEDURES FOR
PARTICULATE AND CONDENSIBLE PARTICULATE SAMPLING TRAIN

RMP-COND

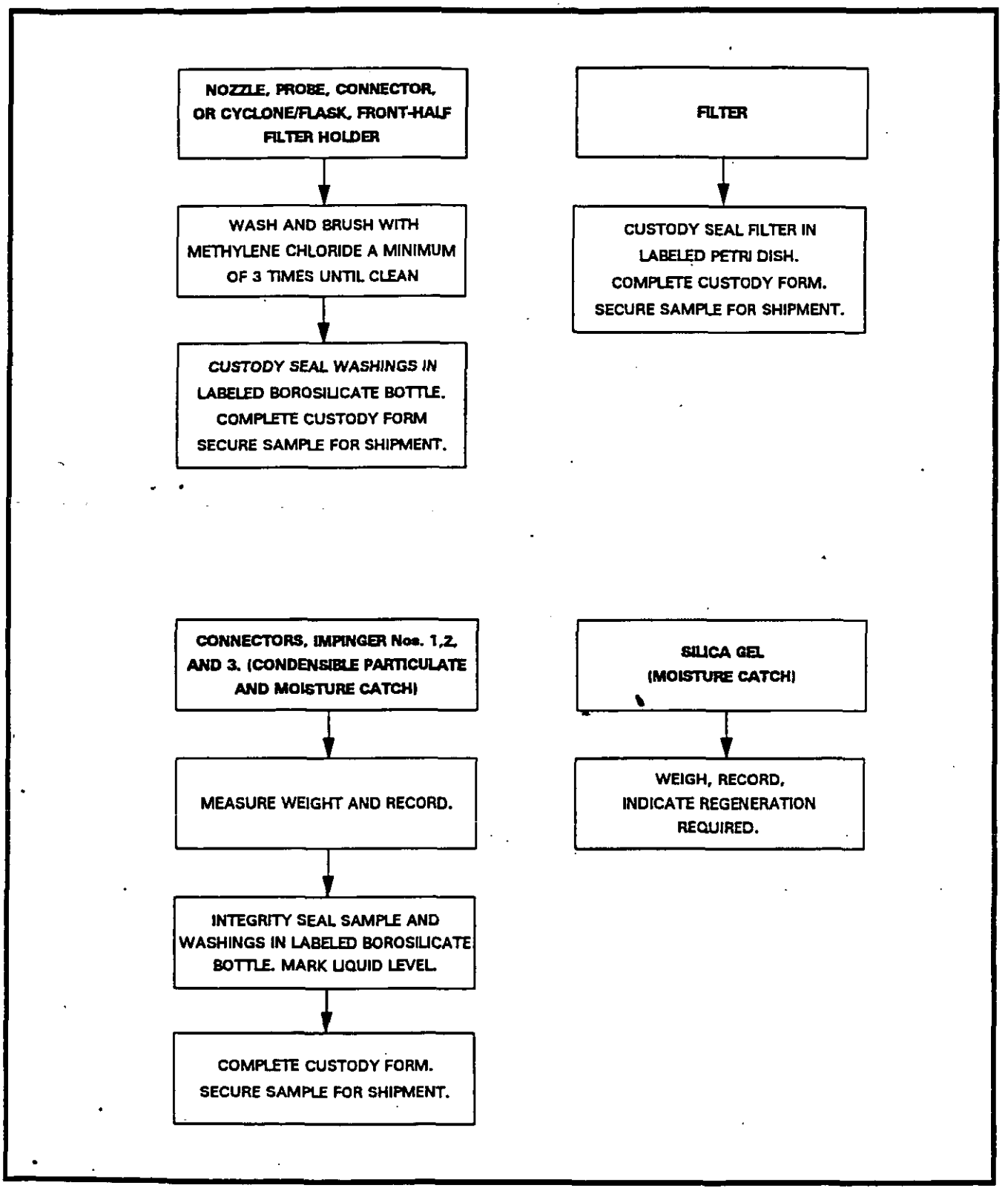


FIGURE 5-9
SAMPLE RECOVERY PROCEDURES FOR
PARTICULATE AND CONDENSIBLE PARTICULATE SAMPLING TRAIN

REC-COND

- The front-half acetone wash samples and corresponding blank were evaporated at ambient temperature and pressure in tared beakers, and then desiccated to constant weight to the nearest 0.1 mg.

- The back-half methylene chloride rinse was evaporated at ambient temperature and pressure in tared breakers and then desiccated to a constant weight to the nearest 0.1 mg.

The material collected in the nozzle, probe, flask or connector, front-half of the filter holder, and on the glass fiber filter represents the EPA Method 5 particulate catch. Water vapor and the condensible particulate were collected in the impinger portion. The total weight measured in the back half wash fraction represents the EPA Method 202 condensible particulate catch for each run. Acetone and methylene chloride blank corrections were made on all wash sample weights.

Figure 5-10 presents the particulate analysis scheme.

5.4.4 PM 10 and Condensible Particulate

PM_{10} emissions from all sampling locations were collected using an EPA Method 201A sampling train. The PM_{10} and condensible particulate emissions at the press stacks were determined using a Method 201A/202 sampling train. A sampling train schematic is shown in Figure 5-11. The sampling train consisted of the following components:

- A PM_{10} stainless steel nozzle with an inside diameter sized to sample isokinetically.

- PM_{10} sizing cyclone designed to aerodynamically fractionate particulate at a 10 micron cut point.

- A heated stainless steel probe equipped with a calibrated thermocouple to measure flue gas temperature and a calibrated S-type Pitot tube to measure flue gas velocity pressure.

- A section of borosilicate tubing to connect the outlet of the sampling probe to the first impinger.

- An impinger train consisting of four impingers. The first two impingers contained 100 ml of H_2O. The third impinger was dry and the fourth contained 300 grams of dry preweighed silica gel.

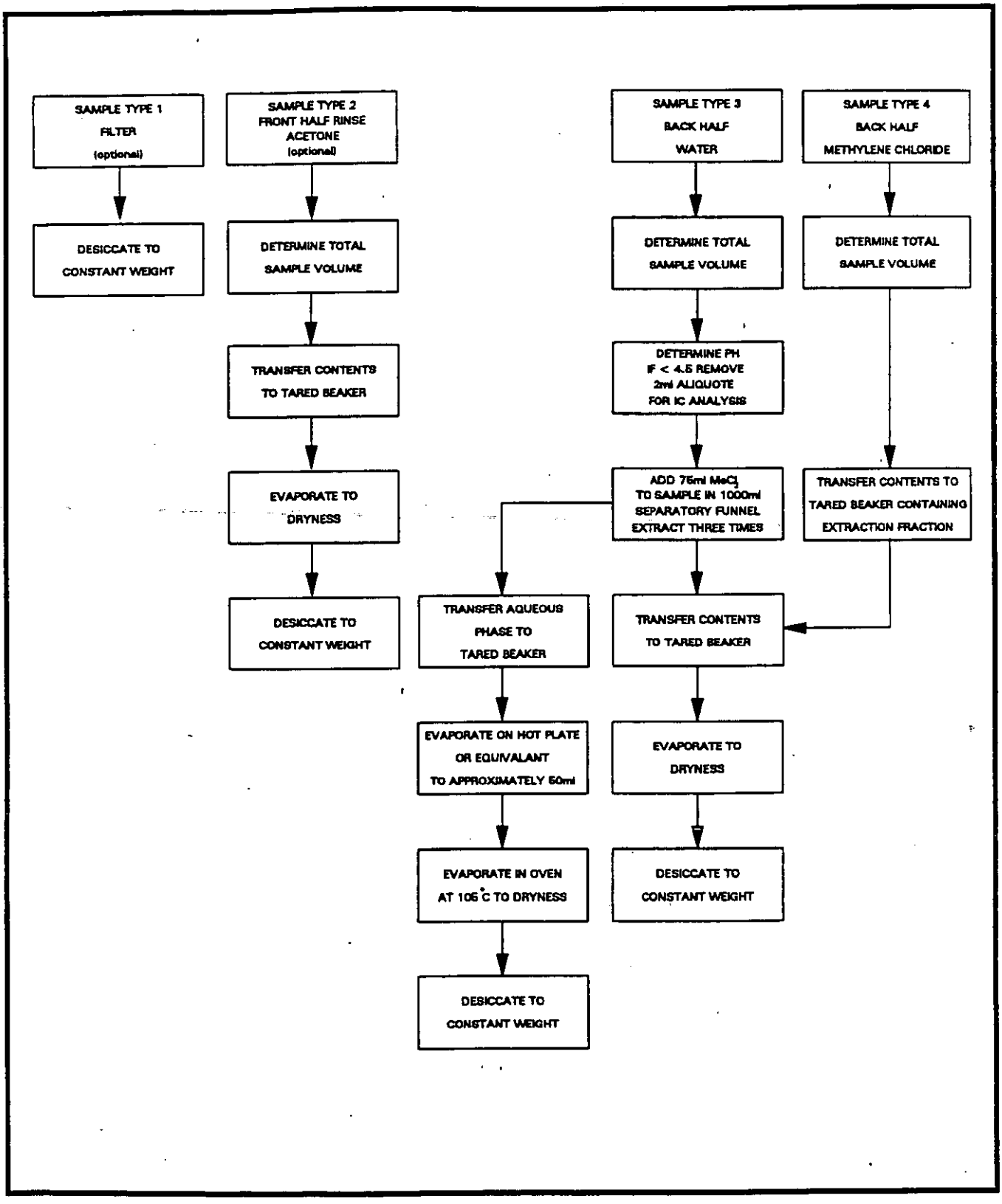


FIGURE 5-10
ANALYTICAL PROCEDURES FOR
CONDENSIBLE PARTICULATE SAMPLING TRAIN

ANL-COND

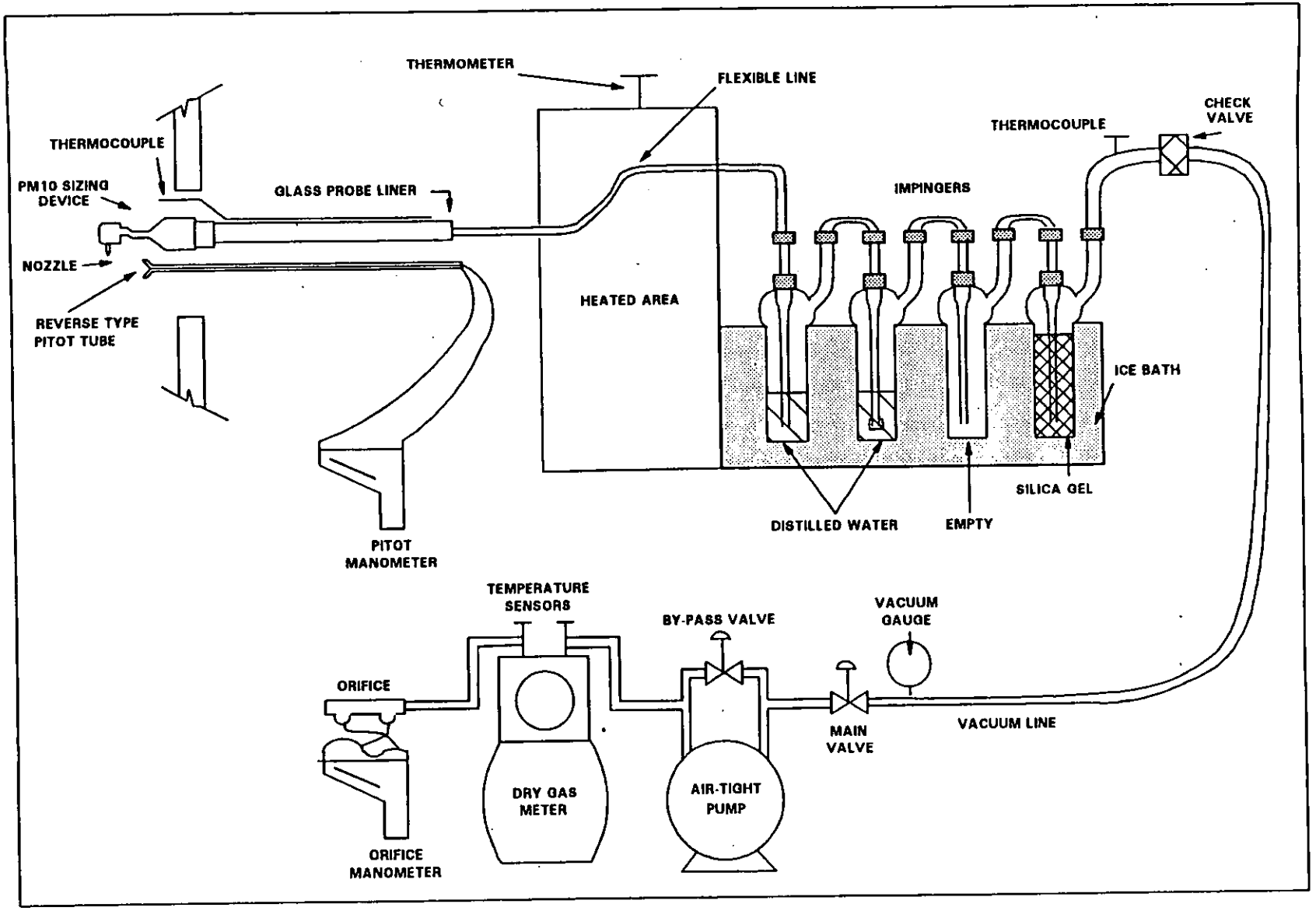


FIGURE 5-11

EPA METHOD 201A

PM10 SAMPLING TRAIN

- A vacuum hose with adapter to connect the outlet of the impinger train to a control module.

