
**EMISSION MEASUREMENT CENTER
GUIDELINE DOCUMENT (GD-043)**

**PREPARATION AND REVIEW
OF
EMISSION TEST REPORTS**

December 1998

PREFACE

This guideline document is made available to promote consistency in the preparation and review of site-specific emission test reports for emission test programs performed for the U. S. Environmental Protection Agency (EPA), State and local agencies, and private sector interests.

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EMISSION TEST REPORT FORMAT

PURPOSE AND USE OF GUIDELINE

The purpose of this guideline is to promote consistency in the preparation and review of test reports for emission test programs sponsored by the U. S. Environmental Protection Agency (EPA), state and local agencies, and the private sector.

The emission test report must provide the information necessary to document the objectives of the test and determine whether proper procedures were used to accomplish these objectives.

The emission test report presents the information gathered according to an emission test plan. Therefore, the contents of the test plan serve as the foundation for the test report.

This guideline presents a standard format for preparing the emission test report. The standard test report contains a table of contents, six sections, and appendices. Rather than discussing the standard format, this guideline lists the contents for each section. Then an example is given to illustrate the intent of each list. The list at the beginning of each section serves a dual purpose: (1) as a guide to the preparer and (2) as a checklist for both the preparer and the reviewer of the test report.

Readers may reproduce any part of this guideline.

1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

In this section, write a brief summary that identifies or states, as applicable, the following:

- *Responsible groups (participating organizations)*
- *Overall purpose of the emission test*
- *Regulations, if applicable*
- *Industry*
- *Name of plant*
- *Plant location*
- *Processes of interest*
- *Air pollution control equipment, if applicable*
- *Emission points and sampling locations*
- *Pollutants to be measured*
- *Dates of emission testing*

EXAMPLE:

1.1 SUMMARY OF TEST PROGRAM

The U.S. Environmental Protection Agency (EPA), Office of Air Quality Planning and Standards (OAQPS), Emission Factor and Inventory Group (EFIG) is responsible for developing and maintaining air pollution emission factors for industrial processes. The EFIG, in collaboration with the **[Trade Organization]**, is presently studying the wood products industry. The purpose of this study is to develop emission factors for oriented strand board (OSB) production facilities. The Emission Measurement Center (EMC) of OAQPS coordinated the emission measurement activities at this plant. **[Contractor]** and **[Trade Organization]** conducted the emission measurements.

EPA/EFIG and **[Trade Organization]** considered the **[Plant]** in **[City, State]** to be one of four facilities that represent the diversity in wood species and dryer control devices. This test was the second of the four and was conducted **[Dates]**. Simultaneous measurements were conducted at the inlet and outlet of the electrified filter bed (EFB) for the No. 1 wood wafer dryer exhaust and at the press vents. Pollutants measured were: particulate matter (PM), condensible particulate matter (CPM), carbon monoxide (CO), nitrogen oxides (NO_x), hydrocarbons (HC), formaldehyde (plus other aldehydes and ketones), and volatile and semivolatile organic compounds.

1.2 KEY PERSONNEL

In this section, include the following:

- *Names, affiliations, and telephone numbers of key personnel*

EXAMPLE:

1.2 KEY PERSONNEL

The key personnel who coordinated the test program and their phone numbers are:

- **[Contractor]** Project Manager XXX/XXX-XXXX
- Environmental Agency Technical Representative[if any] XXX/XXX-XXXX
- **[Plant]** Contact XXX/XXX-XXXX
- **[Trade Organization]** Representative XXX/XXX-XXXX
- **[Contractor]** Process Monitor XXX/XXX-XXXX

2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

2.1 PROCESS DESCRIPTION AND OPERATION

In this section, include the following:

- *General description of the basic process*
- *Flow diagram (indicate emission and process test points)*
- *Discussion of typical process operations, such as:*
 - *Production rates*
 - *Feed material and feed rates or batch sizes*
 - *Equipment sizes and capacities (ratings)*
 - *Production schedules (hours/day, days/week, weeks/year, peak periods)*

In the flow diagram, trace the process from beginning to end. Identify the major operations. Show only those gas, liquid, and solid flow streams that relate to the emission test.

EXAMPLE:

2.1 PROCESS DESCRIPTION

Figure 2-1 illustrates the basic processing steps for OSB production. The steps are:

- Logs are slashed, debarked, cut into shorter lengths, and sliced into thin wafers.
- The wafers are dried, classified, blended and mixed with resin, oriented, and formed into a mat.
- The formed mats are separated into desired lengths, heated, and pressed to activate the resin and bond the wafers into a solid sheet.
- Sheets are trimmed, edge treated, and packaged for shipping.

At **[Plant]**, the wood mix during the test was 60 percent soft wood (e.g., pine), 30 percent soft hardwood (e.g., sweet gum), and 10 percent hardwood. Two 12-foot diameter dryers processed 30,500 lb/hr of flakes. The moisture content of the flakes leaving the dryer was 3 percent. Inlet temperature to the dryer ran at 900°F and the exit temperature was 255°F. A McConnell burner firing recycled waste (wood trim, fines, and resinated sander dust) heated the dryers. An oil-fired Wellens burner served as a backup, but was not used during the test.

The emission test points were EFB inlet and outlet (stack) and the roof vents from the press.

