PLANT INSPECTION WORKSHOP - TECHNIQUES FOR EVALUATING PERFORMANCE OF AIR POLLUTION CONTROL EQUIPMENT

Observing Compliance
Tests

February 1981

U.S. ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

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Observing Compliance Tests

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FOREWORD

The agency field inspector is often involved in observing the conduct of source tests performed by the company or private testing firms for the purposes of demonstrating compliance with the applicable emission standards. The primary function of the agency observer at the test site is to see that the test is performed properly and that the process is operated in a representative manner to assure the results will be a valid assessment of the actual emission rate.

Although planning, coordination and evaluation of a complex compliance test requires highly specialized skills and support from several technical groups within the agency, the field inspector, because of his familiarity with the plant facility, can be especially effective in monitoring the operation of the process and control equipment during the test. Documentation of the process operation is of major importance in determining the acceptability of the test results. The plant operator should be encouraged to utilize good operating practices during the test, however, it is not permissible to resort to specialized operating routines which abnormally reduce emissions.

There are other valid reasons for the field inspector to witness the compliance test. For example, process and control equipment operating conditions and parameters recorded during the initial compliance test can be used to establish baseline data for verifying and comparing conditions observed in future inspections. Any significant deviations from these baseline conditions noted later may indicate possible deterioration of equipment performance with a corresponding increase in emissions. For the same reason it is also very useful to record stack or plume opacity levels measured or observed during the test. Confirmation of low opacities during test periods when the facility has been shown to be in compliance with the emission standards provides a reliable reference point for comparison of later opacity readings. Even though the facility may not be exceeding the legal opacity limit, any detectable increase in opacity levels over a period of time may indicate excessive emissions and signify the need for a followup plant inspection and/or retesting.

A collection of papers, and other information describing the role and function of the agency observer and procedures for documenting compliance test conditions are included in this reference manual. While the material does not attempt to address all of the administrative and technical aspects of planning, conducting and evaluating a source test, practical information is provided on techniques to be used by the field inspector in observing compliance tests as well as extensive checklists for recording data.

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THE ROLE OF THE AGENCY OBSERVER*

Introduction

Air pollution control agency personnel who may not be directly involved in the compliance sourse sampling process are often called upon to evaluate source tests performed by environmental consultants or companies. Since emission testing requires industry at their own expense to contact highly skilled source test teams, the source test observer should be well prepared to insure that proper procedures are followed and that representative data is obtained.

The main purpose for the Agency's observation of the compliance test is to determine that the test data is representative. There are other valid reasons to observe the test such as establishing baseline conditions for future inspections, but the major emphasis is in the evaluation of the acceptability of the initial compliance test.

The seven steps an agency generally uses for establishing the compliance of a source with the Agency's regulatory requiremetns are as follows:

1. Familiarization - The agency establishes contact with the source and becomes familiar with operations, emissions and applicable regulations.
2. Schedule source test - This may be part of a compliance schedule or Federal Standard of Performance for Stationary Source Enforcement (NSPS).
3. Establish methodology - Testing requirements should be established and a testing plan developed by the agency

*Adapted by Jim Jahnke from: Supplemental Training for Technical Workshop on Evaluating Performance Tests" DSSE, EPA by W. G. DeWees. PEDCo - Environmental Specialists Inc.

4. Final Plan and test procedure development - A presurvey should be conducted by a member of the testing team. A pretest meeting between the agency, source representative and test team representative should be held to develop the final test plan.
5. Actual compliance tests - observation of the facility operations and testing methodology by the observers.
6. Review of test data - determination of compliance and official notification.
7. Continuing enforcement of compliance - follow-up inspections using data generated from source tests as baseline for comparison purposes.

In order for data to be representative, there are five areas where problems might develop in obtaining a sample representative of the source emissions. If a question arises as to the integrity of any one of these areas, the compliance test may be considered non-representative. These five areas are:

1. The process and control equipment must be operated in such a manner as to produce representative atmospheric emissions.

2. The sample port and point locations must be representative of the atmospheric emissions.

3. The sample collected in the sample train must be representative of the sample points

4. The sample recovered and analyzed must be representative of the sample collected in the sample train.

5. The reported sample results must be representative of the recovered and analyzed sample.

The source test to be monitored by the observer, then, is developed and conducted by the source test team and observer in four major phases. These phases are (1) preparation and planning, (2) conducting the test, (3) recovery, transportating and analysis of sample (4) submitting report. These phases are discussed below:

Preparation and Planning - In the initial phase of preparation and planning, the agency must clarify for the source test team leader and process representative all procedures and methods to be used during the entire testing program.

The review of the compliance test protocol submitted by the plant management or test consultant will explain the intended sampling plan to the observer. Two of the more important items to be checked are any deviations from standard sampling procedures and the proposed operation of the facility during the compliance test.

Many types of process, sampling locations and pollutants may require some modification to the standard sampling procedure. The agency must determine if the modification will give equivalent and/or greater measurement results than would be obtained with the standard method.

The other major determination to be made from the test protocol is defining what constitutes normal operation of the facility. Example checklists for power plants and electrostatic precipitators are presented here:

The plant representative should understand and agree to all facility baseline conditions prior to the compliance testing, since the determination of representative operation of the facility is for the protection of both the Agency and the plant. The plant representative may suggest additonal factors which should be considered as an upset condition and which would not produce representative emissions.

The observer must be familiar with the process to be sampled. Whenever possible, the Agency field inspector should be the "observer" for the process and control equipment. If the process is large or complicated, the observer may be aided by a process control engineer from the Agency. An emission test run at the wrong process rating or without sufficient process data will not constitute a valid test. Familiarity with the specific process can be acquired through one or more of the many inspection manuals prepared by the Environmental Protection Agency for this purpose. These manuals will indicate the methods and devices employed in monitoring process rates and/or weights.

<u>The Source Test</u> - Some compliance tests may be routine enough that a pre-test meeting on the morning before sampling begins will be sufficient to provide a complete understanding between all parties involved.

The review of the team leader's test protocol should have initiated the formulation of the observer's sampling audit plan. The observer's audit plan should contain the tentative testing schedule, facility baseline conditions preparation or modification of observer's checklist, and details for handling irregular situations that could occur during emission testing.

The sample testing schedule should allow the observer to plan his duties in a logical order and should increase his efficiency in obtaining all of the required data.

The observer's teating forms normally should need little modification. Any accepted modification to the normal sampling procedure should be covered by additional checks from the observer.

The observer should be prepared to handle any non-routine situations which could arise during sampling procedures. A list of potential problems and their solutions should be made prior to the actual testing. The list should also include the unacceptable limits for when the minimum sampling requirements and process rating are not met. For instance, if the sampling box is unable to maintain the filter at minimum temperature or if a power plant was unable to maintain full load conditions because of poor coal. The observer should also know who in his organization is authorized to make decisions which are beyond his capability or authority.

The number of Agency personnel observing the performance test must be adequate to ensure that the facility operation (process and control equipment) is monitored and recorded in such a manner as to provide a basis for the present and future evaluations. The observing team should be able to obtain visible emission readings and transmissometer data for comparison with measured emission rates and should be able to ensure that the prescribed Agency testing methodology was followed.

The plant representative should be available during testing to answer any questions which could arise about the process or to make needed process changes. It should be understood that, if any problems arise, all three parties would be consulted. Since the observer may approve or disapprove the test, his intentions should be stated at the pretest meeting. An ideal emission test would be one where representative data was gathered and where no clarification of sampling procedure was required from the source test leader.

Before actually proceeding with the test, the observor should check the calibration forms for the specific equipment to be used. These as a minimum should include calibration of the following:

1) Pitot tube
2) Nomograph (if used)
3) Dry Gas Meter
4) Orifice Meter

If there is any question as to whether proper calibration procedures were followed, the problem should be resolved before initiating the test.