- A control module containing a 3-cfm carbon vane vacuum pump (sample gas mover), a calibrated dry gas meter (sample gas volume measurement device), a calibrated orifice (sample gas flow rate monitor), and inclined manometers (orifice and gas stream pressure indicators).

- A switchable calibrated digital pyrometer to monitor flue and sample gas temperatures.

The preparation, sampling, and recovery procedures that were used to determine PM_{10} at all locations during the program are included in Figures 5-12, 5-13 and 5-14, respectively. For the Method 202 procedure used in conjunction with Method 201A, refer to Section 5.4.3. Refer to Figure 5-15 for a schematic of the PM_{10} sampling analysis.

5.4.5 Semivolatile Organics

The semivolatile organic emissions at stacks 1 and 2 were determined using Method 0010. The sampling train, as shown in Figure 5-16, consisted of the following components:

- A stainless steel or glass nozzle with an inside diameter sized to sample isokinetically.

- A heated (248 ± 25°F), 5-ft borosilicate-lined probe equipped with a calibrated thermocouple to measure flue gas temperature and a calibrated S-type pitot tube to measure the flue gas velocity pressure.

- A heated oven containing a borosilicate connector, cyclone/flask and filter, holder with a Soxhlet-extracted glass fiber filter.

- A borosilicate connector to join the outlet of the filter holder to the inlet of the impinger train.

- An impinger train consisting of a Graham (spiral) type ice-water cooled condenser, a temperature sensor (thermocouple), an ice-water jacketed solvent module containing 40 grams of 30/60 mesh Amberlite™ XAD-2 (pre-extracted), a 1-liter condensate trap, one standard and one modified Greenburg-Smith impinger each containing 100 ml high purity (HPLC) water, an empty standard Greenburg-Smith impinger, and a final impinger containing 300 grams of dry preweighed silica gel plus a thermocouple to detect sample gas exit temperature.

- A vacuum line (umbilical cord) with adapter to connect the outlet of the impinger train to a control module.