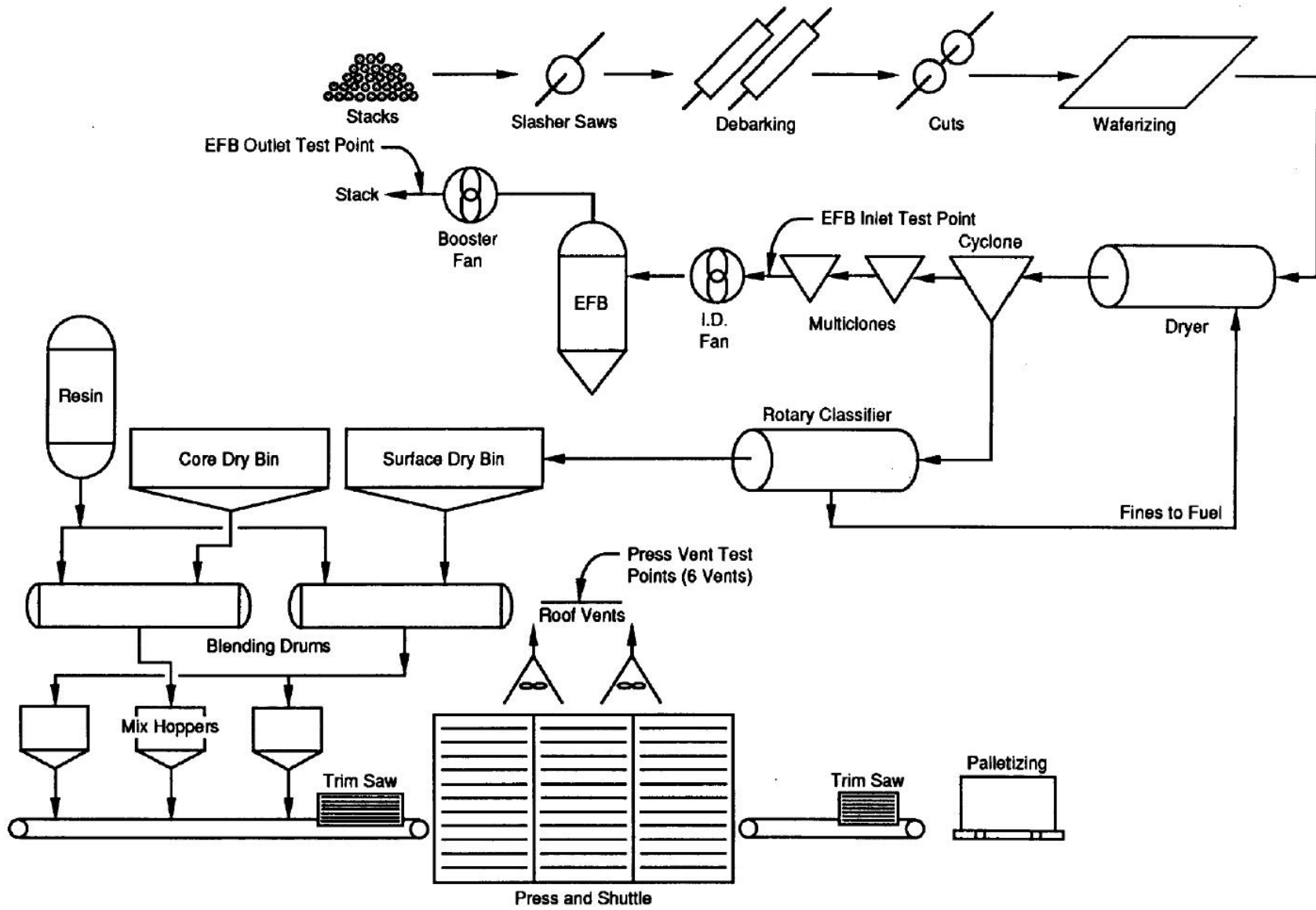


Figure 2-1. Oriented strand board (OSB) process flow diagram.

2.2 CONTROL EQUIPMENT DESCRIPTION

In this section, include the following:

- *Description of all air pollution control systems, if applicable*
- *Discussion of typical control equipment operation and, if necessary, a schematic*

EXAMPLE:

2.2 ELECTRIFIED FILTER BED DESCRIPTION

Particulate matter from the wafer dryer is controlled by cyclones and an electrified filter bed (EFB) manufactured by **[Manufacturer]**. Figure 2-2 is a schematic of an ionizer and gravel bed assembly. The EFB is an electrostatic precipitator (ESP) that uses pea-gravel as its collection electrodes.

The gases enter the EFB into an annular region formed by two concentric cylinders. The inner cylinder is the ionizer. Ions formed by the ionizer stream toward the adjacent cylinder wall and impart electro-static charges on dust particles.

After passing through the ionizer, the gas flows down the chamber into the filter bed section. The filter bed consists of pea-shaped gravel held between two cylindrical louvers. A high DC positive voltage polarizes the gravel and induces regions of positive and negative charge on the pebbles. As the gases pass through the pebble bed, the negatively charged dust particles are collected on the positively charged regions on the gravel.

As dust accumulates in the filter bed, the resistance to gas flow increases. To maintain constant flow and remove collected particles, the EFB slowly and continuously remove gravel from the bottom. The removed gravel is agitated to remove the dust particles and is recycled into the EFB at the top.

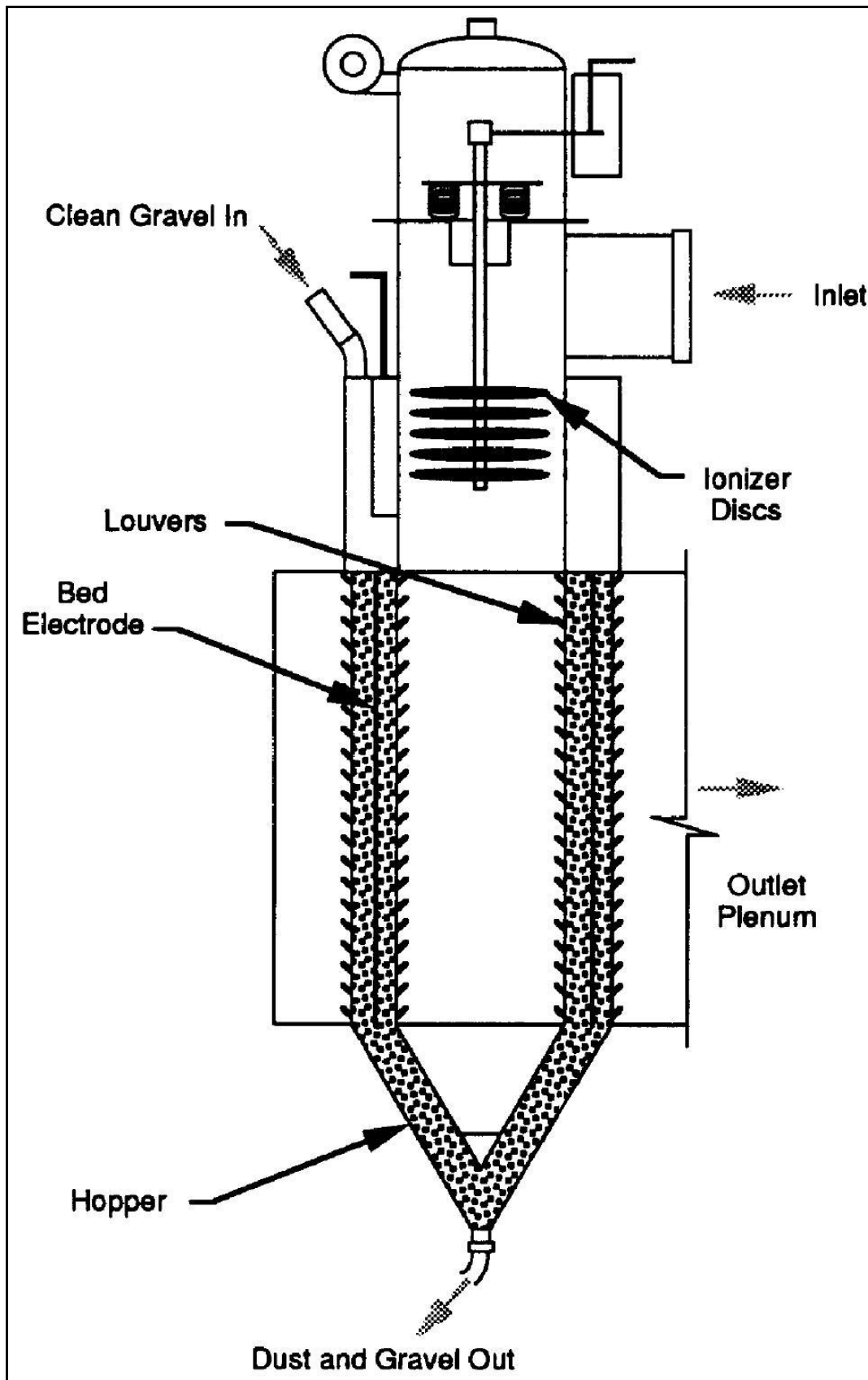


Figure 2-2. Ionizer and gravel bed assembly.