During the test, the outward behavior of the observer is of utmost importance. He should perform his duties quietly, and thoroughly, and with as little interference and conversation with the source test team as possible. He should deal solely with the test supervisor and plant representative or have a clear understanding with them should it become necessary to communicate with the source test technicians or plant operators. Conversely, he should exercise caution in answering queries from the source test team technicians and plant operators directly and refer such inquiries to their supervisor. He should, however, insure that sampling guidelines are adhered to and inform the test team if errors are being made.

Several checks must be made by the observer to ensure adherance to the proper sampling procedures. To eliminate the possibility of overlooking a necessary check, an observer's checklist should be used for the sampling procedures and facility operation. An example of one of these checklists is included below.

To understand the relative importance of the measurement of parameters of emisssion testing, the observer should know the significance of errors. A discussion of errors is given in the second part of this chapter.

Generally, it is best to have two agency observers at the source test. If only one observer is present, however, the schedule given below should be followed.

For the first Method 5 run, the observer should go to the sampling site, after the facility is operating in the correct manner, to observe the sample train configuration and the recording of the initial data. The observer should oversee both the initial leak check and the final leak check. When the observer is satisfied with the sample train preparation, the test should be started. The observer should then observe the sampling at the first port and the change over to the second port. If he is satisfied with the tester's performance, then he should go to a suitable point from the stack and read visible emissions for a six minute period.

The facility operations should then be checked. This includes data from fuel flow meters, operating monitors, fuel composition, F factors, etc. Data from continuous emissions monitoring equipment such as opacity monitors and SO_2 analyzers should also be checked. This data will be useful in evaluating the method 5 data. If the process and control equipment have operated satisfactorily and the data recorded as specified, the observer should make another visible emission reading over a six minute period. The observer should then return to the sample site to observe the completion of the test. The final readings and the leak check after the completion of the test are two of the more improtant items to be checked. The transport of the sample train to the cleanup area and the sample recovery should then be observed.

If the observer is satisfied with all sampling procedures observed during the first run, then the time of the second run will be spent observing the process monitors with the exception of checking the sampling team at the end of the sampling period. During the second run, two six minute visible emission readings should be made with a check of the facility operations between readings. The observer should be satisfied that the facility data recorded are truly representative of the facility operations.

A visual observation of the particulate buildup on the filter and in the acetone rinse from the first two tests should be correlated to the visible emission readings or transmissometer data. This comparison of particulate collected will only be valid if the sample volumes were approximately the same. If the particulate catch on the fiter and in the acetone rinse for the second test was consistent or greater than the visible opacity correlated to the first run then the observer might spend more time overseeing the facility operations. If the second run when correlated to the opacity is less than the first test, more time might be placed on observing the emission test procedures for the third run.

Irregardless on the main emphasis of the third run, the observer should still perform certain observations. The observer should again check all facility operations prior to testing. Two six minute visible emission readings should be made with a check of the facility operation in between. The sample recovery of all tests should be witnessed and the apparent particulate catch compared to the opacity readings. The additional time can be spent by the observer checking the suspected weak points or problem areas.

Sample Recovery and Analysis - The observer should be present during sample recovery. It is imperative that the sample recovery and analysis be done under standard procedures and that each step be well documented. The report may ultimately be subject to the requirements of the Rules of Evidence. Therefore, the observer should have a sample recovery checklist to ensure all tasks have been performed properly.

To reduce the possibility of invalidating the results, all of the sample must be carefully removed from the sampling train and placed in sealed, nonreactive, numbered containers. It is recommended that the sample should then be delivered to the laboratory for analysis on the same day that the sample is taken. If this is impractical, all the samples should be placed in a carrying case (preferably locked) in which they are protected from breakage, contamination, loss, or deterioration.

The samples should be properly marked to assure positive identification throughout the test and analysis procedures. The Rules of Evidence require impeccable identification of samples, analysis of which may be the basis of future evidence. An admission by a lab analyst that he could not be positive whether he analyzed sample No. 6 or sample No. 9, for example, could destroy the validity of an entire report.

Positive identification also must be provided for the filters used in any specific test. All identifying marks should be made before taring. Three or more digits should suffice to ensure the uniqueness of a filter for many years. The ink used for marking must be indelible and unaffected by the gases and temperatures to which it will be subjected.

If any other method of identification is desired, it should be kept in mind that the means of identification must be positive and must not impair the function of the filter.

Finally, each container should have a unique identification to preclude the possibility of interchange. The number of a container should be recorded on the analysis data sheet associated with the sample throughout the test and analysis.

Samples should be handled only by persons associated in some way with the task of analysis. A good general rule to follow is "the fewer hands the better", even though a properly sealed sample may pass through a number of hands without affecting its integrity.

It is generally impractical for the analyst to perform the field test. The Rules of Evidence, however, require that a party be able to prove the chain of custody of the sample. For this reason, each person must have documented from whom he received the sample and to whom he delivered it. This requirement is best satisfied by having each recipient sign a standard chain of custody sheet that was initiated during the sample recovery.

To preclude any omissions of proper procedures after the sample recovery, the observer should have a sample transport and analytical checklist.

Potential sources of error in the analysis lie in the contamination of the sample, analyzing equipment, procedures, and documentation of results. Since the analysis is often performed at a lab, distant from the plant site, the observer is often not present at the sample analysis. If there is any question in the observer's mind about the analyst's ability to adhere to good analytical practices in analyzing and in reporting data, the observer has two recourses. The observer may be present during analysis or he may require the analysis to be done by a certified laboratory if one is available. However, this is an unnecessary burden and should not be done as a general rule.

During the analysis, any remaining portions of the sample should remain intact and placed in a safe place until the acceptance of the final report. Laboratory equipment, especially the analytical balance, should have been calibrated immediately before the sample weighing. The laboratory data and calculations must be well documented and kept in such a manner that the Agency can inspect the recording of any analysis upon request.

As noted in the lectures of this course, the observor should be aware of analytical tricks that can be used to bring a marginal test to within $\pm$ 10% of 100% isokinetic. Care should be taken that the value for the nozzle diameter or Cp does not change. Also, the weight of the impinger catch and silica gel for the determination of B_{ws} should not be changed to accomodate a % isokinetic value. It has been suggested that to ensure an unbiased test, the observer could supply the source tester with his own pre-weighed filter and pre-weighed amount of silica gel. This may be extreme, but may be necessary in special cases.

The Final Report - Upon completion of the compliance field test work, the observer can begin the final task of determining the adequacy of the compliance test data. The observer will be required to write an observer's report for attachment with the source tester's report. The facility operation, data and the field checklists should provide the observer with sufficient information to determine the representativeness of the process and control equipment operation and the sample collection. All minimum conditions should have been met. If the observer suspects a bias in the results this bias should be noted. A resulting bias that can only produce emission results higher than the true emissions would not invalidate the results if the plant was determined to be in compliance. Therefore, any bias that may occur should be listed along with the suspected direction of the bias.

The test team supervisor is responsible for the compilation of the test report and is usually under the supervision of a senior engineer who reviews the report for content and technical accuracy. Uniformity of data reporting will enable the agency to review the reports in less time and with greater efficiency. For this reason, a report format should be given to the test team supervisor along with the other Agency guidelines.

The first review of the test report should be made by the observer. The observer should check all calculations and written material for validity. One of the greatest problems in compliance testing is in the calculation errors made in the final report. Several agencies have gone to the extreme of having the observor recalculate the results from the raw data in order to more easily find any error. Errors should be noted along with comments by the observer. Although the conclusions in the observer's report are not the final authority, they should carry the greatest amount of weight in the final decision concerning the representativeness of the test.

Due to the importance of the observer's report and the likelihood that it will be used as evidence in court, the observer should use a standard report format that will cover all areas of representativeness in a logical manner. An example of an observer's report format is presented here:

In addition to the determination of representative data for the compliance test, the observer should report all conditions under which the facility must operate in the future to maintain their conditional compliance status. These conditions will be reported to the facility as conditions of their acceptance.