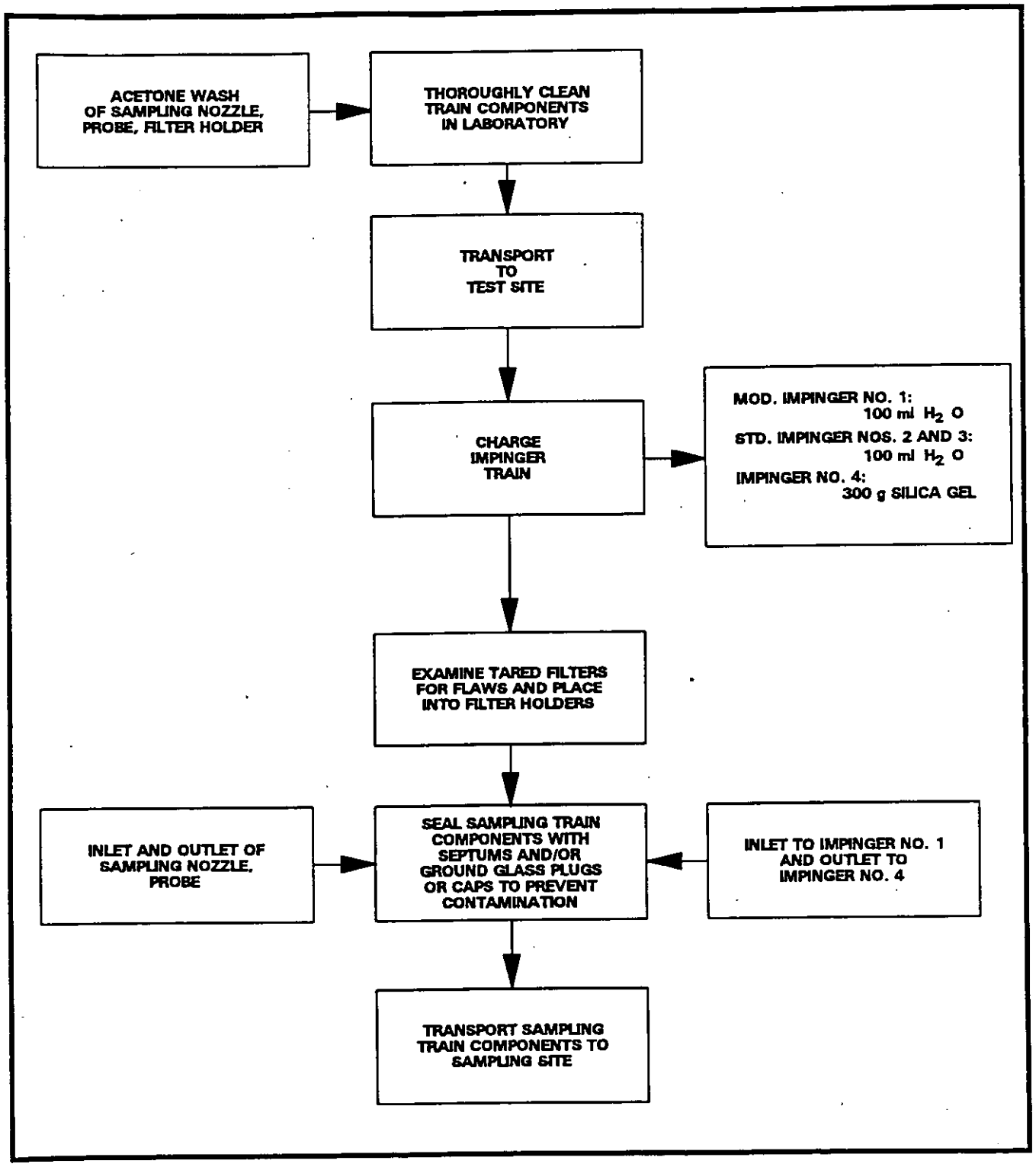


FIGURE 5-12
PREPARATION PROCEDURES FOR
PM10 SAMPLING TRAIN

PREP-PM10

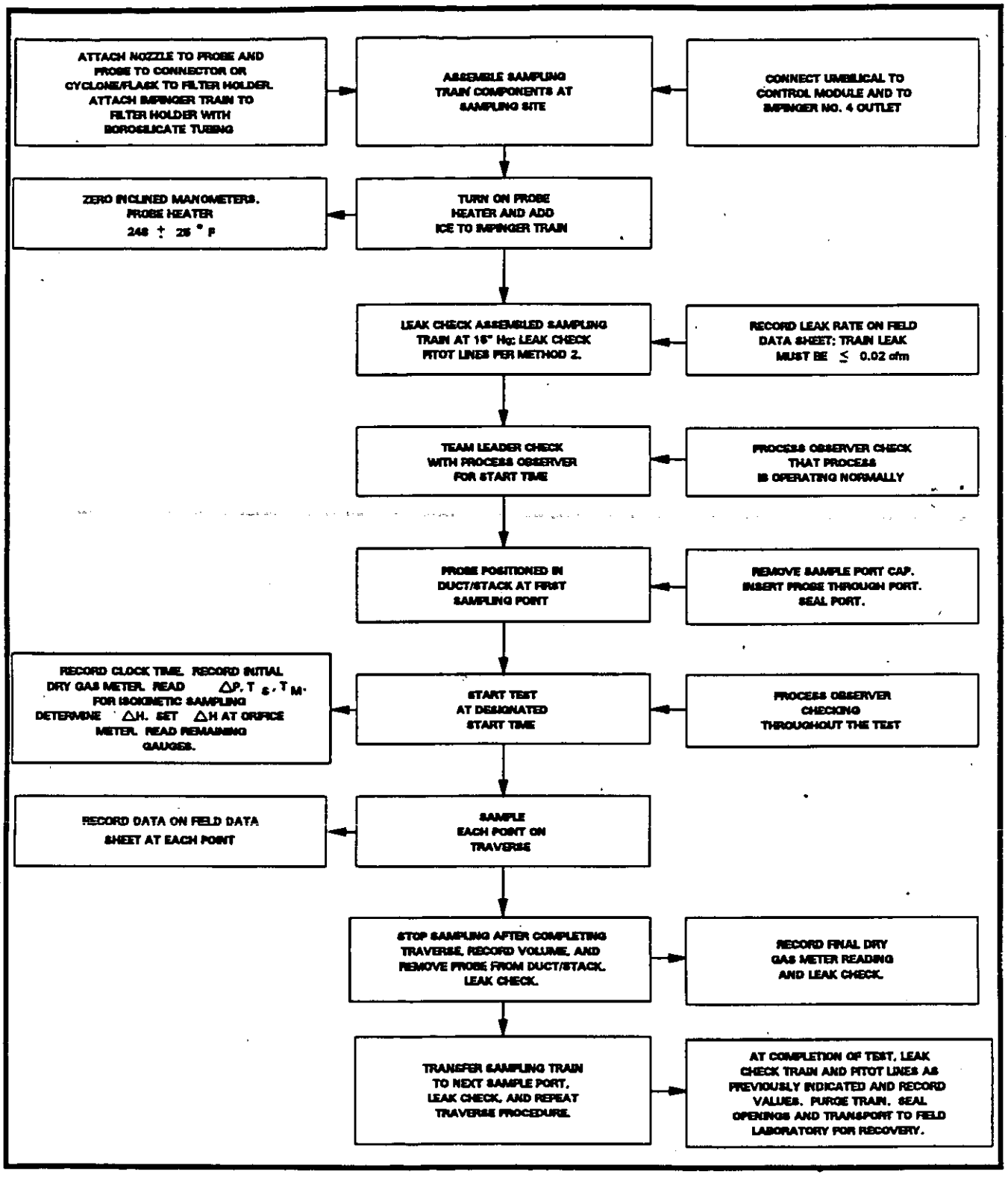


FIGURE 5-13
SAMPLING PROCEDURES FOR PM10 SAMPLING TRAIN

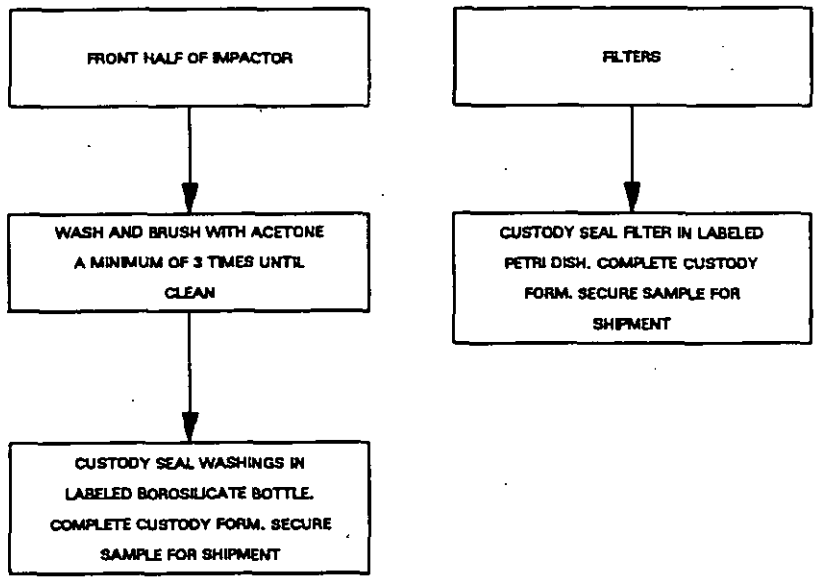


FIGURE 5-14
SAMPLE RECOVERY PROCEDURES FOR
PM-10 SAMPLING TRAIN

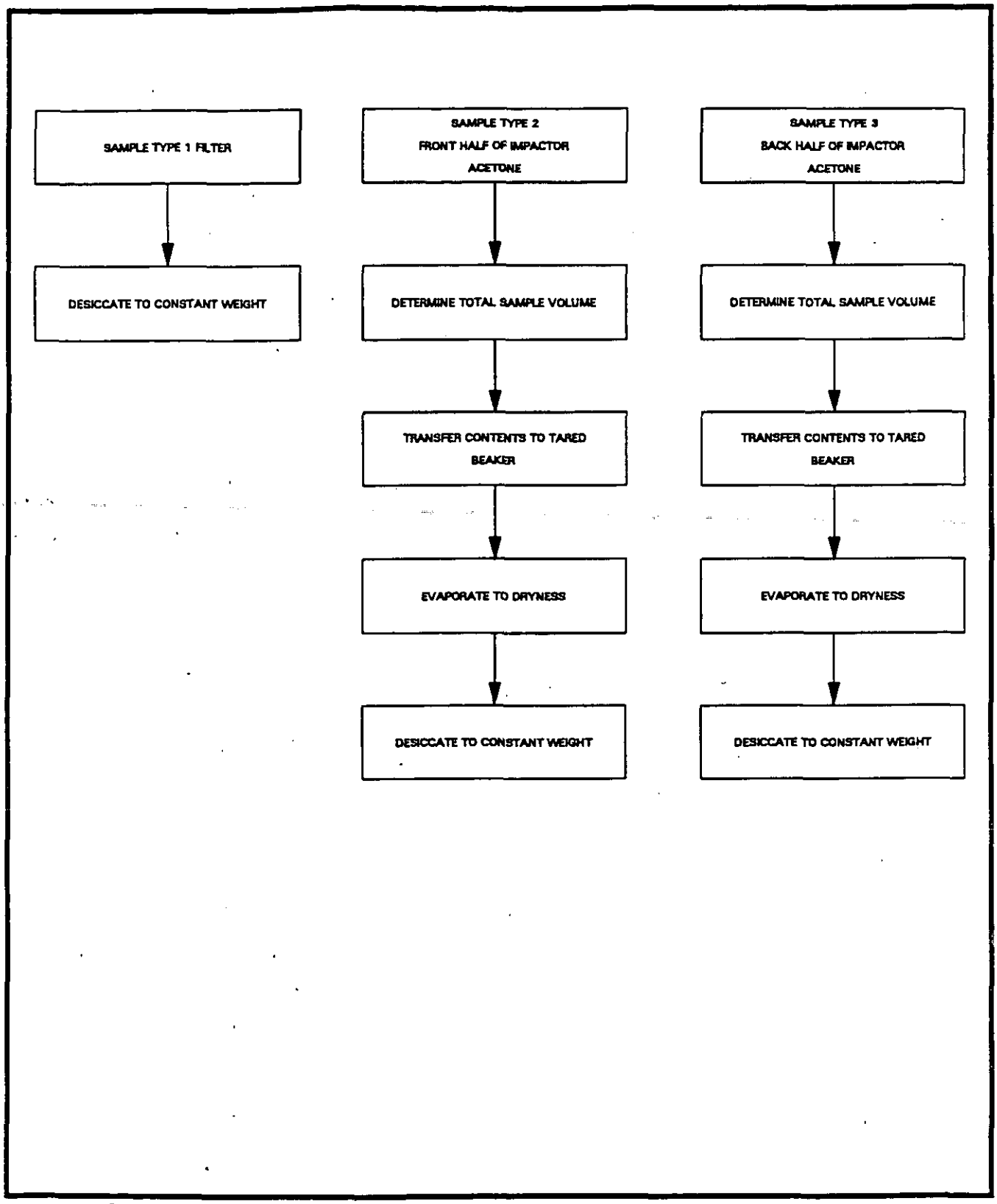
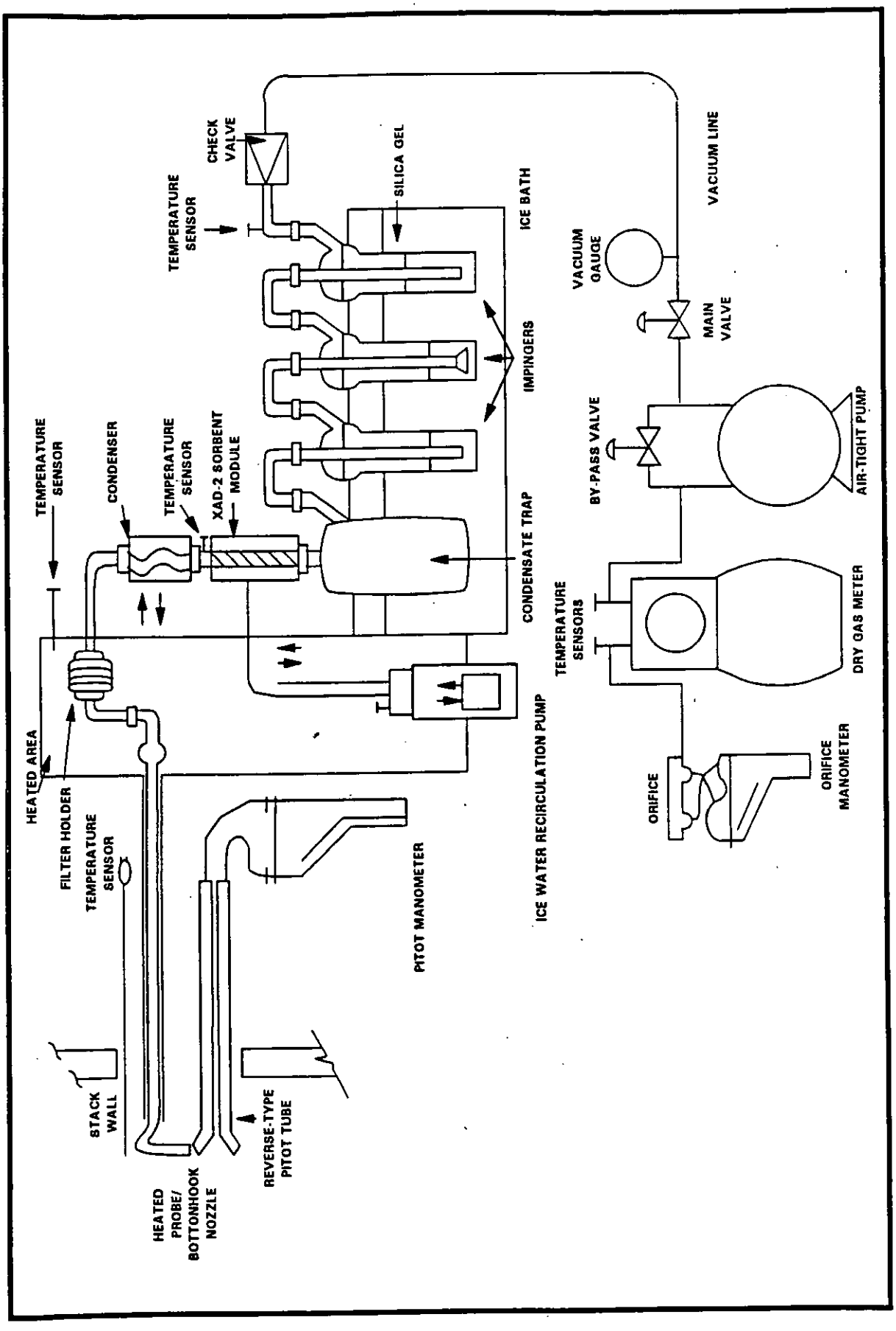


FIGURE 5-15
ANALYSIS PROCEDURES FOR
PM10 SAMPLES

AML-PM10



SC11 MM6

FIGURE 5-16
EPA METHOD 0010
SEMIVOLATILE ORGANICS SAMPLING TRAIN

- A control module containing a 3-cfm carbon vane vacuum pump (sample gas mover), a calibrated dry gas meter (sample gas volume measurement device), a calibrated orifice (sample gas flow rate monitor), and inclined manometers (orifice and gas stream pressure indicators).

- A switchable calibrated digital pyrometer to monitor flue and sample gas temperatures.

The material collected in the nozzle, in the probe, in the connector or cyclone/flask, in the front-half filter holder, and on the glass fiber filter were combined with the rinses/extract of the connectors, condenser, and XAD sorbent for the determination of the semivolatile organics. A minimum of 3 cubic meters of gas was collected per sample.

The preparation, sampling and recovery procedures used for the semivolatile sampling train are included in Figures 5-17, 5-18, and 5-19 respectively. The sampling rate during each test was isokinetic ±10% and never exceeded the maximum rate of 0.75 cfm specified by the test method. A blank train was set up, leak checked, and sealed for the duration of one of the tests performed at the stack 1 and 2 sampling locations. The purpose of this train blank was to determine whether or not contamination occurred during preparation, setup, recovery, or analysis steps as a QC check. These and other QC checks are discussed in further detail in Section 6.

The analytical procedure for the semivolatile organics is summarized below. See EPA Methods 8270 for a more detailed specification of these procedures.

- Concentrate each front-half wash sample to 1-5 ml using a rotary evaporator apparatus. Rinse sample container three times with methylene chloride, add to concentrated solution, and concentrate further to near dryness.

- Add above concentrate to the filter and XAD-2 resin in a soxhlet apparatus that contains a precleaned glass extraction thimble and silica gel. Add semivolatile internal standard. Cover with a plug of precleaned glass wool. Reflux sample with toluene or methylene chloride for 16 hours. Transfer extract using three 10 ml rinses of toluene to a rotary evaporator and concentrate to approximately 8 ml. Reduce to 1 ml under nitrogen stream. Split sample in half. One split is analyzed, and the second is stored.