2.3 FLUE GAS SAMPLING LOCATIONS

In this section:

- *Provide a schematic of each location. Include:*
 - *duct diameter*
 - *direction of flow*
 - *dimensions to nearest upstream and downstream disturbances (include number of duct diameters)*
 - *location and configuration of the sampling ports*
 - *nipple length and port diameters*
 - *number and configuration of traverse points*
- *Confirm that the sampling location met the EPA criteria - If not, give reasons and discuss effect on results*
- *Discuss any special traversing or measurement schemes*

EXAMPLE:

2.3 FLUE GAS SAMPLING LOCATIONS

Emission sampling was conducted at: (1) the EFB inlet on dryer No. 1, (2) the EFB outlet stack on dryer No. 1, and (3) the press vents. Figures 2-3, 2-4, and 2.5 are schematics of these sampling locations.

2.3.1 EFB Inlet. Four 4-inch ports were installed at Sections XX and YY as shown in Figure 2-3. Because of obstructions around the site, Section XX was the only practical location for Methods 202 and 0011. Method 1 requires that Section XX have 24 traverse points; each point was sampled for 2.5 minutes for a total time of 60 minutes. One train traversed into the duct while the other traversed out. At Section YY, about 2 feet below Section XX, one port was used for the paired Method 25 single-point sampling and the second for Method 25A and Method 3.

2.3.2 EFB Outlet. The outlet stack for the EFB has two 4-inch sampling ports A and B as shown in Figure 2-4. Additional 4-inch ports C through H were installed as shown. Methods 202, 0011, and MM5 were conducted at Section XX at 24 points (2.5 minutes at each point), the VOST train were conducted at port E, and Methods 25 (dual), 10, 7E, and 3 were conducted at Section YY.

2.3.3 Press Vents. The press has eight roof vents as shown in Figure 2-5. The two vents on the ends (1 and 8) were not tested because they were not directly over the press and little or no emissions were expected from these vents. Different pairs of the other six vents were sampled for formaldehyde emissions (Method 0011) during each of the three test runs.

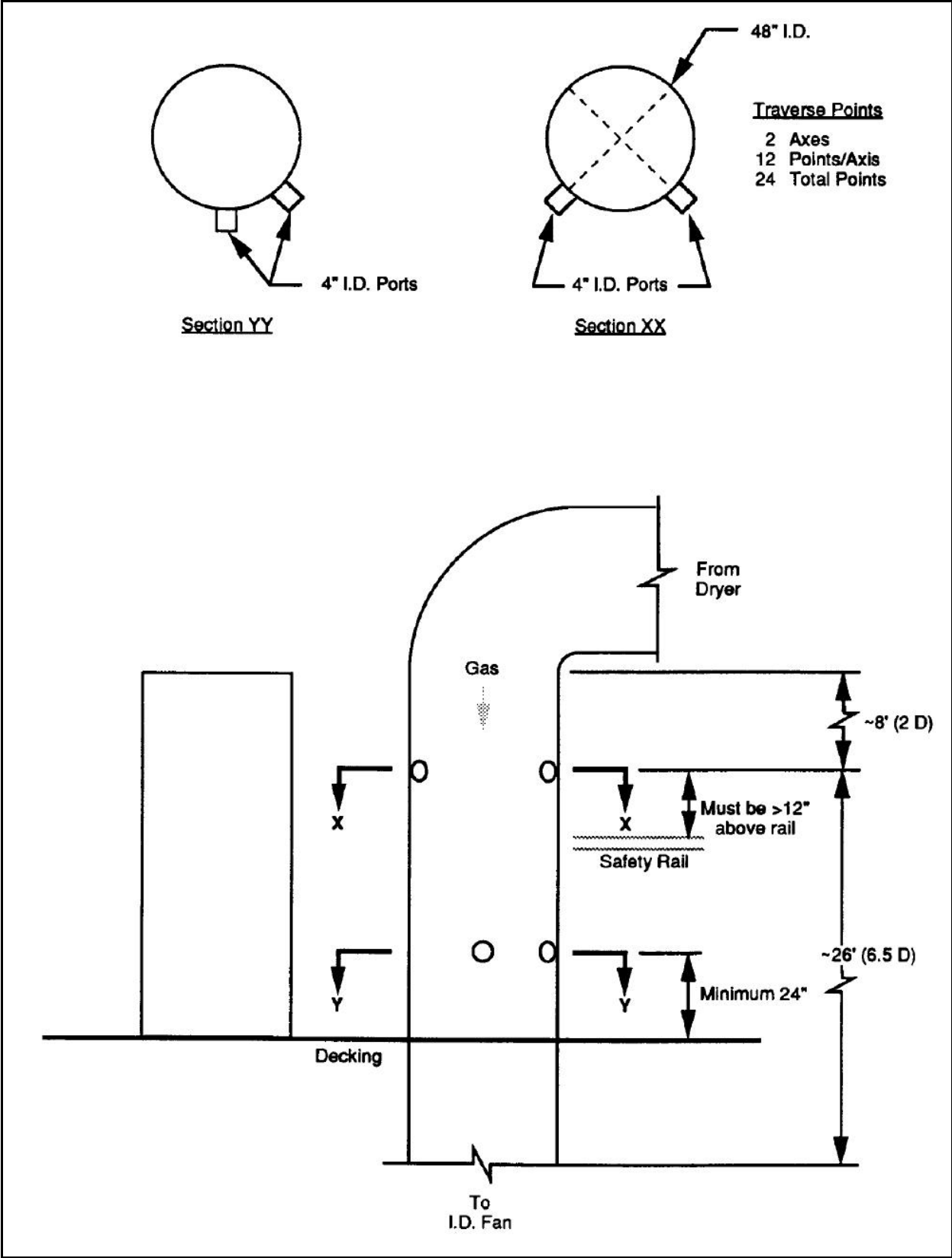


Figure 2-3. Schematic of Unit No. 1EFB inlet sampling location.