These reports and the conditions of the compliance acceptance will provide any Agency inspector sufficient data to conduct all future facility inspection trips.

APPENDIX B

EQUIPMENT NEEDED BY OBSERVER

1. Tape Measure
2. Dial type caliper micrometer (accurate to 0.001")
3. Nomograph
4. Calibrated thermometer or thermocouple
5. Rubber tubing (to connect to Pitot tube for leak check)
6. Rubber tubing and stopper (to leak check metering system)
7. Rubber tubing clamps (to clamp off H line for meter system leak check)
8. Stopwatch
9. Personal Protective Equipment
   a. Hardhat
   b. Safety Shoes
   c. Safety glasses
   d. Respiratory Protection
10. Calculator
11. Tools
    a. Phillips head screwdriver
    b. Flat-head screwdriver
    c. Pliers
    d. Wrench
12. Literature
    a. USAEHA Guidelines for Observing and Evaluating Source Tests
    b. Applicable Emission Standards
    c. Applicable Sampling Procedures

d. Contractor's Test Protocol

e. Equipment Specifications

f. Nomographs (Entropy Env.)

APPENDIX C

CHECKLIST FOR OPERATION OF PROCESS AND CONTROL EQUIPMENT

Location ____________

Date ____________

Observer's Name ____________

Run No. ____________

A. Boilers, Steam Plants, Indirect Heat Exchangers.

1. Equipment.

a. Designation of facility (Bldg No., Boiler No.) ________

b. Designation of unit tested ________

c. Rated capacity ________

d. Capacity being tested ________

e. Type of stoker ________

f. Type combustion control ________

g. Type of soot blowing (continuous, period) ________

h. Unit operating controls (steam gauge, O_2 CO_2) ________

i. Date of last calibration of operating controls ________

j. Type of air pollution control equipment ________

2. Fuel.

a. Type of fuel ________

b. Method of measuring fuel input ________

c. Amount of fuel used during test ________

d. Method of obtaining a fuel sample ________

e. Date last calibration of fuel gauges ________

f. Heat value of fuel (BTU/lb) ________

g. Ash content of fuel (%) __________

h. Sulfur content of fuel (%) __________

3. Operation

a. Rate fuel burned __________

b. Heat input to boiler __________

c. Steam produced (obtain copy of steam charts) __________

d. Combustion recorders (obtain copies where applicable) __________

(1) O_2 (%) __________

(2) CO_2 (%) __________

(3) Opacity (%) __________

(4) Other __________

e. Soot blowing (time and duration) __________

f. Method used to determine heat input to boilers (F-factor, steam flow, meter fuel input) __________

4. Checklist	Yes	No	Not Required
a. Was the operating rate in conformance with that specified by the regulatory agency?	______	______	______
b. Were the operating conditions representative of the normal operating conditions?	______	______	______
c. Were fuel samples taken correctly?	______	______	______
d. Were there any malfunctions, load fluctuations or other conditions that would increase emissions?	______	______	______
e. Were opacity readings satisfactory during the test?	______	______	______
f. Have metering devices, i.e., fuel input, steam flow been calibrated recently?	______	______	______

	Yes	No	Not Required
g. Was soot blowing conducted during the test?	____	____	____
h. Was the soot blowing during the sampling conducted in accordance with the regulatory agency's requirements?	____	____	____

5. Comments, unusual operating conditions, and special observations.

Location ____________

Date ____________

Observer's Name ____________

Run No. ____________

B. Incinerators

1. Equipment.

a. Type of incinerator ____________

b. Capicity ____________

c. Auxiliary fuel type ____________

d. Control meters ____________

e. Type of air pollution control equipment ____________

f. Charging method (manual of automatic) ____________

2. Operation.

a. Charging rate during testing ____________

b. Type of waste changed ____________

c. Temperature in primary chamber (range, avg) ____________

d. Temperature in secondary chamber (range, avg.) ____________

e. Amount of time primary burner on during test ____________

f. Amount of time secondary burner on during test ____________

g. Amount of auxiliary fuel metered ____________

3. Checklist	Yes	No	Not Required
a. Was the operation of the incinerator representative of normal operation?	______	______	______
b. Was the waste charged representative of the waste normally changed?	______	______	______

	Yes	No	Not Required
c. Was the incinerator changed at the rate required by the regulatory agency?	_____	_____	_____
d. Was the auxiliary fuel metered or the burners timed to determine the contrubution of CO_2 from the auxiliary fuel?	_____	_____	_____
e. Were opacity readings satisfactory during the test?	_____	_____	_____

4. Comments, unusual operating conditions, and special observations.

Location ____________

Date ____________

Observer's Name ____________

Run No. ____________

C. Process Equipment

1. Equipment.

a. Type of process ____________

b. Raw materials ____________

c. Product ____________

d. Capacity of unit ____________

e. Air pollution control equipment ____________

2. Operation.

a. Production rate during test ____________

b. Raw material input during test ____________

3. Checklist	Yes	No	Not Required
a. Was the unit operated in a representative manner?	_____	_____	_____
b. Was the rate of operation in conformance with the regulatory agency's requirements?	_____	_____	_____
c. Was opacity readings satisfactory during the test?	_____	_____	_____
d. Were there any upset conditions during the test that may invalidate the results?	_____	_____	_____

4. Comments, unusual operating conditions, and special observations (e.g. cyclical operation, batch process, continuous process).

Location ______________

Date ______________

Observer's Name ______________

Run No. ______________

D. Electrostatic Precipitators

1. Equipment Design Parameters

   a. Gas Volume (acfm) __________

   b. Gas Velocity (fps) __________

   c. Gas Temperature (°F) __________

   d. Voltage (kW) __________

   e. Current (milliampere) __________

   f. Sparking rate (sparks/minute) __________

   g. Design Efficiency __________

   h. No. electrical fields in direction of flow __________

   i. No. rappers in direction of flow __________

   j. Method of cleaning plates __________

   k. Rapping sequence __________

   l. Hopper ash removal sequence __________

2. Operation during test

   a. Gas volume (acfm) __________

   b. Gas Velocity (fps) __________

   c. Gas temperature (°F) __________

   d. Voltage (kW) __________

   e. Current (milliamperes) __________

   f. Sparking rate (sparks/minute) __________

g. Electrical fields in direction of flow ________

h. No. of rappers in direction of flow ________

i. Rapping sequence ________

j. Hopper ash removal sequence ________

k. Temperature of flue gas to ESP ________

3.	Yes	No	Not Required
a. Was the ESP operation representative of normal operation?	____	____	____
b. Were there any malfunctions that would bias results high?	____	____	____

4. Comments, unusual operating conditions, and special observations.

Location ______________

Date ______________

Observer's Name ______________

Run No. ______________

E. Fabric Filters

1. Equipment Design Parameters.

a. Pressure drop across collection just before bag cleaning ________

b. Pressure drop across collector just after bag cleaning ________

c. Gas volume to bag house (acfm) ________

d. Type of cleaning ________

e. Cleaning cycle ________

f. Particulate removal sequence ________

g. Last time filters were changed ________

h. Design efficiency ________

i. Type of filter (material & size) ________

2. Operation during test

a. Pressure drop across filter just before bag cleaning ________

b. Pressure drop across filter just after bag cleaning ________

c. Gas volume to bag house (acfm) ________

d. Cleaning cycle ________

e. Particulate removal sequence ________

f. Temperature of flue gas to bag house ________

3. Checklist	Yes	No	Not Required
a. Was operation of filter representative of normal operation?	____	____	____
b. Did filters malfunction during test?	____	____	____