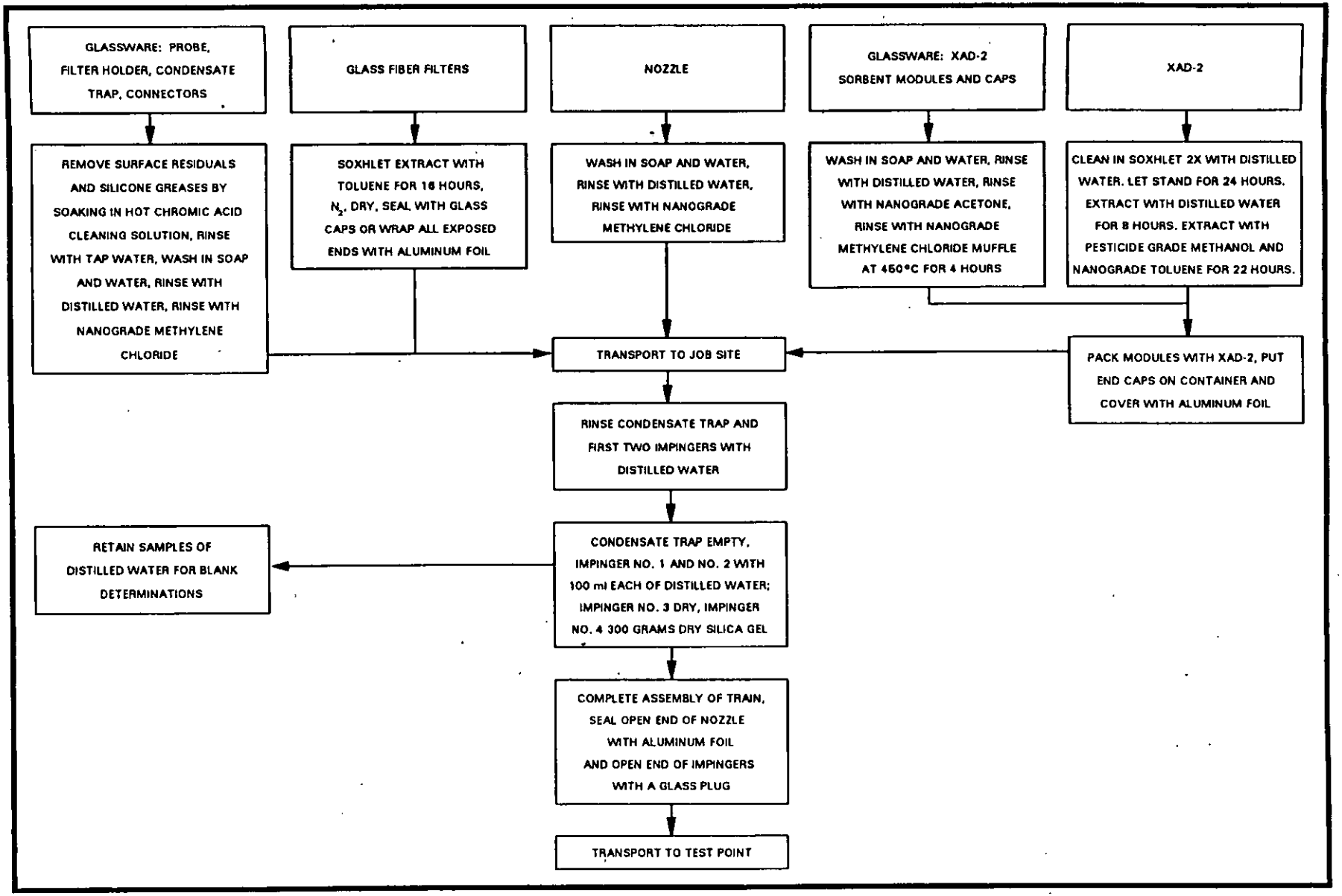


FIGURE 5-17
PREPARATION PROCEDURE FOR
SEMIVOLATILE ORGANICS SAMPLING TRAIN

PRP MM5

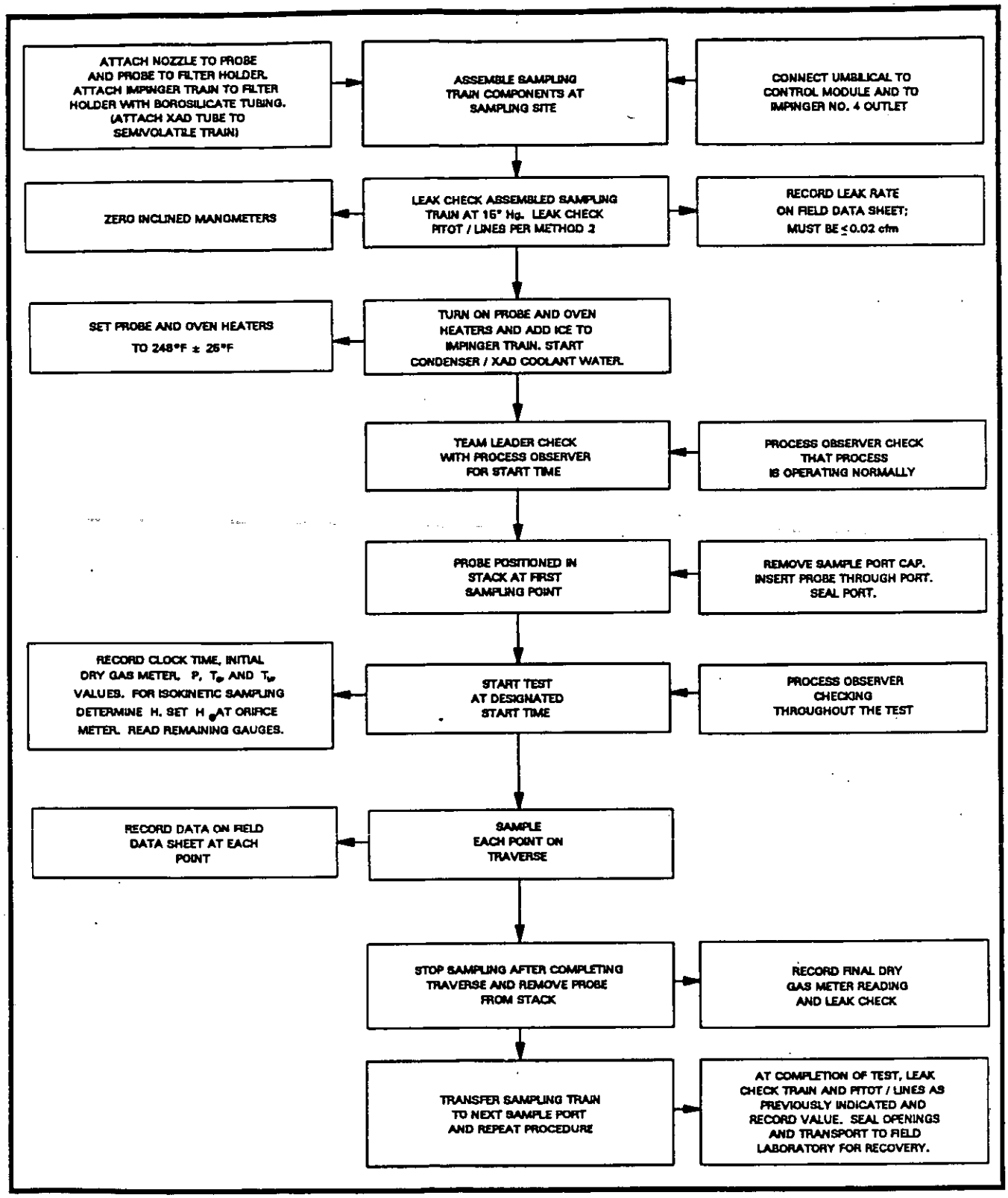


FIGURE 5-18
SAMPLING PROCEDURES FOR
SEMIVOLATILE ORGANICS SAMPLING TRAIN

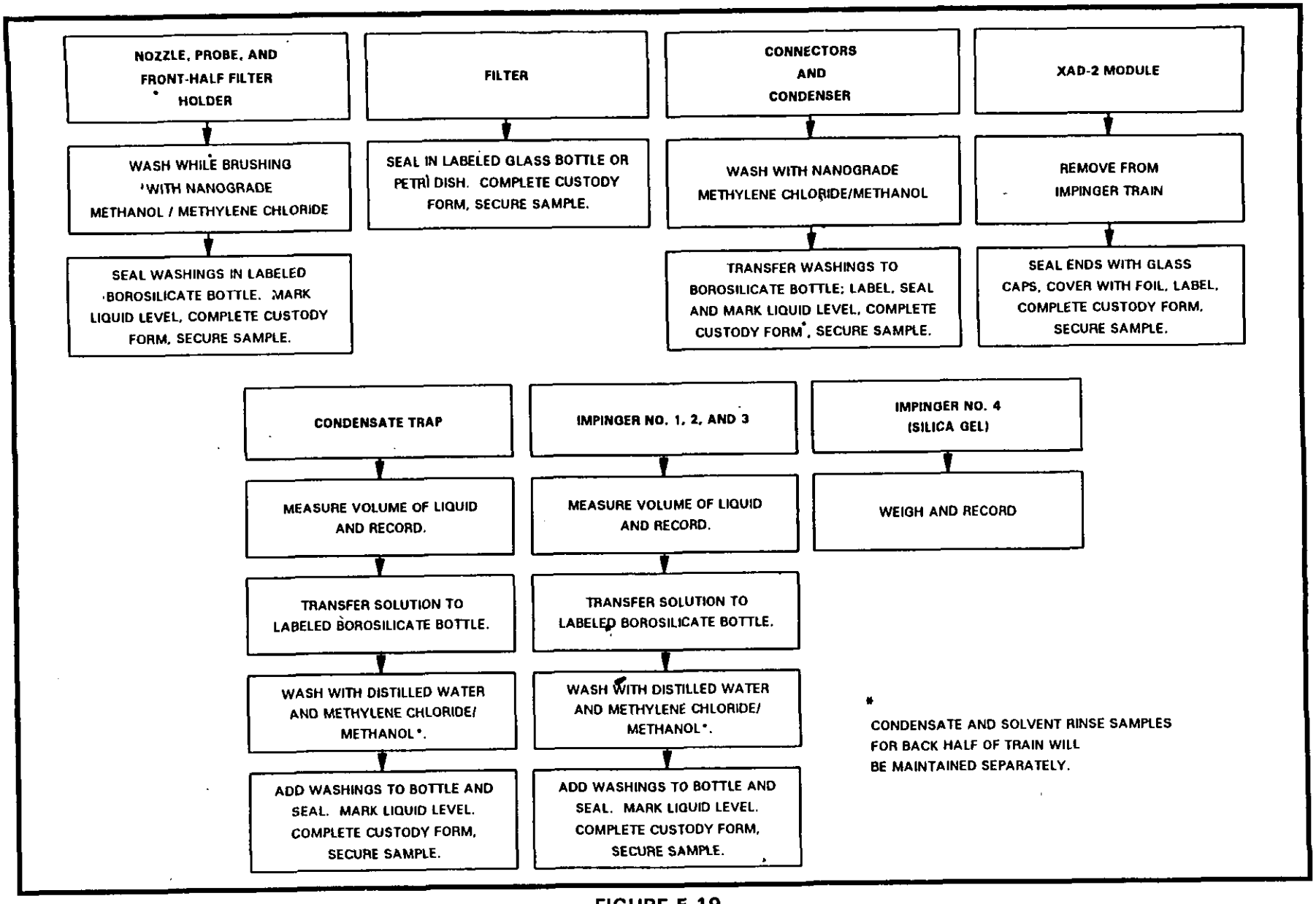


FIGURE 5-19
SAMPLE RECOVERY PROCEDURE FOR SEMIVOLATILE ORGANICS SAMPLING TRAIN

REC-MM5

- The back-half impinger solvent rinse is concentrated to 2 ml using a rotary evaporator, then added to the impinger water/condensate sample. Following solvent addition the sample is spiked with the appropriate semivolatile internal standards. A liquid extraction is conducted using methylene chloride. The extract is combined with the front-half extract for cleanup and analysis.

- The remaining extract is analyzed for the semivolatile organics utilizing EPA Method 8270 procedures for high-resolution GC with low-resolution mass spectrometry.

The analytical scheme for the EPA 8270 procedures is shown in Figure 5-20.

5.4.6 Volatile Organic Compounds

The volatile organics emissions for stacks 1 and 2 were determined by Method 0030. A schematic of the sampling train is shown in Figure 5-21. This sampling train consisted of the following components connected in series:

- A heated glass probe, 3 ft in length, containing a glass wool particulate filter.

- The probe is connected to an ice water-cooled condenser followed by a temperature sensor, an adsorption cartridge containing 1.6 grams of Tenax-GC, and a condensate trap.

- A section of Teflon tubing is used to connect the outlet of the condensate trap to a second condenser which is followed by a back-up sorbent trap containing 1 gram of Tenax-GC and 1 gram of activated charcoal, a second condensate collector, and a tube containing an unweighed amount of dry silica gel.

- The tube of silica gel is connected, via an umbilical cable, to a control console containing flow controllers, a calibrated 1-liter-per-minute dry gas meter, a sample pump, a temperature indicator, and other components.

The preparation, sampling, recovery and analytical procedures that were used to determine the volatile organic compounds are included in Figures 5-22, 5-23, 5-24 and 5-25. The volatile organics were determined by analyzing three of the pairs of traps per test run by EPA Method 5041 purge-trap-desorb GC/MS. EPA Method 8260 was utilized to analyze for volatiles in the condensate samples. After several sets of tubes were analyzed, it was determined that the tubes contained terpene compounds that exceeded the calibration range of the GC/MS system.