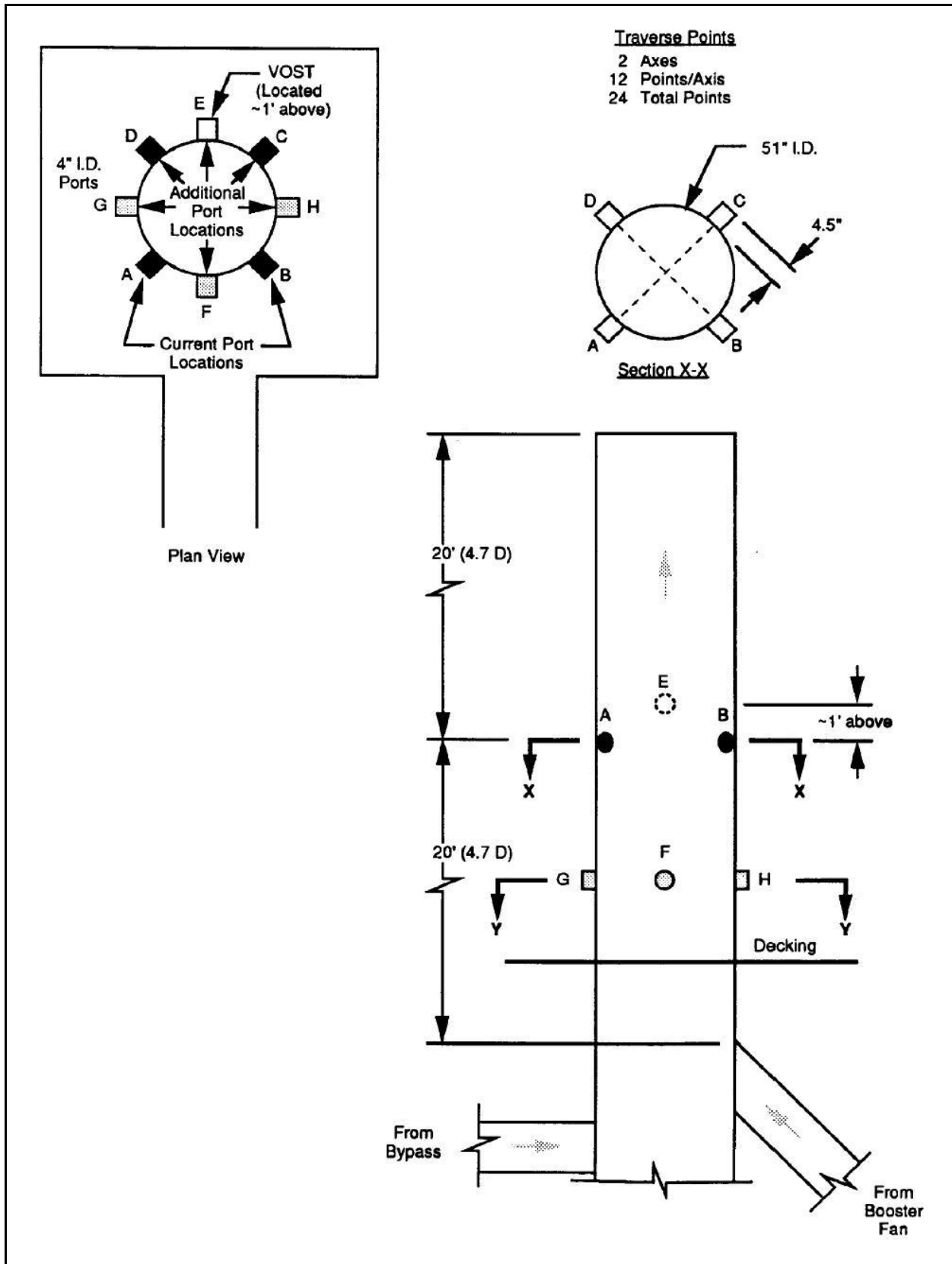


Figure 2-4 Schematic of Unit 1 EFB outlet stack sampling location.

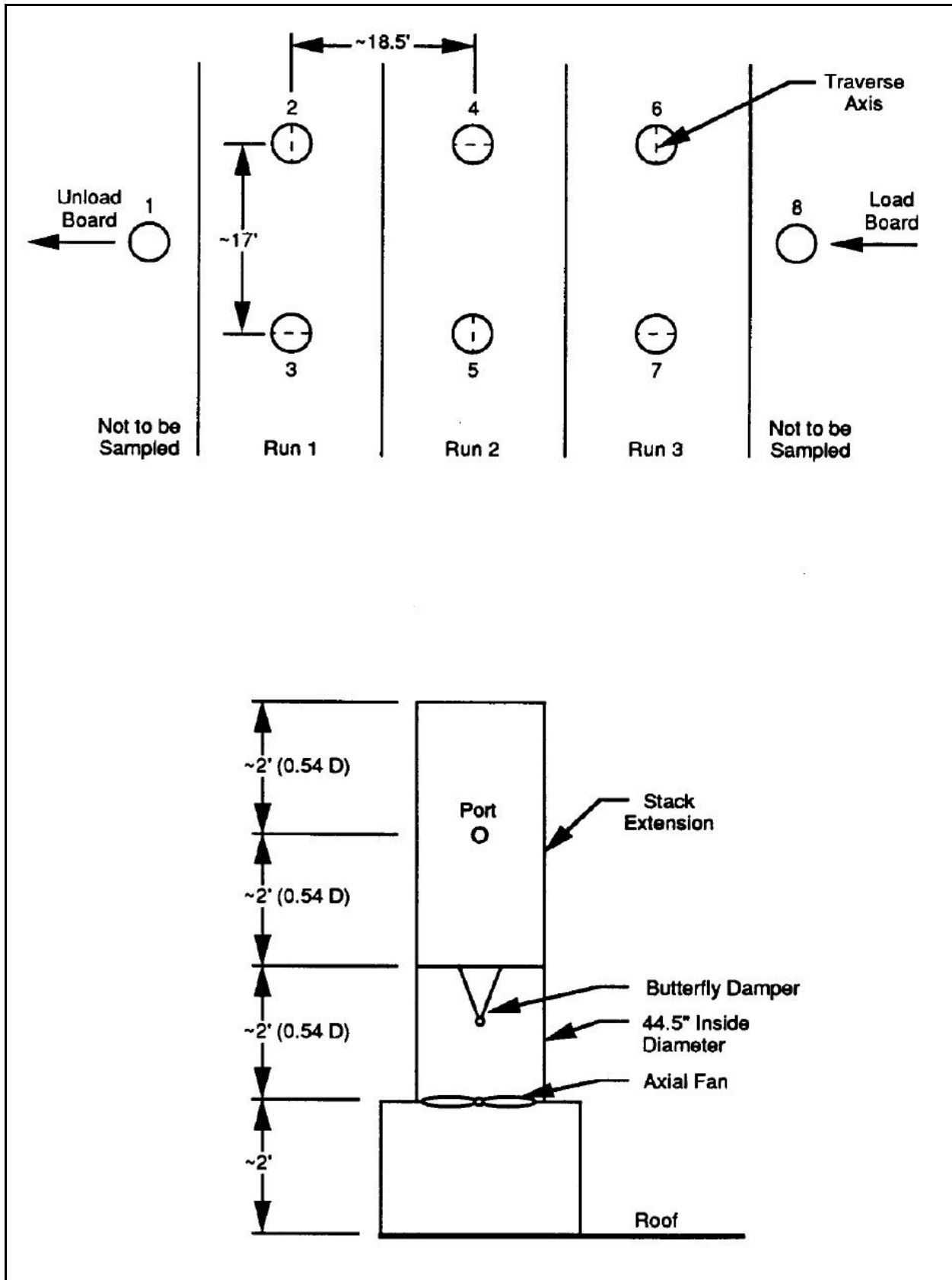


Figure 2-5 Press Vents sampling location configuration and testing scheme.

At this location, a 4-foot stack extension to improve flow conditions was constructed. The extension contained one 4-inch port. Each vent "stack" was traversed (12 points) in only one direction. The traverse of the second vent of a pair was in the direction perpendicular to the first vent traverse. Although the location did not meet Method 1 requirements, the results will not be affected since no particulate sampling was conducted at the press vents. The flow check for non-parallel flow before the test showed that the flow conditions were acceptable, i.e., the flow was not cyclonic.