4. Comments, unusual operating conditions, and special observations.

Location ____________

Date ____________

Observer's Name ____________

Run No. ____________

F. Wet Scrubbers

1. Equipment Design Parameters

   a. Type of scrubber ________

   b. Desgin efficiency ________

   c. Pressure drop across scrubber (in. H_2O) ________

   d. Nozzle pressure (pounds/sq in) ________

   e. Gas flow out of scrubber (acfm) ________

   f. Liquid flow rate to scrubber (gal/min) ________

   g. Recirculation rate ________

   h. Gas temperature of scrubber ________

2. Operation during test

   a. Pressure drop across scrubber (in. H_2O) ________

   b. Nozzle pressure (pounds/sq. in.) ________

   c. Gas flow out of scrubber (acfm) ________

   d. Liquid flow rate to scrubber (gal/min) ________

   e. Recirculation rate ________

   f. Gas temperature of flue gas to scrubber ________

3. Checklist	Yes	No	Not Required
a. Was the operation of the scrubber representative of normal operation?	_____	_____	_____
b. Did scrubber malfunction during test?	_____	_____	_____

4. Comments, unusual operating conditions and special observations.

Date ______

Observer's Name ______

Run No. ______

G. Multicyclones (cyclones)

1. Equipment Design Parameter

   a. Design efficiency ______

   b. Pressure drop across collector (in. H_2O) ______

   c. Gas volume (acfm) ______

   d. Gas temperature (°F) ______

   e. No. dampers to sectionalize collection ______

   f. Hopper ash removal sequence ______

   g. Type of cyclone ______

2. Operation during test

   a. Pressure drop across collection (in. H_2O) ______

   b. Gas volume (acfm) ______

   c. Gas temperature ______

   d. No. of dampers closed during test ______

   e. Hopper ash removal sequence ______

3. Checklist	Yes	No	Not Required
a. Was the operation of the multicyclone (cyclone) representative of normal operation?	______	______	______
b. Were there any malfunctions or unusual conditions that would bias results high?	______	______	______

4. Comments, unusual operating conditions and special observations.

APPENDIX D

CHECKLIST FOR SAMPLING LOCATIONS, PORTS AND POINTS

Location ______________

Date ______________

Observer's Name ______________

Run No. ______________

A. Measurement and Calcualtions.

1. Draw diagram of sampling location on back of this page.
2. Stack cross section dimensions (measured). __________
3. Equivalent diameters (if stack is not round). __________
4. Number of sampling ports. __________
5. Location of ports. __________
   a. Distance upstream of a disturbance. __________
   b. Number of duct diameters upstream of a disturbance __________
   c. Distance downstream of a disturbance. __________
   d. Number of duct diameters downstream of a downstream. __________
5. Number of sampling points required. __________
6. Number of sampling points per port. __________

B. Checklist	Yes	No	Not Required
1. Are the sampling ports properly located?	____	____	____
2. Is the tester sampling at a sufficient number of points?	____	____	____
3. Is the sampling port flush with the inside of the stack?	____	____	____

	Yes	No	Not Required
4. Has the breeching on stack been checked to determine if it needs cleaning?	____	____	____
5. If necessary, was the duct walls and bottom cleaned?	____	____	____
6. Is the duct diameter at least 12 inches or the cross sectional area at least 113 square inches?	____	____	____
7. Is cyclonic flow suspected?	____	____	____
8. Was verification or absence of cyclonic flow determined?	____	____	____
9. For stacks 12-24 inches in diameter, is the first sample point at least 0.5 inches (or the nozzle diameter) from the stack wall?	____	____	____
10. For stacks greater than 24 inches in diameter is the first sample point at least one inch from the stack wall?	____	____	____
11. Are the sampling ports located at least 2 stack diameters downstream and at least 1/2 stack diameter upstream from a flow disturbance?	____	____	____
12. Do the sampling port locations and number of sampling points meet the criterion of the air pollution control regulatory agency?	____	____	____
13. Are there any special circumstances with the stacks e.g., tapered, small, eccentric-shaped stack?	____	____	____
14. Were any modifications made to the criterion for sample point location?	____	____	____
15. Were modifications to the location of sampling ports approved by the regulatory agency?	____	____	____

APPENDIX E

CHECKLIST FOR OBSERVING SAMPLING PROCEDURES

Location ______________

Date ______________

Observer's Name ______________

Run No. ______________

A. Background Information

1. Sampling Method

   a. Sampling method used ______________

   b. Sampling Method required by state standard ______________

2. Equipment and Calibration.

   a. Draw schematic of sampling train on back of this page.

   b. Condition of equipment ______________

   c. Obtain copy of all calibration data ______________

   d. C_p value for Pitot tube ______________

   e. $\Delta H@$ of meter box ______________

   f. Lining of probe ______________

   g. Length of probe ______________

   h. Nozzle diameter (as measured with micrometer) ______________

3. Pretest checks.

   a. Barometric Pressure (How determined?) ______________

   b. Leak test rate (CFM @ 15 in. Hg) ______________

   c. Nomograph set up

   (1) Estimated meter temperature (°F) ______________

   (2) Estimated value of Ps/Pm ______________

(3) Estimated moisture content (%). ____________

(4) C-Factor ____________

(5) Estimated stack temperature (°F) ____________

(6) Desired nozzle diameter ____________

4. Sampling

a. Average time to reach isokinetic sampling rate at each point ____________

b. How was Orsat analysis performed (from integrated bag or stack)? ____________

c. Length of time each point sampled? ____________

d. If data sheets cannot be copied record the following data:

(1) Approximate stack temperature (°F) ____________

(2) Nozzle diameter (inch) ____________

(3) Volume metered (acfm) ____________

(4) Range of ΔP reading (in. H_2O) ____________

(5) Average ΔP reading (in. H_2O) ____________

(6) Average dry gas meter temperature (°F) ____________

5. Post-test checks

a. Leak test rate ______cfm @____in. Hg.

b. Orsat data from check against ambient air ____________% CO_2

____________O_2

____________% CO

____________% N_2

B. Checklist

1. Sampling Method	Yes	No	Not Required
a. Is the sampling method used the same as required by the regulatory agency?	____	____	____
b. Did the regulatory agency approve any alternate sampling procedures?	____	____	____
2. Equipment and Calibration			
a. Does the equipment meet the design criteria of the sampling procedure as required by the regulatory control agency?	____	____	____
b. Has the Pitot tube been properly calibrated?	____	____	____
c. Does Pitot tube meet geometry standards of EPA Method 5?	____	____	____
d. Is the probe lining appropriate for the type of source and temperature of the gas stream (see Method 5, para 2.1.2 40CFR60 as amended by 42 FR 41777)?	____	____	____
3. Pretest Check			
a. Meter box level	____	____	____
b. Pitot tube Manometer (or magnahelic guage) zeroed	____	____	____
c. Orifice manometer zeroed	____	____	____
d. Probe markings correct	____	____	____
e. Probe warmed-up along entire length	____	____	____
f. Filter compartment preheated to proper temperature (normally 248°F $\pm$ 25°F)	____	____	____
g. Thermometer in filter compartment to determine temperature	____	____	____
h. Impingers iced down	____	____	____
i. Filter holder clean before test	____	____	____

	Yes	No	Not Required
j. Filter holder assembled correctly	______	______	______
k. Filter clearly identified	______	______	______
l. Probe liner clean before test	______	______	______
m. Nozzle clean	______	______	______
n. Nozzle tip undamaged	______	______	______
o. Impingers clean before test	______	______	______
p. Impingers in correct order and correctly charged	______	______	______
q. Pitot lines leak checked	______	______	______
r. Does the Pitot line leak check?	______	______	______
s. Was the metering system leak checked?	______	______	______
t. Does C-Factor on nomograph equal 0.95 when ΔH@ = 1.80, Tm = 100°F, %H_2O = 10 %, and Ps/Pm = 1.00?	______	______	______
u. Does ΔP Reference on the nomograph equal about 0.118 when C=0.95, T_s = 200°F, and D_n = 0.375	______	______	______
v. Align ΔP = 1.0 with ΔH = 10 on the nomograph. Does ΔP = 0.01 align with ΔH = 0.1?	______	______	______
w. Does stack thermometer check against ambient temperature?	______	______	______
x. Was the gas sampling equipment leak checked?	______	______	______
y. Was the gas sampling bag leak checked?	______	______	______
z. Was the gas sampling probe and liner thoroughly purged with stack gas before sampling?	______	______	______