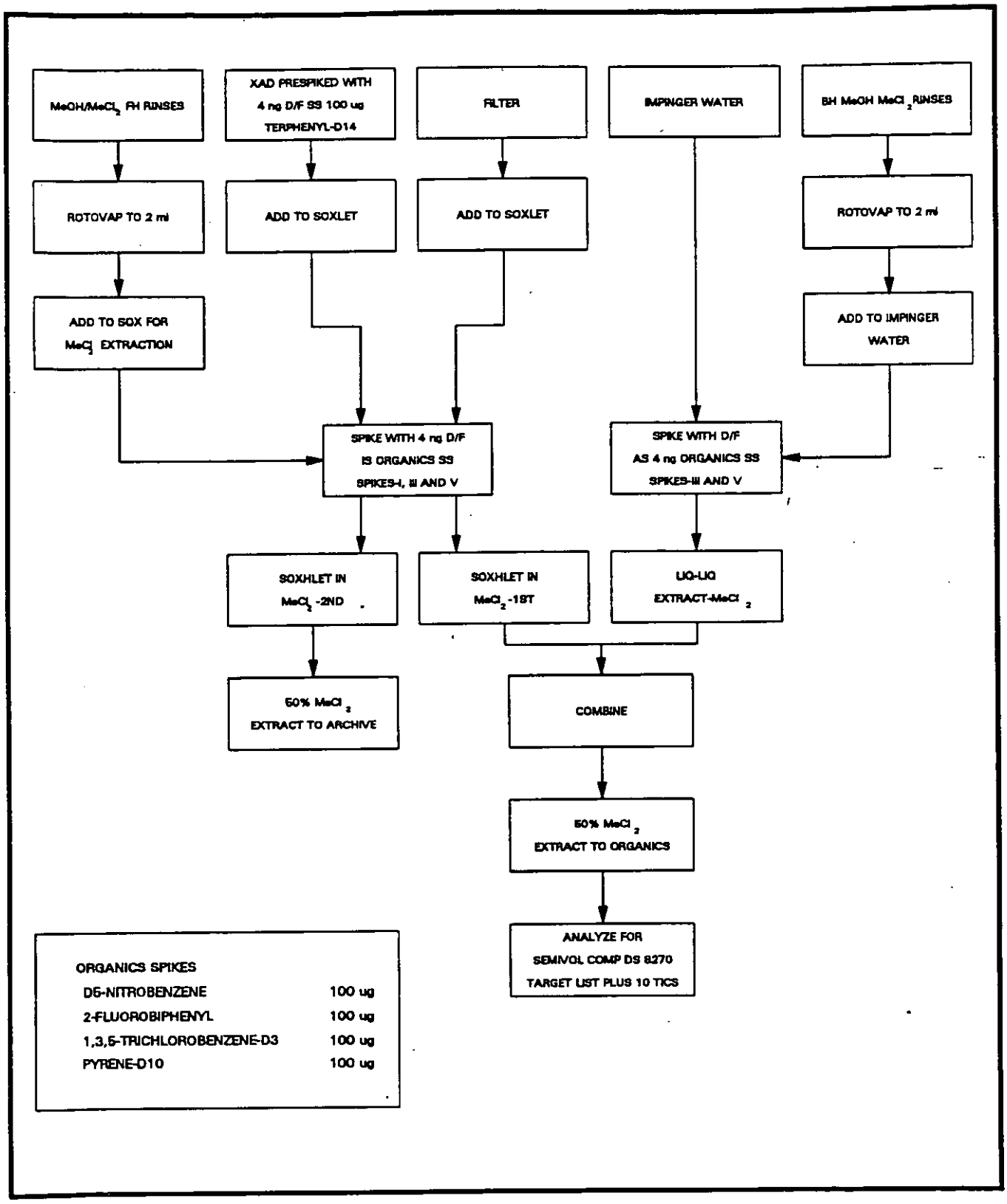


FIGURE 5-20
ANALYSIS PROCEDURES FOR
SEMIVOLATILE ORGANICS SAMPLING TRAIN

ANL-M/M5

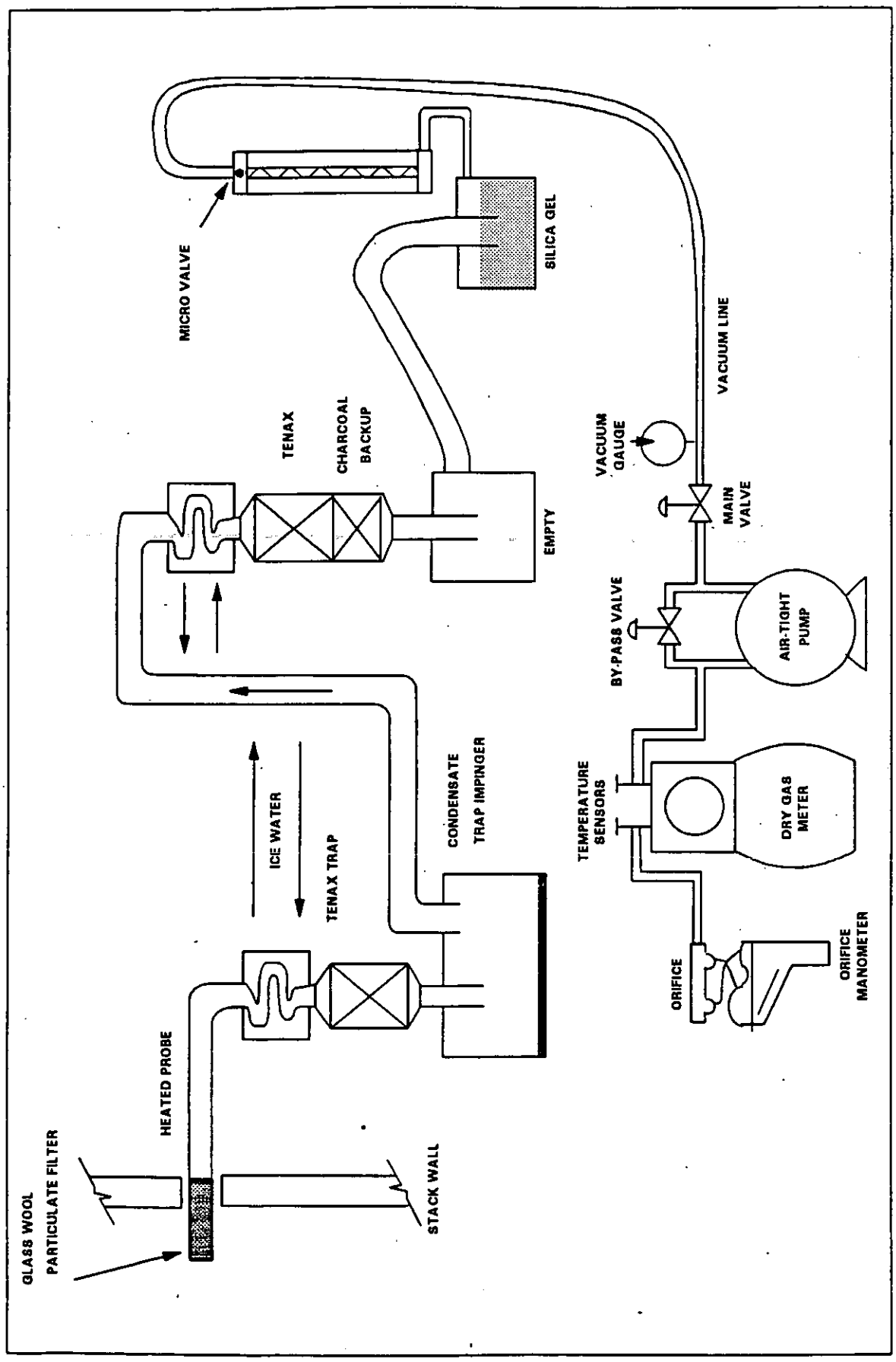


FIGURE 5-21
EPA METHOD 0030
VOLATILE ORGANIC SAMPLING TRAIN (VOST)