2.4 PROCESS SAMPLING LOCATIONS

If process stream samples were taken, include the following:

- *Schematic of locations, if helpful*
- *Description of each sampling or measurement location*
- *Description of procedure used to obtain samples or measurements*
- *Discussion on the representativeness of each of the process stream sampling locations and samples*

EXAMPLE: *No process samples were required to be taken during the OSB test. Therefore, the example below is from a site-specific test plan for a drum mix asphalt plant. At this plant, a tank of waste fuel was used to supply the burners for the drum mixer. The plan required one grab sample per run of the waste fuel.*

2.4 WASTE FUEL SAMPLING LOCATION

The sample for each test run was taken from a tap at the outlet of the waste fuel supply tank to the burners. The sample at this point was expected to be homogeneous. However, to ensure representativeness of the sample for each run, equal volumes of sample were taken at the beginning, middle, and end of the run.

3.0 SUMMARY AND DISCUSSION OF TEST RESULTS

3.1 OBJECTIVES AND TEST MATRIX

In this section:

- *Restate the overall purpose of the test program.*
- *List the specific objectives.*
- *Include a test matrix table showing the following (include schematics, if helpful):*
 - *Run no. and date*
 - *Sample type/pollutant*
 - *Test method*
 - *Sampling locations*
 - *Clock time*
 - *Sampling time*

EXAMPLE:

3.1 OBJECTIVES AND TEST MATRIX

The purpose of the test program was to develop emission factors for OSB production facilities from the wood products industry.

The specific objectives were:

- Measure the emissions of PM, CPM, CO, NO_x, THC, formaldehyde, other aldehydes, and ketones, and volatile and semi-volatile organics at the wood wafer dryer EFB inlet and outlet locations.
- Measure formaldehyde, other aldehydes, and ketones emissions from the press vents.
- Determine the relationship between Method 25 and Method 25A for HC, and between Method 202 and the Oregon Department of Environmental Quality (ODEQ) Method 7 for particulates (PM and CPM).
- Assess the suitability of deriving a correction factor for Method 25A.
- Obtain production rates, inlet and outlet dryer temperatures, drying rates, belt speed, EFB bed voltage and current, and EFB voltage and ionizer current.

Table 3-1 presents the sampling and analytical matrix and sampling log.

TABLE 3-1. SAMPLING MATRIX

| RUN NO. DATE | SAMPLE TYPE | TEST METHOD | LOCATION/CLOCK TIME/SAMPLING TIME | | |
|---------------------------------|---------------------------------|----------------|--------------------------------------|---------------|---------------------------------|
| | | | EFB INLET | EFB OUTLET | PRESS VENTS |
| 1 7/30/98 | PM/CPM | M5/202 | 1130-1420 | 1130-1428 | 1123-1233 60 (Vents 2/3) |
| | O ₂ /CO ₂ | M3 | 60 | 60 | |
| | F/A/K | M0011 | 60 | 60 | |
| | SVOC | MM5 | | 60 | |
| | VOC | M0030 | | 60 | |
| | TGNMO | M25 | 60 | 60 | |
| | THC | M25A | 60 | 60 | |
| | NO _x | M7E | | 60 | |
| | CO | M10 | | 60 | |
| | 2 7/30/98 | F/A/K | M0011 | | |
| 2 7/31/98 | PM/CPM | M5/202 | 1215-1327 | 1215-1349 | |
| | O ₂ /CO ₂ | M3 | 40 | 45 | |
| | F/A/K | M0011 | 40 | 45 | |
| | SVOC | MM5 | | 45 | |
| | VOC | M0030 | | 45 | |
| | TGNMO | M25 | 40 | 45 | |
| | THC | M25A | 40 | 45 | |
| | NO _x | M7E | | 45 | |
| | CO | M10 | | 45 | |
| | 3 7/31/98 | PM/CPM | M5/202 | 1800-1933 | |
| O ₂ /CO ₂ | | M3 | 60 | 60 | |
| F/A/K | | M0011 | 60 | 60 | |
| SVOC | | MM5 | | 60 | |
| VOC | | M0030 | | 60 | |
| TGNMO | | M25 | 60 | 60 | |
| THC | | M25A | 60 | 60 | |
| NO _x | | M7E | | 60 | |
| CO | | M10 | | 60 | |

3.2 FIELD TEST CHANGES AND PROBLEMS

If no field test changes or problems occurred, this section may be omitted. In this section, include the following items:

- List and discussion of any changes in sampling and analytical methods for emissions or process information*

EXAMPLE:

3.2 FIELD TEST CHANGES AND PROBLEMS

3.2.1 Percent Isokinetics. Three of the 18 runs exceeded the percent isokinetic requirements of ± 10 percent as a result of incorrect data input. The magnitude of the exceedances all occurring at the EFB outlet were as follows:

- Run 1, MM5 train for SVOC: 83.3%
- Run 2, M0011 train for formaldehyde/aldehydes 112.1%
- Run 3, M0011 train for formaldehyde/aldehydes 112.1%

Since the sample analyses involved the gaseous (formaldehyde/aldehydes) components and semi-volatile components at the EFB outlet, these deviations are not expected to affect the results.

3.2.2 Shortened Sampling Time. Run No. 2 had a sampling time of 40-45 minutes rather than 60 minutes. The plant went down at 2:47 p.m. The EMB test coordinator determined this run to be adequate.

3.3 PRESENTATION OF RESULTS

In this section and subsequent sections (one section for each objective):

- *Address each of the specific objectives and present a summary of the results in tabular form*
- *Discuss the data*

EXAMPLE: *This example is for only one of the objectives. Subsequent sections should be similar in content.*

3.3 FLOW RATES FROM EFB AND PRESS VENTS

To determine mass emission rates and EFB collection efficiency, flow rate is an important component. In this test program, three separate trains provided simultaneous measurements of velocities, temperatures, and moisture contents. Table 3-2 summarizes the flow rate data. Method 3 data for O₂ and CO₂ are added to this table.

The following observations are made:

- The temperature measurements of the EFB inlet and outlet compare to within $\pm 2^{\circ}\text{F}$ of each other, except for Run I-1, which is within $\pm 4^{\circ}\text{F}$.
- The moisture contents of the EFB inlet and outlet compare to within ± 1 percent moisture of each other.
- The flow rate from M5/202, Run I-2 appears to be high, and all three runs from M5/202 outlet appear to be too low when compared to flow rates from the other trains. According to the O₂/CO₂ data, the flow rate at the outlet should be slightly higher than that of the inlet.

Based on the above observations, Runs I-2 and the measurements made at the stack (EFB outlet) for M5/202 were deleted from the averages. The average flow rates as shown in Table 3-2 were considered to provide the best data and, therefore, were used to calculate the mass emission rates.