	Yes	No	Not Required
aa. Was the filter checked visually against light for irregularities or pinholes?	______	______	______
bb. Was the filter properly (and uniquely) labeled?	______	______	______
cc. Was filter weighed to constant weight?	______	______	______
4. Sampling			
a. Was sampling begun immediately after probe was put in stack?	______	______	______
b. If not, was the nozzle sealed when the probe was in stack and pump turned off?	______	______	______
c. Did the nozzle scrape the stack wall or the inside of the port opening?	______	______	______
d. Is an effective seal made around the probe at the port opening (especially important if stack has negative static pressure)?	______	______	______
e. Is probe seal made without disturbing flow inside stack?	______	______	______
f. Is the probe moved to each point at the proper time?	______	______	______
g. Are probe markings adequate to properly locate each point?	______	______	______
h. Are nozzle and Pitot tube kept paralled to stack wall at each point?	______	______	______
i. Was nozzle changed during run?	______	______	______
j. Is the data recorded completely and in a permanent manner?	______	______	______
k. Is nomograph setting changed when stack temperature changes significantly (i.e., 10 % change)?	______	______	______

	Yes	No	Not Required
l. Are velocity pressures (ΔP) recorded accurately?	____	____	____
m. Was static pressure determined correctly?	____	____	____
n. Was the gas sample determined correctly for the type of source (e.g., integrated sample for an incinerator, see 40 CFR 60, Subpart C through AA)?	____	____	____
o. Was the gas sampling bag leak checked according to Method 3 (40 CFR 60)?	____	____	____
p. Were filters or any other components changed during the test (if yes, explain in comment section)?	____	____	____
q. Did the observer obtain a copy of the raw data sheets?	____	____	____
r. If integrated Method 3 sampling is performed, is the bag sample taken simultaneously with and for the total length of time as the particulate sample run?	____	____	____
s. Was the sampling tube and sampling volume equal to or greater than the minimum sampling time specified in the test procedures or required by the regulatory agency?	____	____	____
t. Was sampling time at each point at least 2 minutes?	____	____	____
5. Post-test checks			
a. Is a leak test performed at completion of the run at the maximum vacuum encountered?	____	____	____
b. Was Orsat analyzer leak checked after analysis?	____	____	____
c. Was Orsat analyzer checked against ambient air?	____	____	____

	Yes	No	Not Required
d. Were the Pitot lines leak checked (mandatory)?	____	____	____
e. Was there breakthrough of the silica gel?	____	____	____

C. Comments, observations, and special conditions.

APPENDIX F

CHECKLIST FOR OBSERVING SAMPLE RECOVERY AND ANALYSIS

Location ____________

Date ____________

Observer's Name ____________

Run No. ____________

1. Checklist	Yes	No	Not Required
a. Is the probe triple brushed and rinsed?	____	____	____
b. Is the stainless steel or other metal probe liner brushed and rinsed six times?	____	____	____
c. Was brush brought out too quickly and sample lost?	____	____	____
d. Are there any visible particles on the filter (should be none)?	____	____	____
e. Are there any brush bristles in the probe washings?	____	____	____
f. Was the probe adequately cooled before sample recovery?	____	____	____
g. Were the ends of the probe capped before transporting to the cleanup site?	____	____	____
h. Is all external particulate matter wiped off the probe before sample recovery?	____	____	____
i. Is the grease removed from the probe before the end is capped?	____	____	____
j. Is the grease removed from the inlet and outlet of the filter holder and the the inlet and outlet capped?	____	____	____
k. Is the nozzle removed before cleaning the probe liner?	____	____	____

	Yes	No	Not Required
l. Is the sample recovery site in an area free of wind?	______	______	______
m. Are the wash bottles clean?	______	______	______
n. Are the brushes clean?	______	______	______
o. Are the brushes rusty and bristles loose?	______	______	______
p. Are the recovery jars clean?	______	______	______
q. Is the reagent grade acetone used?	______	______	______
r. Is the filter recovery and handling adequate?	______	______	______
s. Is the probe handling adequate?	______	______	______
t. Are the impinger handled satisfactorily?	______	______	______
u. Was there breakthrough on the silica gel?	______	______	______
v. Are acetone blanks (and water if needed) taken?	______	______	______
w. Is the probe lining clean (after nozzle is removed and probe held up to a light source)?	______	______	______
x. Is the filter holder clean?	______	______	______
y. Is front half of filter holder cleaned and particulates put with probe washings?	______	______	______
z. Are the impingers clean?	______	______	______
aa. Is the nozzle clean?	______	______	______
bb. Are the recovery jars adequately labeled?	______	______	______
cc. Are the recovery jars sealed tightly?	______	______	______

	Yes	No	Not Required
dd. Is the liquid level marked on the jars?	______	______	______
ee. Are the recovery jars packed adequately for transporting?	______	______	______
ff. Is the sample recovery procedure adequate?	______	______	______
gg. Is the sample recovery procedure for condensibles adequate?	______	______	______

2. Other data.

a. Grade of acetone used __________

b. Specification for residue on evaporation for the acetone __________

c. Specification on chemicals used for condensible analyses __________

3. Comments and observations.

THE ROLE OF THE REGULATORY AGENCY OBSERVER IN A SOURCE EMISSION TEST

by
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ABSTRACT

From the technical and legal standpoint, the emission test is the ultimate determination of compliance. While the test may be manpower and equipment intensive as well as expensive, the results of a test are of great significance to both the regulatory agency and the source. The results often determine the course of future litigation between the agency, the source, and control manufacturer. Considering the significance attached to the results, it is important that the test be performed in a valid representative manner. This paper describes the technical and administrative responsibilities of the agency observer in efforts to assure the adequacy of an emission test. It covers the observer's involvement from initial coordination work, through the pretest survey and conference, on-site testing activities, and report review. The relationship between the observer, the source, and the test consultant are discussed. The various procedures including questionnaires, forms and on-site calculations used to effectively track and validate a test program are described.

Introduction

Historically, the involvement of regulatory agency personnel in compliance testing activities has varied from a brief review of the emission test report to total responsibility and performance for the test program. The degree of involvement depended upon the resources available within the agency and the relative significance of the source being tested. The recent emphasis in the achievement of Ambient Air Quality Standards through restrictive source emission limitations has resulted in expanded regulatory involvement in the hundreds of emission tests performed each year for compliance determination purposes. The complex nature of the various sampling methods coupled with extremely low emission standards, has put added responsibilities on agency personnel to assure each test is an accurate representation of a source's actual emissions.

The objective of this paper is to describe the technical and administrative functions of the regulatory agency observer in his efforts to assure the adequacy of a compliance test. It will discuss the procedures necessary for implementing and coordinating a successful test program from the regulatory standpoint.

Significance of an Emission Test

From the legal and technical standpoint, the emission test is the ultimate determination of compliance. While opacity observations and continuous monitoring instrumentations are used to determine how adequately a source is operated and maintained, it is the emission test that determines if the inherent design of a facility and its associated control equipment can meet the emission standard.