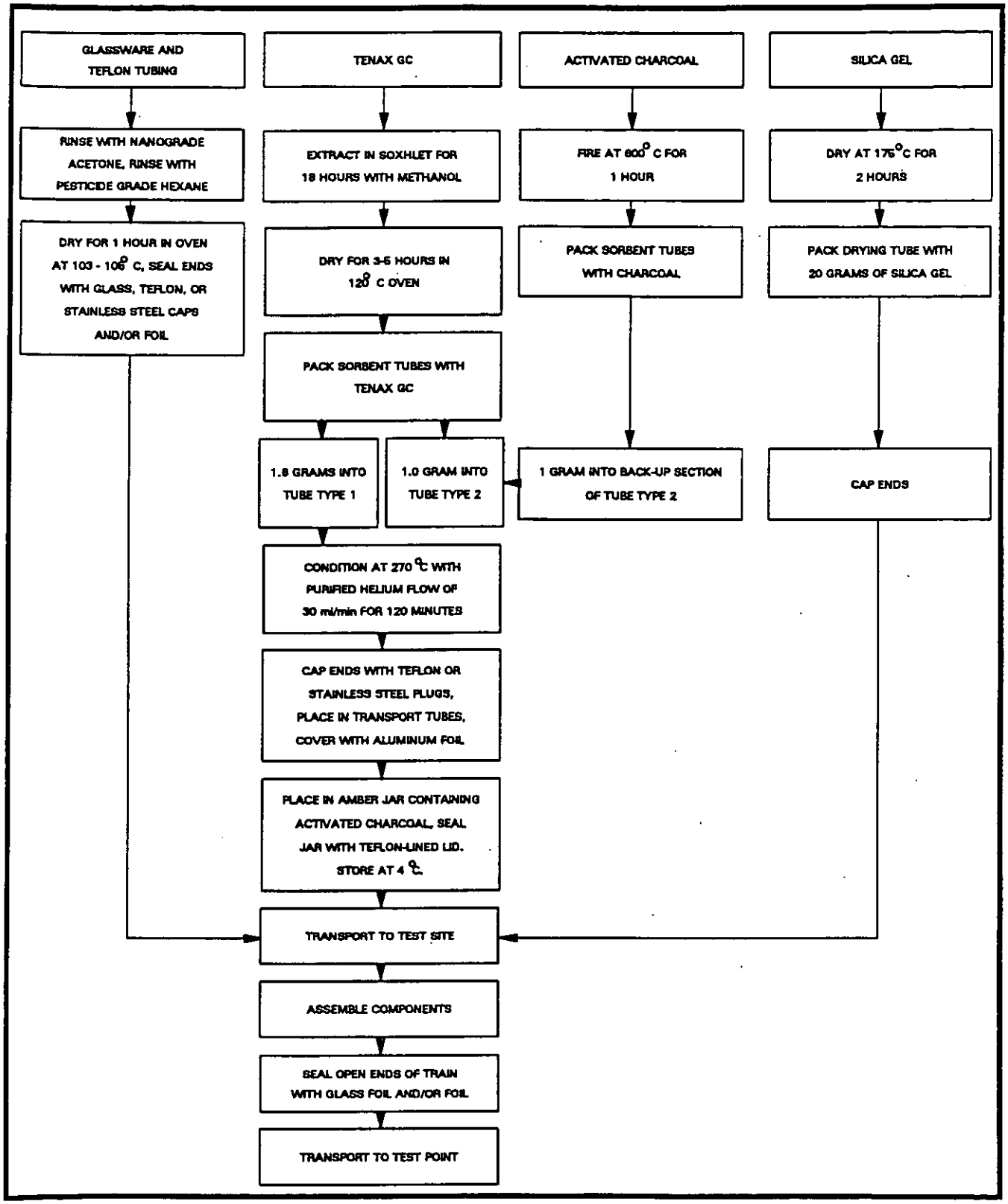


FIGURE 5-22
PREPARATION PROCEDURES FOR
VOLATILE ORGANIC SAMPLING TRAIN

PREP-VOST

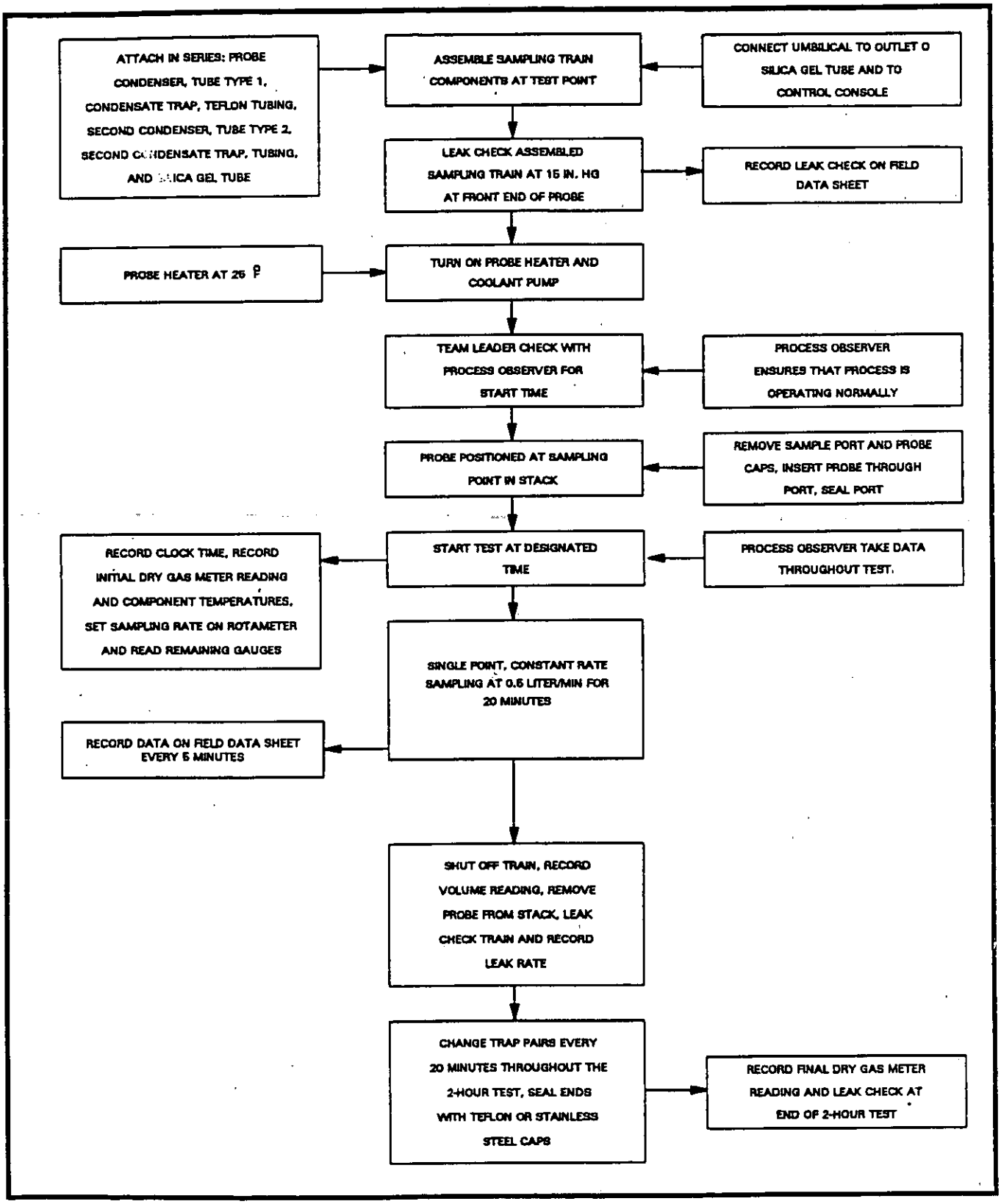


FIGURE 5-23
SAMPLING PROCEDURES FOR VOLATILE ORGANICS

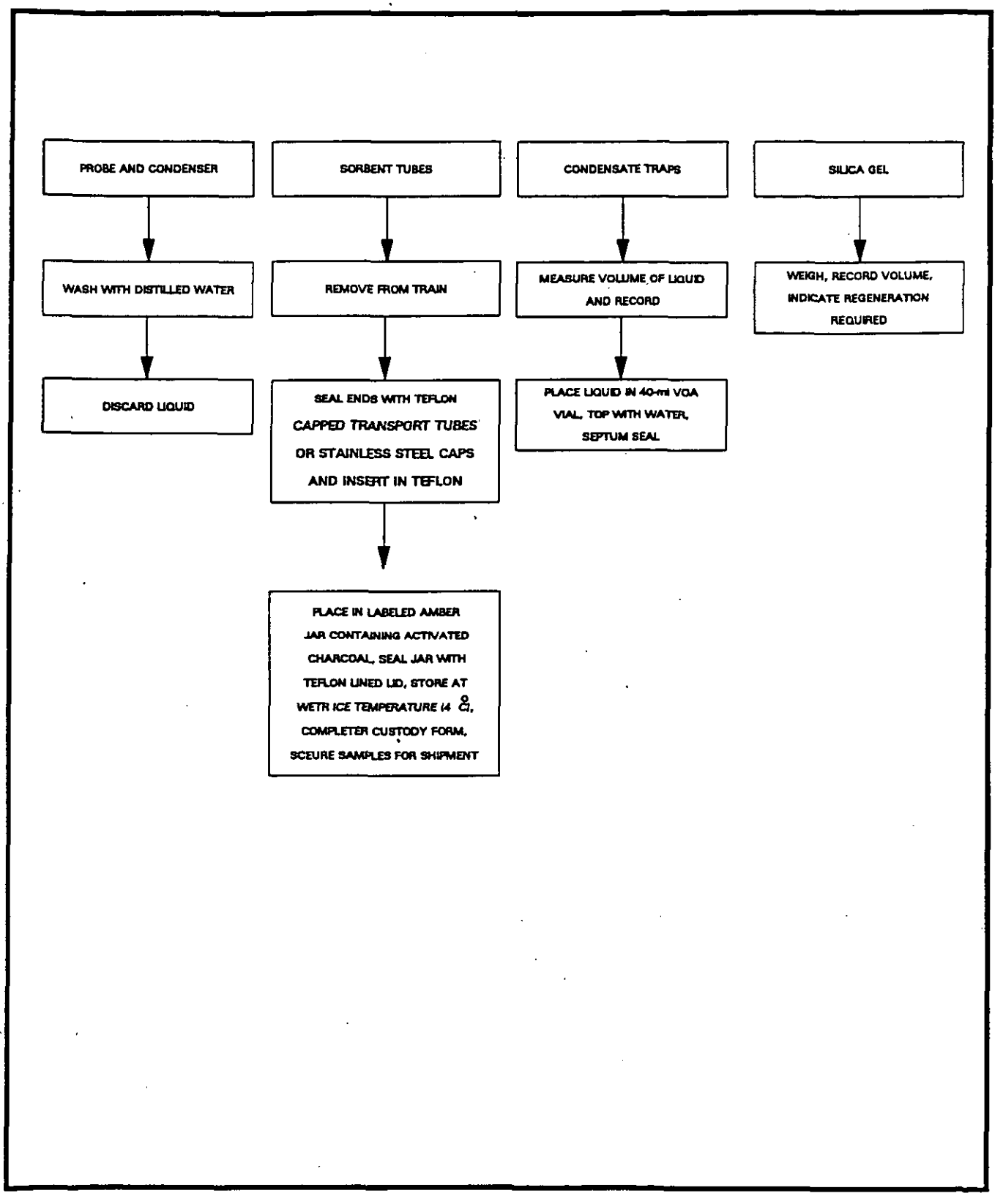


FIGURE 5-24
RECOVERY PROCEDURES FOR
VOLATILE ORGANICS

RSD-VOST

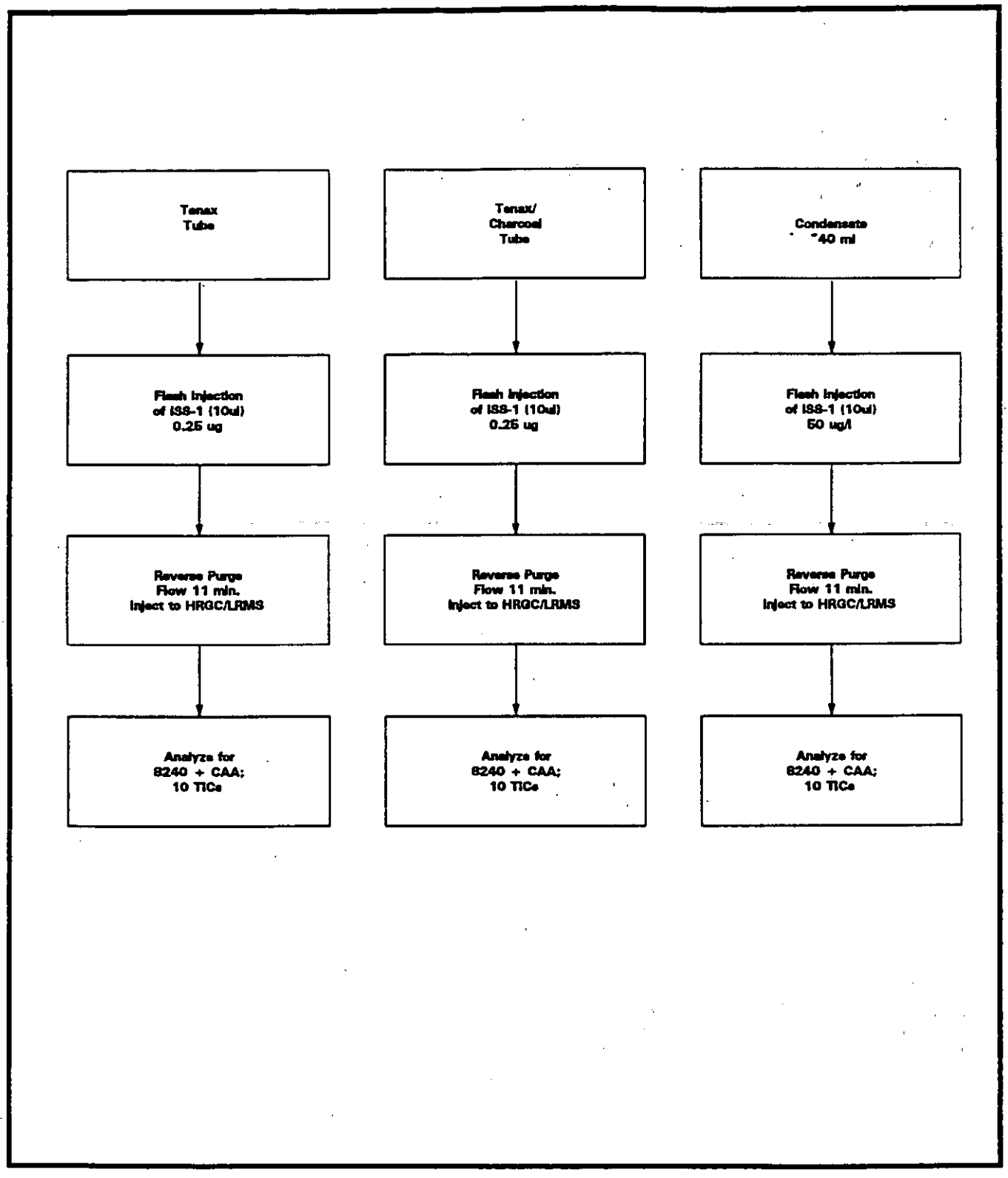


FIGURE 5-25
ANALYTICAL PROCEDURES FOR
VOLATILE ORGANICS

ANL-VOST

To quantify these high levels, MRI developed a technique to fractionate the contents of a Tenax trap onto two, new Tenax traps, and to analyze each fraction for the target analytes. As part of the analysis, additional surrogates were selected and spiked onto the original sample traps before fractionation.

The VOST sample split technique involved the spiking of a surrogate onto the original sample trap (to track the efficiency of the new splitting technique), desorbing the original sample trap onto two, cooled, and clean Tenax traps with regulated flows such that approximately a 120:1 split of the sample occurred.

A procedure was developed and followed in order to ensure that the sample traps were handled in the same manner. The procedure began with new sample traps which were cooled to 5-10° C and inserted into the split device, the nitrogen purge gas was connected, and the gas flows were verified. The original sample trap was then inserted into the heated portion of the split device, and thermally desorbed at 220° C for 5 minutes. Each flow was checked using stopwatches and bubble meters. By recording the exact flows of the nitrogen purge pass at the exit of each new trap during desorption, the exact ratio for the split could be obtained.

A labeling system was developed in order to quickly identify the sample fraction using the letters A, B, C. The original VOST trap was labeled with "A" to indicate that the sample has been desorbed and split onto two clean Tenax traps. The new trap with the high flow (approx. 150 mL/min) of nitrogen contained 99% of the original sample and was labeled with the original sample name and with "B" (i.e. S1-2D-T, B). The new trap with the low flow (approx. 1.2 ml/min) of nitrogen contained 1% of the original sample, and was labeled with the original sample name and with "C" (i.e. S1-2D-T,C). See Figure 5-26 for a diagram demonstrating the sample split scheme.

Once the design was tested, one system blank and three replicate samples were generated, split, and analyzed in order to demonstrate the performance of the device and to optimize the procedure.