TABLE 3-2. VOLUMETRIC FLOW RATE DATA

| RUN NO. | FLOW RATE, dscmh | | | | TEMPERATURE, °F | | | MOISTURE, %H ₂ O | | | ORSAT, % | |
|---------|------------------|--------|--------|---------------------|-----------------|-------|-----|-----------------------------|-------|------|----------------|-----------------|
| | M5/202 | M0011 | MM5 | Average | M5/202 | M0011 | MM5 | M5/202 | M0011 | MM5 | O ₂ | CO ₂ |
| I-1 | 54,586 | 54,334 | | 54,460 | 225 | 233 | | 23.4 | 24.4 | | 16.8 | 4.0 |
| I-2 | 60,806 | 53,131 | | 53,131 ^a | 225 | 228 | | 22.7 | 24.5 | | 16.5 | 4.4 |
| I-3 | 55,510 | 54,874 | | 55,192 | 224 | 226 | | 22.8 | 24.4 | | 17.0 | 3.8 |
| Avg | 56,967 | 54,113 | | | 225 | 229 | | 23.0 | 24.4 | | 16.8 | 4.1 |
| S-1 | 51,054 | 54,871 | 55,342 | 55,106 ^b | 227 | 226 | 227 | 23.3 | 22.5 | 23.8 | 17.6 | 3.2 |
| S-2 | 52,489 | 55,803 | 55,153 | 56,433 ^b | 222 | 223 | 226 | 23.3 | 23.4 | 24.0 | 17.1 | 3.8 |
| S-3 | 52,398 | 55,165 | 57,063 | 56,114 ^b | 227 | 225 | 227 | 23.4 | 22.9 | 24.0 | 16.8 | 4.0 |
| Avg | 51,980 | 55,280 | 55,853 | | 225 | 225 | 227 | 23.3 | 22.9 | 23.9 | 17.2 | 3.7 |
| V-1 | | 32,163 | | 32,163 | | 111 | | | 2.2 | | | |
| V-2 | | 31,324 | | 31,324 | | 130 | | | 3.6 | | | |
| V-3 | | 39,087 | | 39,087 | | 133 | | | 3.3 | | | |
| Avg | | 34,191 | | | | 125 | | | 3.0 | | | |

^a Does not include M5/202

^b Does not include M5/202 runs

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 TEST METHODS

In this section, include the following:

- *Schematic of each sampling train*
- *Flow diagram of the sample recovery*
- *Flow diagram of sample analysis*
- *Description of any modifications*
- *Discussion of any problematic sampling or analytical conditions*

If a non-EPA method was used in place of an EPA method, explain the reason. Place a copy of all methods in Appendix A to the report. Be sure that non-EPA methods are written in detail similar to that of the EPA methods.

EXAMPLE: *This example is for just one of the test methods. The test report should include similar schematics and flow diagrams for each of the test methods.*

4.1 TEST METHODS

4.1.1 Particulate Matter/Condensable Particulate Matter. PM/CPM at the inlet and outlet of the EFB were determined by Method 202. One of the objectives of this test was to compare Method 202 with ODEQ Method 7, which is identical to Method 202 except for the following:

- A second filter is placed just before the silica gel impinger.
- Acetone rather than methylene chloride is used in the final rinse of the impingers and connecting glassware.
- An optional out-of-stack filter is used before the impingers.

Because of space limitations, Method 202 was modified by inserting a second filter in the same position as that in the ODEQ Method 7. This back-up filter was analyzed gravimetrically according to the ODEQ procedure. All other procedures were those of Method 202. Figures 4-1 and 4-2 are schematics of Method 202 (showing modification) and ODEQ Method 7, respectively.

Figures 4-3 and 4-4 illustrate the sample recovery procedure and analysis schemes, respectively.

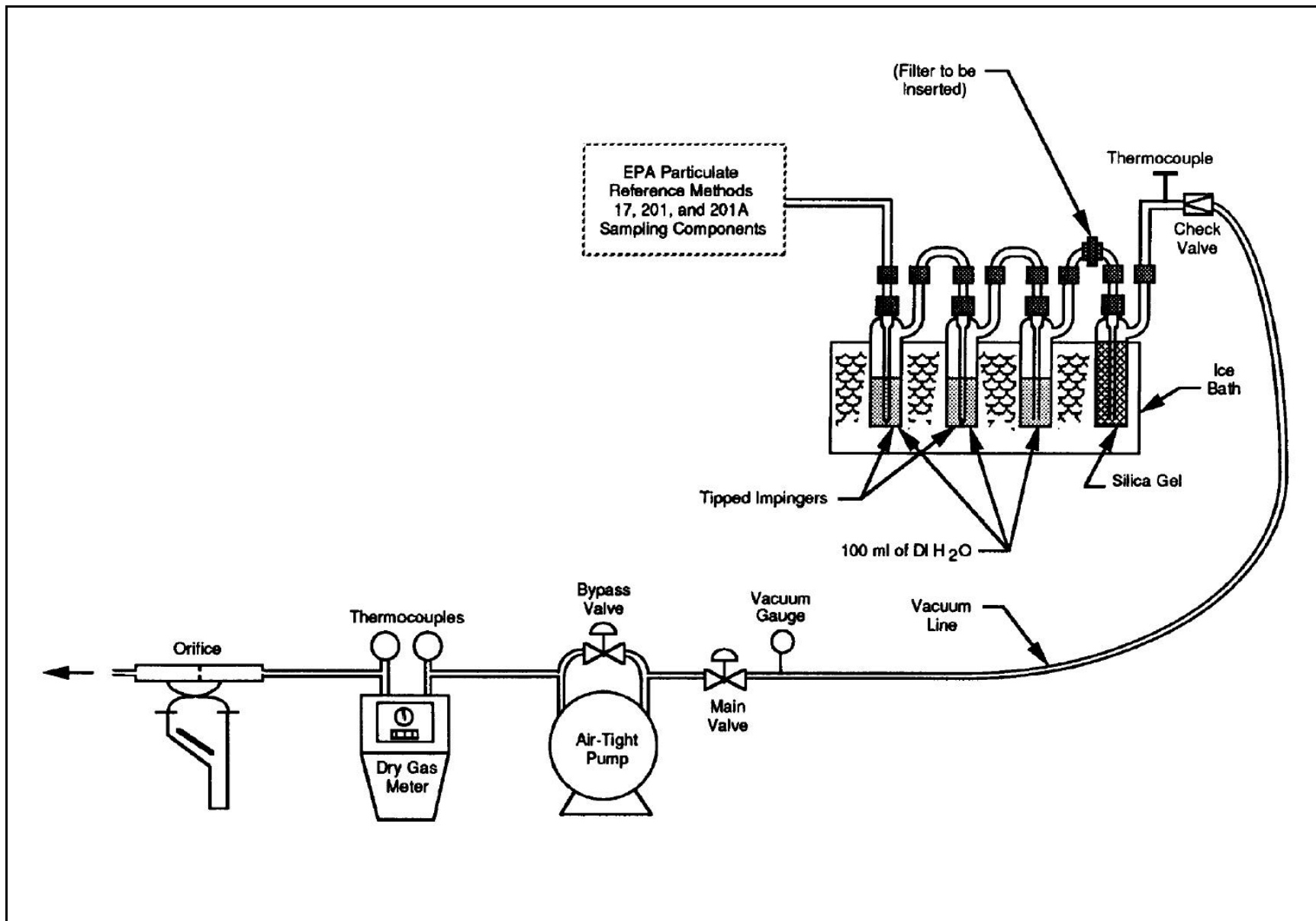


Figure 4-1. EPA Method 202 (modified with back filter) condensable particulate sampling train.