For the most part, an emission test is equipment and manpower intensive. Because only a small fraction of the total exhaust flow can be actually sampled, and many variables can be encountered in flowing gas streams, complex test methods and extreme care must be exercised in obtaining representative samples. Satisfactory sampling sites are usually found in logistically difficult locations, often hundreds of feet up in the stack. While the expense and effort involved in performing an emission test can be considerable, it is important to keep in perspective the significance of obtaining a valid representative sample. The results of the test will determine the future course of regulatory action. They will serve as legal evidence to both the regulatory agency and the source as a demonstration of the compliance status of the facility. Significant monetary decisions concerning control equipment expenditures are often based upon the results of the compliance test.

In the case where control equipment guarantees are involved, the results may determine the future course of litigation between the source and its equipment vendor.

Considering the significance attached to the compliance test, it is imperative it be performed in a satisfactory manner and the valid representative data are obtained. The following sections will discuss the various aspects involved in coordinating and implementing a successful test program, with particular emphasis on the role of the regulatory agency observer.

Initial Coordination

Generally, most source tests are performed at the specific request of the regulatory agency or as a result of established administrative regulations. Once the requirement for testing has been established, it is the obligation of the regulatory agency to inform the source what will be expected, considering the burden of actually performing the sampling usually rests with the source and/or its test consultant. It is at this point where the regulatory agency observer should initiate the communication process, specifying to the source the general test procedures and requesting information in return concerning the specific application of these methods. Exhibit 1 contains a suggested Pretest Informational Questionnaire for implementing this communication process. While standardized test methods have been established, the application of these methods and the defining representative operating conditions is often unique to each facility. The Questionnaire references the test procedures and regulations used by the agency, thus giving the source a starting point from which it can determine its applicability and testing requirements. It requests specific responses from the source concerning the operation of the process, how the general test methods will be applied, what sampling and process data will be collected, along with chain of custody and quality assurance procedures.

Satisfying the informational requirements of the Questionnaire serves several important purposes benefiting all the parties involved in the test program. The information supplied as well as requested in the document alerts the source to the general requirements of the agency. The response of the source will serve as the basic test protocol from which further specific matters concerning the test program may be discussed. The regulatory observer should review the information submitted by the source, familiarize himself with the operation of the facility, and check to see if the test plan submitted as a result of the Questionnaire satisfies all legal and technical requirements.

Pretest Conference

Assuming all the parties involved in the test program now have a basic understanding of the test plan, the next step involves finalizing the plan at the pretest conference. Here, the involved parties (agency, source, test consultant), can personally discuss the specifics of the test program, resolve any ambiguities or problems concerning test methodology, and establish representative process operating conditions for the test period. At the meeting, each party should designate a prime contact, through which any problems or communication can be appropriately directed as the test program progresses.

The meeting should be held at the source and should include a survey which will allow all parties to become familiar with the physical set up and operation of the facility. Depending upon the complexity of the source and the test program, it should take place anywhere from several days to several weeks prior to the scheduled test date. This will allow adequate time for any modifications or installation of support equipment which may be required to accomodate the sampling apparatus. The format of the meeting should include a survey of the facility followed by a discussion covering the information contained in the Pretest Questionnaire. Since the regulatory observer will be making the ultimate decisions concerning the adequacy and acceptability of the test plan, he should play a lead role in directing the discussion.

While standardized methods have been established for compliance tests, the application of these methods may vary from source to source. Most regulations grant agency personnel some flexibility in approving minor modifications to the methods to accomodate special circumstances. In approving such modifications by giving consideration to the practicality of a situation, the regulatory observer must assure himself that the validity of the test both from the technical and legal standpoint will not be sacrificed. The pretest conference provides the forum where these situations as well as others can be discussed and resolved, in an effort to assure an orderly successful test program. Above all, the meeting should preclude any problems from arising due to a lack of communication between the involved parties.

On-site Testing Activities

The primary function of the regulatory observer at the test site is see the tests are performed properly and that the process is operated in a representative manner in an effort to assure the results will be a valid assessment of the actual emission rate. From the agency standpoint, the observer has the responsibility to insure the legal and technical aspects of the test are sufficiently satisfied. This involves constant monitoring and evaluation of the test procedures and process operating parameters.

Prior to actually initiating the sampling, it is recommended all parties meet briefly to review the current status of the test program and to discuss any unforeseen problems that might have arisen since the pretest conference. It should be recognized by all involved parties that the intent of the observer is not to look over the shoulder and criticize the work of the test personnel but to indicate if there are any problems in the procedures or process operating conditions which might sacrifice the validity of the test results. If such a situation occurs, the observer should promptly inform the appropriate contact person so the nature of the problem can be discussed and clarified prior to continuation of the test program. In this respect, it is important to all parties that any problems be brought to light at this point, to avoid any after-the-fact difficulties from arising, considering the significance of the tests. Generally, where the involved parties have an understanding, the test plan along with each other's responsibilities and objectives, most problems at the test site can be promptly settled in a professional manner. The value of the pretest conference becomes evident at this point, in that most significant problems will have already been addressed and clarified prior to initiation of the actual sampling.

After each test run, it is recommended all involved parties review the test and process data to assure it is complete and no obvious discrepancies exist. The observer will generally carry a log book for recording significant events and some of the test and process data for his own purposes. It is usually the responsibility of the test personnel and source to obtain a complete log of all pertinent data for preparation of, and inclusion into, the report document. The purpose of performing the on-site post test data review is to determine if any additional tests or measurements will be required prior to disassembling and packing up the test equipment. It will preclude situations where several days after conclusion of the test, while performing the data reduction calculations, the sampled volume is found to be inadequate or the sampling rate is non-isokinetic. This presents an embarrassing situation to the test consultant, finding that the statutory requirements of the test method along with his obligation to his client are not truly fulfilled. Furthermore, the agency is put into an awkward position, having to decide whether to accept or reject the test results because of questionable validity. While some minor inconsistences in the method can be tolerated to an extent with technical justification, when the results of a test are marginal in comparison to the standard, this becomes an uncomfortable situation for all involved parties.

In order to preclude the above situation from occurring, the on-site data review is recommended. In the case of particulate testing, where an isokinetic sampling rate must be satisfied, an abbreviated set of calculations can be performed within minutes with a pocket calculator to determine if the rate is in the general ballpark. Exhibit 2 is a typical calculation sheet used for this purpose. The procedure involves calculation of an average velocity head square route ($\sqrt{\Delta P}$)ave, and measuring the volume of condensed impinger water and the silica gel weight gain on-site. Other parameters such as average temperatures, pressures, molecular weights, which their relative accuracy is not extremely critical to the isokinetic calculation, are "eyeballed" from the field data sheet. While the isokinetic value calculated is not truly exact, it is usually accurate enough to flag any significant variations, where a more detailed analysis can be performed. The use of this sheet in special test situations (high moisture, high stack pressure or vacuum, unique flue gas constituents) is subject to caution.

Access by the observer to the above field data at the conclusion of the tests for purposes of performing this isokinetic calculation should be understood by the involved parties. The few minutes it takes to perform the computations is of benefit to all parties. It precludes the possibility of a complete retest of the facility at a future date due to unrecognized sampling deficiencies at the site.

Review of the Emission Test Report

The emission test report should contain all pertinent data concerning the test program. In addition to reporting the results, it should include descriptions of the source, the sampling and analytical methodology used, the process operating conditions, all field data and calculation methods. It should be representative of a quality engineering or scientific report, its contents presented in an understandable, orderly manner. Since the report will serve as evidence to both the agency and the source as a demonstration of the compliance status of the facility, it is important it be complete in content and adequate in quality. Exhibit 3 (Emission Test Reporting Requirements) contains a suggested format and content for a typical emission test report. It is recommended these requirements be sent to the source with the Pretest Informational Questionnaire (Exhibit 1).

This will provide the source with an overall understanding of all submittal requirements at the onset and should help assure the adequacy of the test program.