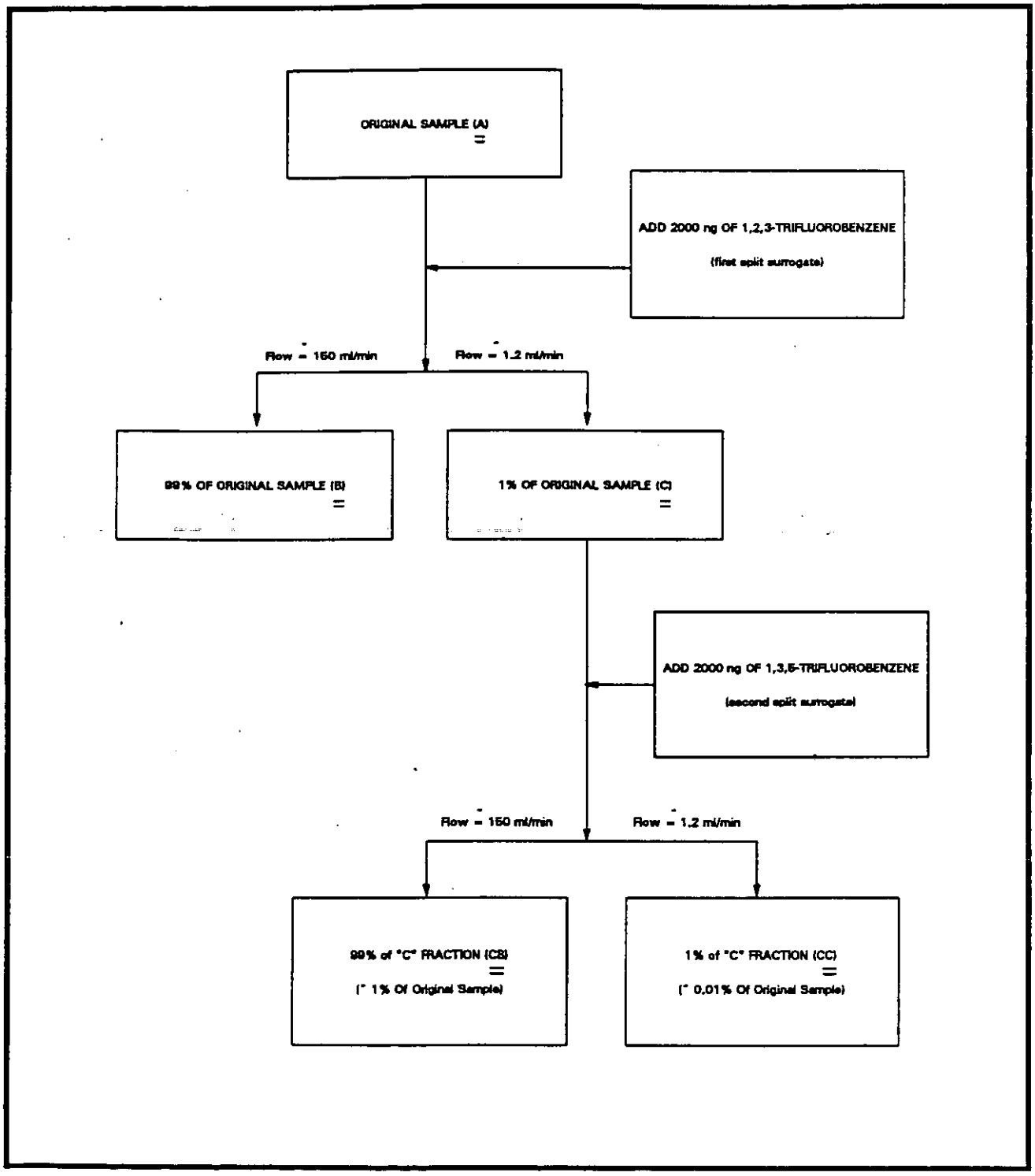


FIGURE 5-26
VOST FRACTIONATION SCHEME

The blank sample was spiked with 2000 ng of the split surrogate, 1,2,3-trifluorobenzene. The sample was fractionated, and all three traps (the spent blank trap (A), the 99% fraction (B), and the 1% fraction (C) were spiked with the internal standard/surrogate solution and analyzed.

In order to mimic the actual samples, three laboratory-generated replicate samples, were spiked with terpenes at 20,000 ng, all other target analytes were spiked at 100 ng, and the split surrogate was spiked at 2000 ng. These three samples were then split, generating nine total VOST traps to be analyzed. Each VOST trap was then spiked with the internal standard/surrogate solution, and analyzed. The spent VOST traps were analyzed to determine if the target analytes had been removed. All 99% fraction samples (B) contained approximately 100 ng for the target analytes, as expected, and saturated peaks for the terpenes. All 1% fraction samples (C) contained the terpenes at approximately 300 ng. When the amount was corrected using the actual split ratios for each sample, the final concentration in the 1% fraction (C) was 20,000 ng.

For the remaining stack 1 samples, only one split was required, and one surrogate (1,2,3-trifluorobenzene) was used to confirm the split ratio. For the remaining Stack 2 samples, one split was not sufficient to quantitate the terpenes. So, a second split was performed on the "C" portion of the initial split sample, effectively generating a serial dilution and three possible fractions to be analyzed. The three fractions included the 99% fraction (B), the 1% fraction (CB) and the 0.01% fraction (CC). The surrogate used for the first split was 1,2,3-trifluorobenzene, and the surrogate used for the second split was 1,3,5-trifluorobenzene.

Each sorbent tube sample that was analyzed was spiked with internal standards, then thermally desorbed in a tube oven onto the Tenax analytical adsorbent trap. This procedure is described in Section 7 of the reference method. Each sample was then desorbed from the analytical adsorbent trap into the GC/MS system per EPA Method 5041. The transfer line temperatures were increased to 170° C and the trap desorption temperature was increased to 220°C. These changes were necessary to remove high boiling point compounds from the traps and to minimize system contamination.

Analysis of the condensate samples was conducted as specified in EPA Method 624, P-T-D GC/MS. Laboratory results are reported as total nanograms of each volatile organic in the samples.

SECTION 6

QUALITY ASSURANCE/QUALITY CONTROL ACTIVITIES

6.1 PRESENTATION

This section summarizes the quality assurance and quality control (QA/QC) activities that were implemented to assure the goals and objectives of this assignment were successfully met. These procedures were an integral part of the testing program activities. Section 6.2 addresses the data quality objectives. Section 6.3 covers method-specific QC results for the flue gas sampling. Laboratory QC checks are discussed in Section 6.4. QC checks for data reporting are covered in Section 6.5, and audits and corrective actions are discussed in the Sections 6.6 and 6.7. The appendices present all necessary backup data.

6.2 DATA QUALITY OBJECTIVES

The overall objective of the sampling and analysis effort was to provide data that are precise, accurate, comparable, representative and complete for characterizing the sources to be evaluated under this assignment. The data quality objectives for this testing program were deemed complete if all planned data are obtained within the QA/QC criteria noted in the Test Plan and established by the applicable methods.

Data quality objectives are measured in terms of precision, accuracy and completeness. The QA objective of having 95% of the laboratory data usable without qualification was achieved. The overall QA objective of obtaining at least 80% usable data without qualification was obtained.

The comparability of the data is a qualitative, not quantitative, review of the measurement data. This QA objective determines the confidence with which data sets can be compared. The comparability has been ensured by WESTON's use of standardized test methods, QA plans, sample container preparation, sample handling procedures, analytical procedures, calculation procedures, and report preparation. In addition, these activities were performed by properly trained, experienced personnel. The data from this survey can be compared to those obtained from other planned or previous performed programs that meet the data quality objectives.

6.3 QC FOR SAMPLE COLLECTION

The following subsections provide a list of method-specific QC procedures employed during the field sampling effort. The procedures specified for the particulate/condensibles will also apply to the other isokinetic sample trains (PM_{10}, aldehyde/ketone, MM5). General QC checks that applied to all methods include the following:

- leak checks;
- use of standardized forms, labels and checklists;
- maintenance of sample traceability;
- collection of appropriate blanks;
- use of calibrated instrumentation;
- use of Protocol 1 and/or NIST traceable calibration gases;
- review of data sheets in the field to verify completeness; and
- use of validated spreadsheets for calculating results.

While each team member shares in the responsibility to follow the stated Test Plan, the Field Manager was ultimately responsible for assuring each of these QC checks were fully and properly implemented.

6.3.1 Method 0011 Aldehyde/Ketone

QC procedures used to determine the accuracy of M0011 sampling runs are outlined in Draft SW-846 Method 0011, Sampling for Aldehyde and Ketone Emissions from Stationary Sources, Sections 3.5.11 and 3.5.12. These checks include:

- Use of reagents that meets method criteria. A supply of the DNPH reagent was prepared within 5 days of scheduled use. Two aliquots from each lot of DNPH were reserved for blank analysis as per Method 0011A.
- Collection of two field spike samples.
- Collection of two audit samples.
- Collection of two field blanks.

To further assure valid, representative sample collection for this system, the impingers were analyzed separately. In general, the sampling strategy used was effective in the capture of aldehyde/ketone emissions. Refer to Section 3.2.1 of this report for a discussion of the results.

The preparation and recovery of the EPA Method 0011 (M0011) test train was performed in an area isolated from the preparation and recovery activities for the other test trains. This was done to minimize the potential for contamination of the M0011 samples from acetone. Blank trains (identical to the EPA M0011 sample train) were charged, leak checked, and recovered. Blank trains were setup for stacks 1 and 2 and for stacks 3, 4, and 5. The blank trains were analyzed as a QC check to determine whether or not contamination occurred during preparation, setup, recovery or analysis. Variability in the acetone and methyl ethyl ketone results introduced a degree of uncertainty. As such, these values should only be used for general estimates.

The samples collected at all sampling locations were not shipped on ice as required by M0011. This procedure should not have affected the samples since the samples were shipped in January and the ambient temperatures did not exceed 70° F.

6.3.2 Continuous Emissions Monitoring

The QC procedures were performed on-site according to EPA Methods 10, 7E, and 25A for carbon monoxide, nitrogen oxides, and total hydrocarbon emissions, respectively. Additionally, the analyzers used were calibrated prior to leaving the home office and upon return from the job. Specific QC checks include:

- Use of Protocol 1 gases (verify ± 10% of known concentration)
- Performance of zero and calibration drift tests (± 10% of span)
- Performance of system bias check (± 5% of span).

6.3.3 Methods 5/202 Particulate/Condensibles

EPA Method 5 served as the QC guideline for precise sampling criteria. Special attention was given to the following quality control (QC) checks:

- Prior to and following each run and port change, the sampling train was leak checked. All trains met the required method criteria for leak checks.
- The outlet of the silica gel impinger was maintained at less than 68°F during sampling.
- Isokinetic sampling was maintained at 100 percent ± 10 percent and readings were recorded at 5-minute or less intervals.
- Use of organic rinsed glassware and sample containers.

6.3.4 Method 201A PM_{10}

Quality control procedures outlined for EPA Method 5 sampling were also followed for this system. A pretest leak check was performed through the entire system. Mid-point and post-test leak checks were not conducted through the PM_{10} cyclone to avoid disturbing the fractionated particulate collected in the PM_{10} sizing device. A leak check was done through the impingers at the completion of the test run. The runs performed at stacks 3, 4, and 5 ran approximately four hours to ensure the capture of enough particulate sample to perform gravimetric analysis.

6.3.5 Method 0010 Semivolatiles

QC guidelines for Modified Method 5 were followed as stated in SW-846 Method 0010 (M0010), "Modified Method 5 Sampling Train" Section 11. Additional quality control considerations are outlined in Method 8270. Sampling criteria are given in EPA Method 5. QC measures employed for this procedure include:

- Use of organic rinsed glassware and sample containers.
- Collection of field bias blanks.
- Use of Teflon tape instead of silicone grease.
- Collection of field bias blanks.

As noted by the laboratory, the solvent rinse and the condensate samples were not shipped to the lab on ice as required by EPA M0010. Since the samples were shipped in January and the ambient temperatures were less than 70° F, the sample integrity should not have been compromised.

6.3.6 Methods 1-4 Velocity/Volumetric Flow Rate QC Procedures

The QC procedures for velocity/volumetric flow rate determinations followed guidelines set forth by EPA Method 2. Incorporated into this method are sample point determinations by EPA Method 1, flue gas oxygen (O_2) and carbon dioxide (CO_2) concentration determinations by EPA Method 3, and gas moisture determination by EPA Method 4. Volumetric flow rates were determined using measurement methods and procedures outlined in Reference Method 2. Checks were performed at all sample locations to verify the presence or absence of cyclonic flow. Oxygen (O_2) and carbon dioxide (CO_2) concentrations at the stack 1 and 2 locations were determined using Orsat and Fyrite analyzers. The use of a Fyrite analyzer was deemed acceptable since none of the reported emissions data was corrected for dilution effects.

6.3.7 Method 0030 VOST

The major QC item associated with the VOST sampling was the completion of the VOST audit. This is a useful check for determining method precision and accuracy for both the field and laboratory components. Other QC measures included maintaining VOST tubes samples at or below 4°C, collection of condensate samples in VOA vials, and special precleaning of all glassware and containers. A field bias blank was collected at each of the stack 1 and 2 sampling locations. The VOST sample volume was determined based on the measured total hydrocarbon concentrations in an effort to minimize trap saturation.

6.4 QC PROCEDURES FOR ANALYSES

The following subsections outline the basic quality control components associated with the analytical procedures to be utilized. Several different types of samples were analyzed as part of the ongoing quality control program for this assignment. Blank samples were analyzed in order to assess possible contamination from the field and/or laboratory, so that corrective measures of future programs can be taken if necessary. The types of QC samples analyzed during this assignment include:

- *Field Blanks* - These blank samples were exposed to field and sampling conditions, and analyzed in order to assess possible contamination from the field (one for each lot of samples analyzed).

- *Reagent and Solvent Blanks* - These blanks were prepared in the laboratory and analyzed in order to determine the background of each of the reagents (or solvent in the case of particulate samples) used in each type of analysis (one for each new lot number of solvent used).

- *Duplicates* - multiple analysis of specific samples were completed by the analyst to check on the validity of certain analogous samples.

- *Matrix Spike* - A known quantity of standard was added to the sample during the preparation stage. The amount detected after analysis was reported as a percent recovery and used to assess accuracy in consideration of possible matrix interference. On a selected number of samples, a *matrix spike duplicate* was prepared to assess precision and accuracy.

- *Calibration Standards* - A calibration standard was analyzed as required by the applicable method.

6.4.1 Methods 5/202 Particulate/Condensibles

EPA Method 5 served as the QC guideline for precise sampling criteria. Special attention was given to the following quality control (QC) checks:

- All samples were desiccated a minimum of 24 hours prior to the first weighing: Constant weight is achieved when consecutive reading agree within 0.5 mg. These reading must be at least 6 hours apart.