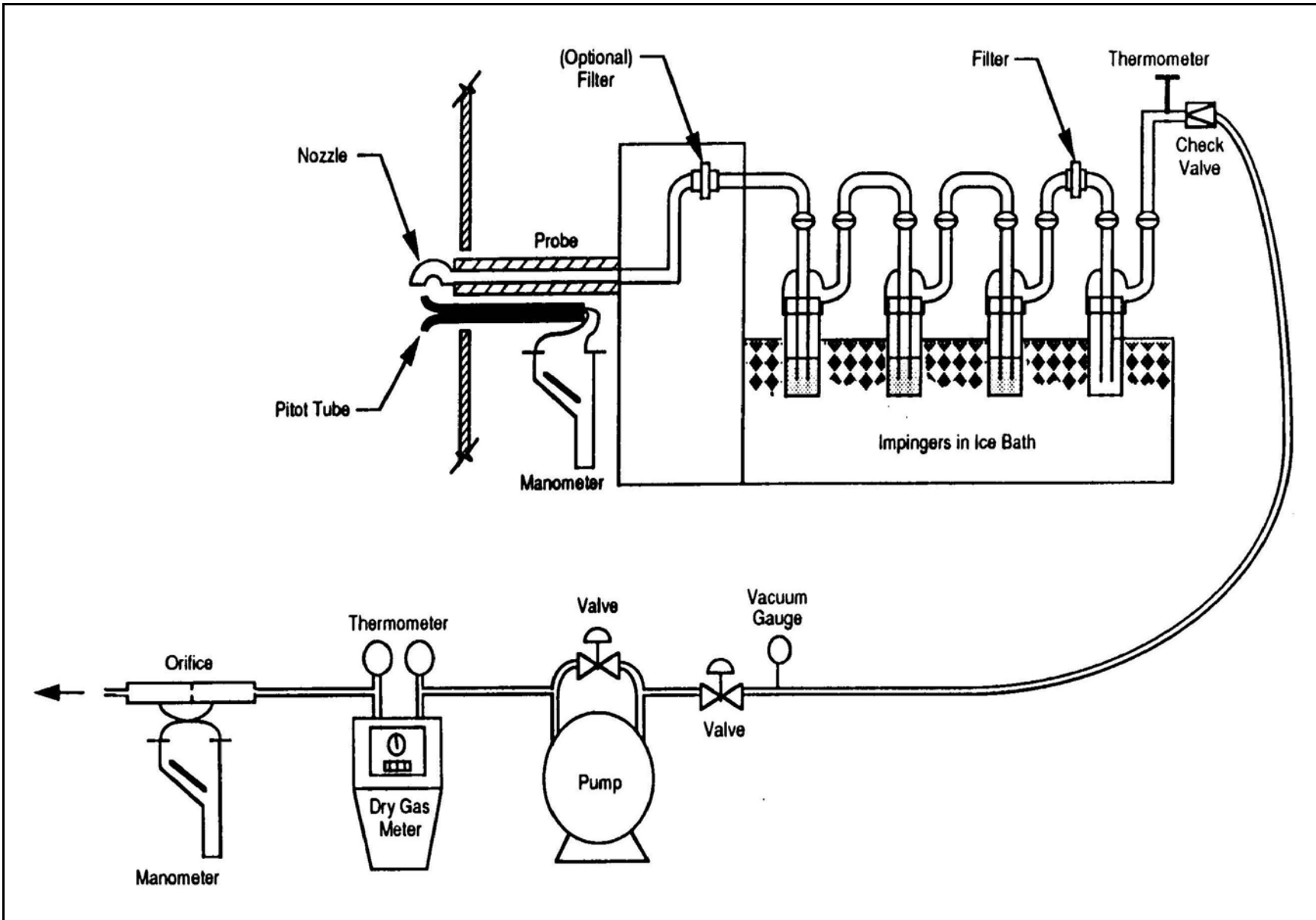


Figure 4-2. Oregon DEQ Method 7 sampling train.

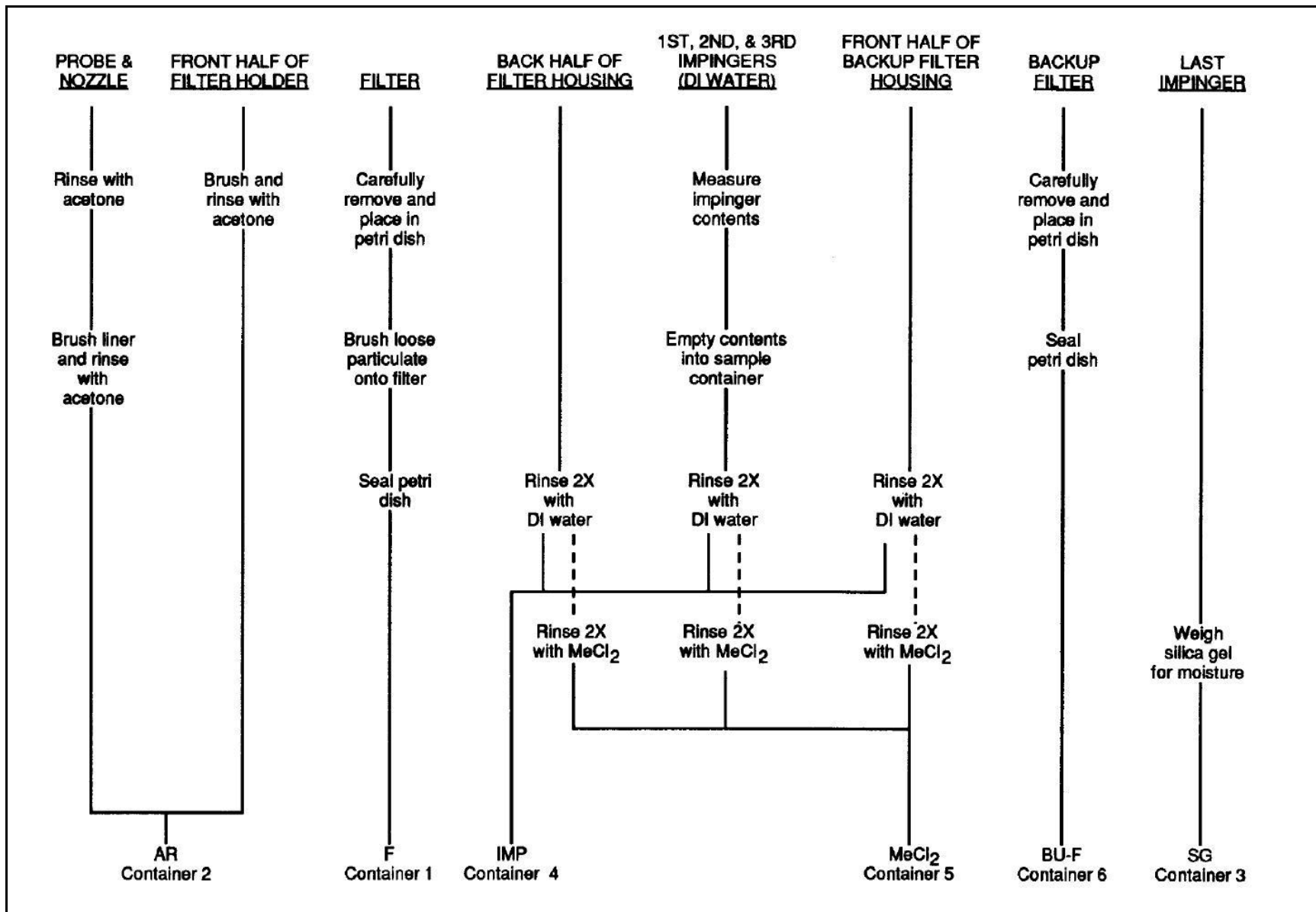


Figure 4-3. Sample recovery scheme for particulate/condensables samples.