The observer will usually review the test report to determine if it is adequate in content and if the results, as reported, are valid. This involves an overall review of the supporting data contained in the report, along with his independent observations taken at the test site. As a check on the calculation procedures used to process the field and analytical data, it is recommended the results be independently calculated directly from the field and laboratory data. In the event of a discrepancy in results, the observer should perform a detailed analysis of the input parameters and calculation methods used by both parties, to determine where the problem lies. Upon completion of the review, the observer should appropriately contact the source to inform them of his findings, and to discuss any discrepancies or inadequacies which might be present.

Summary and Conclusions

1. The achievement of National Ambient Air Quality Standards through restrictive source emission limitations has resulted in significant numbers of source emission tests being performed for compliance determination purposes.

2. From the legal and technical standpoint, the emission test is the ultimate determination of compliance, the result of which determines the future course of regulatory action. The need to obtain accurate representative emission measurements through the use of complex test methods has resulted in increased responsibilities on the part of the agency observer to assure the tests are adequately performed.

3. In order for a test program to be successful, a significant amount of communication, coordination, and cooperation between the involved parties (agency, source, test consultant) is required. The agency observer should play a major role in brining these various needs together, to assure all regulatory aspects will be satisfied.

4. The Pretest Informational Questionnaire and the Pretest Conference provide vehicles through which the communication and planning processes of the test program can be effectively implemented.

5. On-site data review and quick check calculations should be performed immediately after each test, to assure statutory sampling criteria have been satisfied.

6. In an effort to assure the adequacy of the emission test report, the agency should establish minimum reporting requirements. The review of the report should include an independent evaluation, starting with the field data.

Disclaimer

The content and recommendations included in this report are those of the author. They may not necessarily reflect the views or policies of the U.S. Environmental Protection Agency.

Exhibit 1. Pretest Informational Questionnaire

PRETEST INFORMATIONAL REQUIREMENTS

In order to establish uniform requirements and help ensure proper test methods and procedures are utilized, the information specified below must be submitted to (indicate regulatory agency office) at least 30 days prior to the scheduled test data. After review of the information, a pretest conference will be scheduled by the agency to discuss and finalize the test plan. In the event of any major deficiencies or discrepancies in the test protocol, the company and/or test consultant will be notified prior to the conference. Submittal of this information will minimize the possibility of a test rejection as a result of improper sampling or data collection procedures.

Testing shall be performed in strict accordance with procedures specified in the Code of Federal Regulations, Title 40, Part 60, Appendix A, Standards of Performance for New Stationary Sources, as amended (or as stipulated by the control agency). A satisfactory test shall consist of three repetitive runs. Any variations in the sampling or analytical procedures must be indicated in the pretest information and receive approval from this office prior to testing.

1. Identification and a brief description of the source to be tested. The description should include:

   a) type of industrial process or combustion facility
   b) type and quantity of raw and finished materials used in the process
   c) description of any cyclical or batch operations which would tend to produce variable emissions with time.
   d) basic operating parameters used to regulate the process
   e) rated capacity of the process.

2. A brief description of the air pollution control equipment associated with the process including:

   a) type of control device
   b) operating parameters
   c) rated capacity and efficiency
   d) ultimate disposal of wastes.

3. Type of pollutant to be sampled (particulate, NO_x, SO_2, hydrocarbon, etc.).

4. A description of the emission sampling equipment including a schematic diagram of the sampling train.

5. A description of the sampling and analysis procedures. Reference standard methods, if applicable. Indicate any proposed variations with justification.

6. A sketch with dimensions indicating the flow of exhaust gases from the process, through the control equipment and associated ductwork to the stack.

7. According to Method 1, 40 CFR 60:

   a) An elevation view with dimensions of the stack configuration indicating the location of the sampling ports and distances to the nearest upstream and downstream flow interferences.
   b) A cross-sectional sketch of the stack at the sampling location with dimensions indicating the location of the sampling traverse points.

8. Estimated flue gas conditions at sampling location, including temperature, moisture content, and velocity pressure.

9. A description of the process operating conditions or ranges during which the tests will be run, along with background information substantiating the conditions are representative of maximum normal operation.

10. A description of the process and control equipment operating data to be collected during the sampling period.

11. Copies of the field data sheet form to be used during the tests.

12. Names and titles of personnel who will be performing the tests.

13. A description of the procedures for maintaining the integrity of the samples collected, including chain of custody and quality control assurance.

14. Calibration sheets for the dry gas meter, orifice meter, pitot tube, and any other equipment or analytical procedures which require calibration.

15. A list of preweighed filters to be used during particulate emission testing, including identification and tare weights.

(Requirements 14 and 15 must be submitted prior to actual testing, but do not have to be included with the pretest information.)

Exhibit 2. Isokinetic On-Site Quick Check

Source: ______________________ Date: ______________ Run No. ____

ΔP $\sqrt{\Delta P}$ (each traverse point)	
	Ts = 460 + °F = °R "Eyeball" Average
	Tm = 460 + °F = °R "Eyeball" Average
	ΔH = "Eyeball" Average
	Vl = ml. gain impingers +
	= wt. gain silica gel =
	Ms = 27 to 30 (Use 29 for most boilers)
	An = $D^2/183.35$ = D= nozzle diameter, inches
	Pbar $\approx$ 29.9 $\approx$ Ps (usually) θ = Sample time, minutes
	Vm std $= Vm\,(17.71)\dfrac{(Pbar + \Delta H/13.6)}{Tm}$
	Vw std = 0.0474 (Vl)
	Bwo $= \dfrac{Vw\ std}{Vw\ std + Vm\ std}$ Check Bwo calculated vs. Bwo nomograph
	Vs $= 85.48\,(Cp)\sqrt{\dfrac{Ts}{Ps\,Ms}}(\sqrt{\Delta P})ave$
+ ______	
Total = ______	I $= \dfrac{Ts[(0.00267)Vl + \frac{Vmstd}{17.71}]\ 1.667}{\theta\ Vs\ Ps\ An}$
No. Points =	
$(\sqrt{\Delta P})$ave =	
	$90 \leq I \leq 110$?

77-12.6

Exhibit 3. Emission Test Reporting Requirements

The emission test report should contain all pertinent data concerning the tests including a description of the process and operating conditions under which the tests were made, the results of the tests, and test procedures. While the exact format of the report will vary depending upon the type and objective of the tests, indicated below is a suggested format containing required information.

1. Introduction
    a) Identification, location, and dates of tests.
    b) Purpose of tests.
    c) Brief description of source.
    d) Name and affiliation of person in charge of tests.

2. Summary of results
    a) Operating and emission data.
    b) Comparison with applicable emission regulations.

3. Source description
    a) Description of process including operation of emission control equipment.
    b) Flow sheet (if applicable).
    c) Type and quantity of raw and finished materials processed during the tests.
    d) Maximum normal rated capacity of the process.
    e) Description of process instrumentation monitored during the test.

4. Sampling and analytical procedures
    a) Description of sampling train and field procedures.
    b) Description of recovery and analytical procedures.
    c) Sketch indicating sampling port locations relative to process, control equipment, upstream and downstream flow disturbances.
    d) Sketch of cross-sectional view of stack indicating traverse point locations.

5. Test results and discussion
    a) Detailed tabulation of results including process operating conditions, flue gas conditions.
    b) Discussion of significance of results relative to operating parameters and emission regulations.
    c) Discussion of any divergencies for normal sampling procedures or operating conditions which could have affected test results.

OBSERVER'S REPORT*

The observer's report is usually written in two segments. The first segment is written as soon as possible after the observer returns from the field testing. This allows maximum recollection of events for summarizing all notes, checklists, logs and other data. The field testing evaluation portion of the observer's report is written independently of the source test report and will provide a separate accounting of the tests. The observer's determination of representativeness of data could not be influenced at this time by the measured pollutant values.