- Gravimetric measurements were checked with a set of Class S weights. Measurements were made in the approximate range of the actual field samples.

6.4.2 Method 201A PM_{10}

Quality control procedures outlined for EPA Method 5 analyses were also followed for Method 201A. Some of the reported results were at or very near the minimum detection limit for the gravimetric analysis. This aspect of the PM_{10} data must be considered in reviewing any of the reported results.

6.4.3 Method 0011A Aldehyde/Ketone Analysis

Two matrix spike and two audit samples were performed for formaldehyde, hexaldehyde, methyl ethyl ketone (MEK) and benzaldehyde. The results are summarized on Table 6-1. Results for the field bias blank are provided in Table 6-2.

TABLE 6-1

M0011a Matrix Spikes and Audit Samples Percent Recoveries

Analyte	Audit 1	Audit 2	Matrix 1	Matrix 2
Formaldehyde	128	108	119	122
Hexaldehyde	100	85.0	97.4	101
Methyl Ethyl Ketone	176	147	157	166
Benzaldehyde	107	92.7	112	111

TABLE 6-2

M0011a *Field* Bias Blank

Compound	Field Bias Blank, µg			
	Stacks 1 and 2	Stacks 3, 4, and 5		
		Imp. 1	Imp. 2	Imp. 3
Formaldehyde	288	218	29	30
Acetaldehyde	174	18	<2*	<1*
Acrolein	12	<2*	<2*	<1*
Propionaldehyde	<3*	3*	<2*	6
Acetone	2780	12	2	<1*
n-Butyraldehyde	3	<2*	<2*	<1*
Methyl ethyl ketone	<3*	<2*	<2*	<1*
Benzaldehyde	32	<2*	<2*	<1*
Isovaleraldehyde	<3*	<2*	<2*	<1*
Valeraldehyde	5	<2*	<2*	<1*
o-Tolualdehyde	<3*	<2*	<2*	<1*
m-Tolualdehyde	<3*	<2*	<2*	<1*
p-Tolualdehyde	<3*	<2*	<2*	<1*
Hexaldehyde	42	2	2	1
2,5-Dimethylbenzaldehyde	<3*	<2*	<2*	<1*

<* *analyte not detected* * *analyte present but less than detection limit*

High-performance liquid chromatographs were calibrated prior to each day of use. Calibration standard mixtures were prepared from appropriate reference materials and contained analytes appropriate for the method of analysis. A summary of calibration results is presented in the laboratory reports in Appendix B-6.

For continuing calibrations, the data quality objective was 100% ± 20% for all compounds except MEK which was 100% ± 35%. MEK was the only compound that did not continually meet the data quality objective. The values were just outside the range on the high side. The MEK audit sample recoveries averaged 162 percent. Based on test results, audit results, and previous test programs, M0011 may not be appropriate for quantifying MEK emissions. M0011 has not been validated for MEK.

6.4.4 Method 0010 Semivolatiles

Stack samples collected using Method 0010 were analyzed in accordance with the guidelines of Method 8270. The samples were analyzed as a combined front half (methanol/methylene chloride probe rinse and filter), back half (XAD and back half rinse) and impinger (aqueous) sample extract. Quality control measures included: pre-spiking the XAD resin with surrogate compounds, initial calibrations, continuing (daily) calibrations, and field and laboratory blanks.

The calibration solutions are prepared with mixtures of analytes in solutions ranging from 5 to 160 µg/ml with the internal standards injected at a concentration of 40 µg/ml. Individual response factors (RF) were determined at concentrations of 5, 10, 25, 75, 125 and 160 µg/ml RF.

All XAD traps were pre-spiked with 100 µg terphenyl-d_{14} prior to field use. Prior to extraction, all samples were fortified with 100 µg each of four additional surrogate spike compounds. The majority of the recoveries of the field surrogate were high. The spiking solution was checked with the results being 130%. The data were not corrected for the high recovery. All recoveries of the laboratory surrogate compounds were within the method criteria of 50 to 150%.

The field bias blank (FBB) was performed at stack 1. α-Terpineol and bis(2-ethylhexyl)phthalate were detected in the field blank. The terpineol results were at least 450 times higher than the

blank and, therefore, the data were not blank corrected. The bis(2-ethylhexyl)phthalate results for stack 1 were less than the FBB and, therefore, were not considered native to the sample. A performance audit sample was analyzed and met the objective of 50% to 150% accuracy.

6.4.5 Method 0030 VOST

The VOST analysis is based on the guidelines of Method 5040 and 8240. Quality control measures included performance of initial calibrations (using internal standards, analytes of interest and surrogate standards), continuing calibrations (daily), analysis of blanks and analysis of audit samples.

System performance was checked using five compounds. Of these compounds, bromoform did not meet the minimum RRF (relative response factor) objective. For initial calibrations, most analytes met the 30% RSD (relative standard deviation) objective. All RRF values were consistent except benzene. Background levels of benzene were observed and were suspected to be from the degraded tenax trap that was used for the calibrations. For acetone and trans-1,4-dichloro-2-butene, the detection limits were above 10 nanograms. A four point calibration was used instead of the five point calibration specified in the method.

Analysis of field blanks and laboratory blanks revealed low levels of the compounds of interest. Contamination of the tubes was reported for several compounds including acetone, chloromethene, α-pinene, and acrolein. Table 6-3 summarizes the compounds and levels reported in the field bias and trip blanks. For the fractionated analysis, all spent VOST tubes were analyzed and found free of any target compounds except for the water soluble compounds which were found at approximately 20-30 μg. Results of the analysis of the VOST tubes collected from the two EPA audit cylinders are reported in Table 6-4.

The VOST sampling and analyses were performed with some required variation from standard protocol. These variations were attributed to the high concentrations of α and β- pinene. The majority of the pinene data is considered estimated due to the use of the non-standard analytical procedure. This procedure is discussed in detail in Appendix B.

TABLE 6-3

Field, Trip, & Lab Blank VOST Tube Results Expressed in Nanograms (ng)

Compound	Field Blanks				Trip Blanks		Lab Blanks	
	Stack 1		Stack 2				Tenax	
	Tenax	Tenax/Charcoal	Tenax	Tenax/Charcoal	Tenax	Tenax/Charcoal	1	2
Chloromethane	9.3	121.8	15.0	17.4	16.3	15.0	--	--
Bromomethane	7.7	81.6	11.9	14.5	11.4	12.2	--	--
Acetone	9.6	197.7	12.6	8.9	--	98.2	--	--
Methylene Chloride	--	15.1	--	--	72.2	--	8.1	28.0
Methyl Ethyl Ketone	--	--	13.7	--	27.9	37.4	8.8	12.9
Chloroform	--	--	--	--	26.8	--	--	--
Carbon Tetrachloride	--	--	--	21.4	--	--	--	--
Benzene	--	43.1	6.8	14.1	--	18.3	--	--
Toluene	--	9.3	--	--	7.0	5.4	--	--
1,1,2,2-Tetrachloroethane	--	--	--	--	--	--	7.6	--
Carbon Disulfide	--	10.6	7.6	--	16.1	--	--	--
4-METHYL-2-PENTANONE	13.2	21.6	12.8	16.0	10.1	14.6	15.9	13.4
Styrene	--	5.9	--	--	9.5	--	--	--
A-Pinene	--	122.7	--	41.4	--	7.5	--	--
B-Pinene	--	7.2	--	--	--	--	--	--
P-Cymene	--	7.4	--	--	--	--	--	--
Acrolein	--	239.2	--	24.5	120.4	224.7	35.8	36.4
Acrylnitrile	--	--	--	--	96.3	84.0	--	--

TABLE 6-4

VOST AUDIT SAMPLES

	Audit 549				Audit 550		
	A	B	C	Average	E	G	Average
Date	1/21/93	1/21/93	1/21/93	--	1/21/93	1/21/93	--
Start Time	1010	1039	1104	--	1316	1405	--
Stop Time	1030	1059	1124	--	1336	1425	--
Sampling Parameters:							
Volume Sampled	9.930	9.910	9.440	--	8.310	9.950	--
Meter Temperature, C	17	20	22	--	19	20	--
Barometric, In. Hg	30.24	30.24	30.24	--	30.24	30.24	--
Meter Delta H, In H2O	1.1	1.1	1.1	--	1.1	1.1	--
DGM Gamma	0.995	0.995	0.995	--	0.995	0.995	--
Volume Sampled, DSL	10.112	9.980	9.450	--	8.419	10.029	--
Concentration, ppb							
CHLOROMETHANE	10.1	4.0	3.9	6.0	1.1	1.5	1.3
BROMOMETHANE	9.6	11.5	12.3	11.2	0.8	0.7	0.7
ACETONE	3.3	3.3	1.9	2.8	1.7	4.5	3.1
METHYLENE CHLORIDE	67.3	19.0	20.3	35.5	41.9	36.5	39.2
METHYL ETHYL KETONE	8.8	12.5	9.5	10.3	0.4	1.3	0.9
1,1,1-TRICHLOROETHANE	29.3	31.4	30.8	30.5	0.2	--	0.1
CARBON TETRACHLORIDE	--	0.1	1.1	0.4	0.6	1.6	1.1
BENZENE	0.6	0.9	0.8	0.7	0.9	0.9	0.9
1,2-DICHLOROETHANE	11.4	12.2	11.8	11.8	--	--	0.0
TRICHLOROETHENE	0.2	8.1	8.0	5.5	0.1	--	0.1
TOLUENE	1.5	0.4	0.4	0.7	0.5	0.4	0.5
CARBON DISULFIDE	0.4	1.1	0.6	0.7	0.9	0.5	0.7
IODOMETHANE	0.1	--	--	0.0	--	--	0.0
m,p-XYLENE	0.7	0.6	0.7	0.7	0.3	0.3	0.3
o-XYLENE	0.2	--	--	0.1	34.3	29.5	31.9
STYRENE	--	--	--	0.0	1.6	1.5	1.5
P-CYMENE	0.3	0.1	--	0.1	--	--	0.0
ACROLEIN	4.1	5.2	3.3	4.2	2.7	8.2	5.5
ACRYLONITRILE	--	0.3	--	0.1	6.0	5.5	5.8

6.4.6 Method 7E Nitrogen Oxides, Method 10 Carbon Monoxide and Method 25A Total Hydrocarbons Monitoring

All analyses for these parameters were completed on-site during the field effort. The field bias check and calibration on run MDFP3-M25A-2 was the only run not within the Method requirements. An additional run was performed to replace this run.

6.5 QA/QC CHECKS FOR DATA REDUCTION, VALIDATION, AND REPORTING

Data quality audits were conducted using data quality indicators which require the detailed review of: (1) the recording and transfer of raw data; (2) data calculations; (3) the documentation of procedures; and (4) the selection of appropriate data quality indicators.

Some of the data quality indicators used for data validation are:

1. Comparison of the relative concentrations of the emissions at the different sampling locations;
2. Comparison of the results to previous field test results (i.e., are there any similarities);
3. Comparison of the results for a particular parameter with those from each condition (i.e., are the concentrations similar and do they show the same relationship for a material balance).

All data and/or calculations for flow rates, moisture content, and isokinetic rates generated by a computer software program were validated by an independent check. All calculations were spot checked for accuracy and completeness.

In general, all measurement data was validated based on the following criteria:

- Process conditions during sampling or testing;
- Acceptable sample collection procedures;
- Consistency with expected other results; and
- Adherence to prescribed QC procedures.

Any suspect data was flagged and identified according to the specific deviation from prescribed criteria and its potential effect on the data quality. Upon completion of testing, the field

coordinator was responsible for preparation of a data summary including calculation results and raw data sheets.

6.6 CORRECTIVE ACTIONS

No corrective action measures were implemented during this assignment other than repeating test runs where a problem was noted. A possible field contamination problem associated with the VOST condensate samples was noted. WESTON has initiated corrective measures to address this concern. All HPLC squeeze bottles and HPLC water sources will be investigated prior to the initiation of any future Work Assignments.

6.7 QA AUDITS

M0011 and VOST audits were conducted during this assignment. M0011 results are discussed in subsection 6.4.3. A known amount of the aldehyde and ketone compounds listed in Table 6-1 were transferred from sample vials to sample jars containing DNPH reagent. The samples were analyzed as per M0011A. The VOST audit results were discussed in subsection 6.4.5. This audit involved the use of a multi-gas audit cylinder of known concentration. A measured amount was drawn into the VOST sample system and analyzed with other project samples. This audit provided an estimate of method precision and accuracy. EPA does not assign a pass or fail value for this audit. Typically agreement is better than 50% relative difference for all audit tubes analyzed.