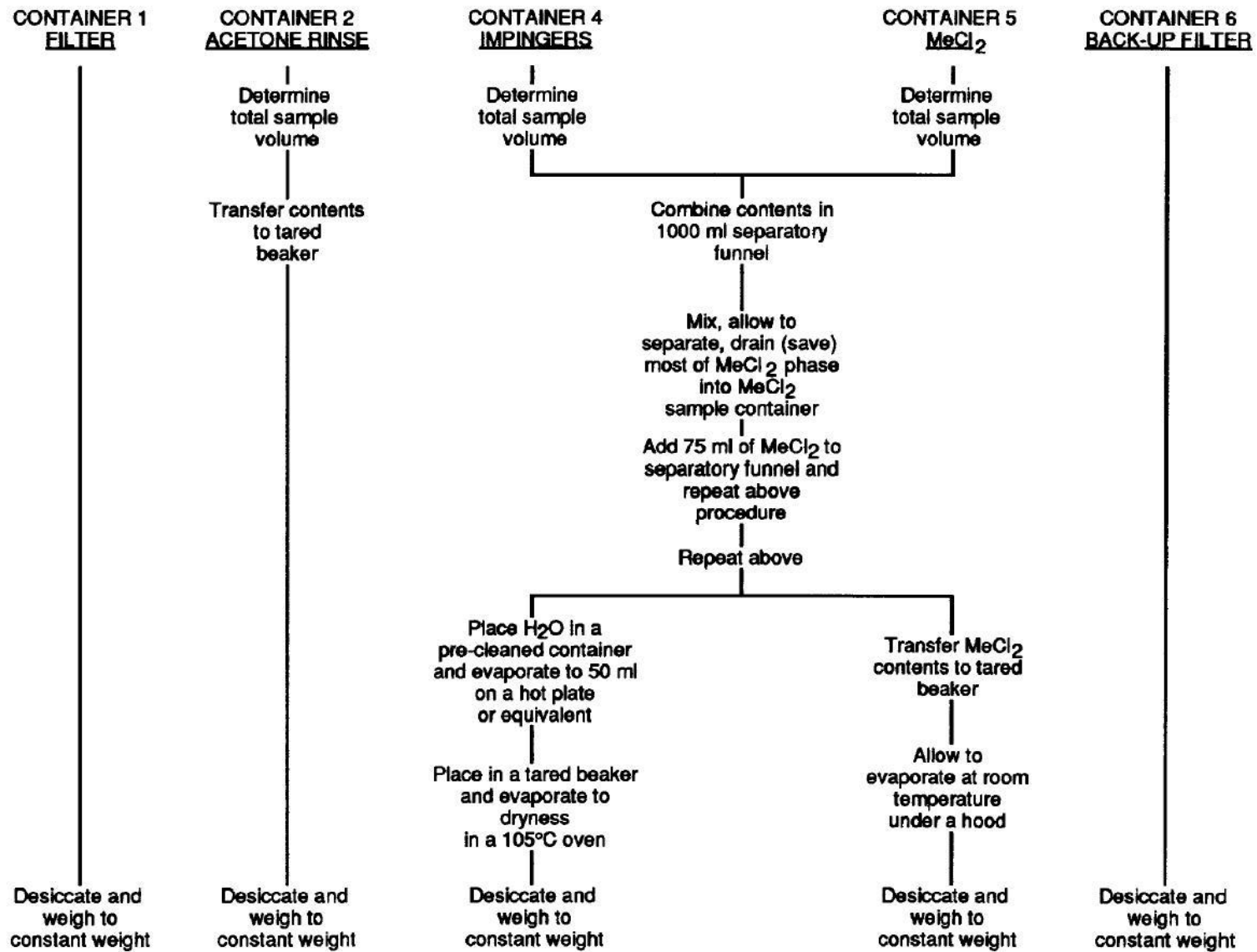


Figure 4-4. Analytical scheme for particulate/condensables samples.

4.2 PROCESS TEST METHODS

In this section, include the following:

- *Description of procedures used to obtain process stream and control equipment data*
- *Calibration procedures for any test equipment, if appropriate*

EXAMPLE:

4.2 PROCEDURES FOR OBTAINING PROCESS DATA

The [**Process Monitor**] counted the number of press loads for each test period, and obtained the dryer data from the central control panel, amount of wafer flakes dried from digital meters calibrated to measure the amount of flakes leaving the dryer, and the EFB data from the EFB control panel.

5.0 INTERNAL QA/QC ACTIVITIES

5.1 QA/QC PROBLEMS

In this section, discuss:

- *QA/QC problems that occurred during the test*
- *Sample identification and custody problems*

EXAMPLE:

5.1 QA/QC PROBLEMS

One field spike was performed at the EFB outlet location as a check of field handling and recovery procedures. The field spike consisted of introducing 200 µl (0.80 mg) of the Field Spike Standard into an impinger containing 200 ml of the DNPH solution and following normal recovery procedures.

Only 0.094 mg out of 0.802 mg was recovered. A check of the DNPH solution revealed that the cause of the poor recovery was due to the deterioration of the solution.

5.2 QA AUDITS

For each of the test methods for which an audit was conducted, list (if applicable) the following:

- *Type of audit conducted*
- *Limits of acceptability*
- *Supplier of audit material*
- *Audit procedure*
- *Summary of results*

EXAMPLE: *An example for Method 5 dry gas meter audit is provided below.*

5.2 METERING SYSTEM AUDIT

An on-site audit of the meterbox calibrations was conducted using calibrated critical orifices supplied by EPA. The procedure that accompanied the orifices were used. The results of this audit are presented in Table 5-1. All audit values were within the acceptable range of 5%.

Table 5-1. Meter Box Calibration Audit

| Meter Box Number | Pre-Audit Value | Allowable Error | Calculated Y. | Acceptable | | |
|------------------|-----------------|------------------|---------------|------------|--|--|
| EN-1 | 0.9247 | 0.8877 <Y<0.9617 | 0.9498 | Yes | | |
| EN-2 | 0.9968 | 0.9569<Y<1.0367 | 1.0164 | Yes | | |
| NU-7 | 0.9900 | 0.9504<Y<1.0296 | 0.9712 | Yes | | |
| RAC-1 | 1.0437 | 1.0020<Y<1.0854 | 1.0601 | Yes | | |
| RAC-2 | 1.0183 | 0.9776<Y<1.0590 | 1.0386 | Yes | | |
| RAC-3 | 1.1330 | 1.0877<Y<1.1783 | 1.1393 | Yes | | |
| RAC-5 | 1.0450 | 1.0032<Y<1.0868 | 1.0367 | Yes | | |