The second segment of the observer's report is written upon the receipt of the emission test report which will probably be 30 to 60 days later. This portion of the observer's report deals with the review of the source test report to determine its acceptability. The main emphasis of the procedures to be presented will deal with the first segment of the observer's report for writing the field evaluation summary. The review of the source test report is covered in "Source Testing Reports Suggested Format and Review Procedures", EPA Contract 68-01-3172, Task 5.

*Paper by W. DeWees included in Compliance testing observation and evaluation workshop manual - Volume III, Administrative Aspects of Performance Tests, prepared for Division of Stationary Source Enforcement, U.S. Environmental Protection Agency.

The source test report documents all events and data gathered by the emission testers, and the observer's report documents the sequence of events as he perceived them. The observer's report will accompany the source test report through the entire agency's review procedure.

Since the observer may not be present during the final determination of the acceptibility of the compliance test and or may not perform the review of the compliance test report, a diligent effort must be put forth to provide an accurate picture of representativeness of the field test work. The observer should also be aware that a logged entry of an event by one party usually takes legal precedence over another party that witnessed the same event without an entry into a log.

The observer's representativeness evaluation of field testing will be based on the sampling procedures and facility operating conditions that were agreed upon through the use of a test protocol and pretest meeting. The facility operation conditions include the established baseline conditions for the process and the air pollution control equipment. The standard sampling procedures include calibration, sample collection, sample recovery, and sample analysis. All operating conditions and standard procedures should be agreed upon prior to the compliance field testing. No additional restrictions and or conditions should have to be placed on the facility or emission testers after the field testing begins.

Reporting Requirements

The observer's report should be written with the idea that the report will be used as evidence in court and will be presented to layman. Because the final legal decision on compliance may be made by individuals with little or no knowledge of emission testing, the observer's report must be clear, concise, traceable to the proper point in time, and present all documentation of materials, discussions, and decisions used to form the basis for determining the representativeness of compliance test data. The observer's summary and presentation of data must demonstrate the facility's and test team's performance or non-performance of all established baseline conditions and procedures.

The inability of the facility or test team to meet all the established conditions will not always invalidate the test. Many conditions may either produce only a small percentage error or will tend to always bias the results in the same direction. If the facility was in violation then biases which produce higher values would still be acceptable to the agency but would be brought up in court by the facility to invalidate the test.

Although the observer determines only representativeness of compliance test data, not compliance with control regulations, the observer should be aware that the only conditions for which the test would be acceptable to the facility and agency are: (1) compliance or violation with no biases, (2) compliance with known high bias, and (3) violation with known low bias(s). For this reason if biases are known to the observer, he should explain the source of the error and the magnitude and direction on the results if known or determinable.

A standard observer's report format as shown in Figure 1 should be used to provide uniformity and efficiency in report preparation and ease of use by other agency personnel. The observer's report format should be tailored to the source test report which has been designated by the agency for ease in comparison and review.

The data collection and reporting procedures will not be the same for every agency. The agency should only require the testers and facility to collect data that will be used by the agency. For any process and control equipment data collection requirements the agency should be able to justify in court that the data will be used for some purposeful meaning within the agency.

OBSERVER'S REPORT FORMAT

COVER

1. Plant name and location (Federal AQCR)
2. Source sampled
3. Date sampled
4. Testing firm
5. Control agency

CERTIFICATION

1. Certification by observer(s)
2. Certification by author if not observer
3. Certification by key agency personnel

INTRODUCTION

1. Agency name
2. Purpose for observer's report
3. Purpose for test
4. Plant name, location and process type
5. Test dates
6. Pollutants tested
7. Applicable regulations
8. Agency sections and personnel directly involved

SUMMARY OF REPRESENTATIVENESS OF DATA

1. Compliance test protocol
2. Calibration of sampling equipment

Figure 1. Observer's report format.

3. Process data
4. Control equipment data
5. Sampling procedures
6. Sample recovery procedures
7. Analytical procedures
8. Compliance test report

FACILITY OPERATION

1. Description of process and control device
2. Baseline conditions
3. Observer's facility data (checklists)
4. Representativeness of process and control device
5. Baseline conditions for agency inspector

SAMPLING PROCEDURES

1. Acceptability of sample port and point locations
2. Compliance test protocol
3. Calibration of sampling equipment
4. Observer's sampling data (checklist)
5. Representativeness of sampling
6. Observer's sample recovery data (checklist)
7. Representativeness of recovered sample
8. Observer's analytical data
9. Representativeness of sample

COMPLIANCE TEST REPORT

1. Introduction
2. Summary of results
3. Facility operation

Figure 1. (cont.)

4. Sampling procedures

5. Appendices

APPENDICES

A. Copy of pertinent regulations

B. Related correspondence

C. Compliance test protocol

D. Observer's checklists

E. Observer's test log

F. Other related material

Figure 1. (cont.)

The following is a discussion of each reporting requirement and guidelines to supplement the outline. (Figure 1)

Cover

The cover should indicate the name and location of the plant tested, along with a description for the specific source sampled. A date containing the month and year should be included to discriminate this report from a previous test or retest of the same process. The name and address of the testing firm (or agency) who conducted the test should be given. Finally the name and address of the responsible agency.

Certification

The report should be certified by a minimum of two individuals. The observer(s) should certify that the facility operations and sampling procedures were performed during their direct observation and general guidance. The author of the report, if not the observer, should certify that all data and conclusions are authentic and accurate. The last certification should be by a key person within the agency certifying that he has reviewed the report and that the conclusions are accurate and supporable.

Introduction

The introduction should explain to the reader the purpose and content of the report. All parties involved should be identified along with their duties and responsibility. The plant name, location and process type should be given. The applicable regulations, important regulation dates or descisions, sampling and analyticol procedures, and facility operating procedures should be given to provide the basis for the report.

A detailed explanation of all procedures and guidelines is not warranted but should be referenced. If presented in court the introduction would include sufficient information to provide understanding of the purpose for the compliance test and agency's review.

Summary of Representativeness of Data

Since the purpose of the report is to determine the representativeness of the observed compliance test the report should not make a direct statement with regard to compliance with the performance regulations. The observer may indirectly make a compliance judgement by presenting the degree of realiability of the compliance test but this statement will be directed toward the acceptability of the compliance test and report.

A summary of representativeness of the facility operations, sampling and analytical procedures, and the evaluation of the source test report should be presented. The facility operations include the determination of whether the process operating conditions were within the limits set by the agency and the control equipment was operated in a normal manner. The sampling and analytical procedures should include any deviation from the written and agreed upon procedures. The evaluation of the source test report should include any inaccuracies or deficiencies of compliance test data presentation.

All deviations from the set procedures and conditions should be initialed into the summary. The expected magnitude and direction of the bias for each deviation should be given if known or determinable. As previously mentioned the compliance test may contain a known bias and still be acceptable to the agency and facility.

All unusual occurances which were logged by the observer should also be mentioned. These occurances would include such things as process upsets, exclusion of tests, restart of tests, and extreme weather conditions.

Most errors or inaccuracies presented in the report by the observer should not come as a suprise to the testers or the facility. The observer's purpose is not just to determine representativeness of one compliance test data, but to aid the facility and testers in obtaining representative test data. In this way the actions and decisions by the agency and facility can be expedited to achieve the main goal of compliance.

Facility Operations

Facility operations are composed of the process operations and air pollution equipment operation. Most control agencies have a good working knowledge of air pollution equipment operations. The direct effect on emissions for various process operations is not usually known by the agency because detailed studies have not been made to provide the needed data. The facility operating procedures presented must be tailored to the agency's laws, regulations and definitions.

The agency normally defines the facility operations. The process is generally operated at its normal maximum operating capacity during testing. This capacity normally produces the greatest steady state emissions. The process after the compliance determination is then allowed to operate at any condition which does not exceed some percentage above normal maximum capacity as long as the process is not modified.

If the agency uses process and control equipment operating conditions as an enformcement tool, then the documentation of the facility operations during the compliance test will become part of the performance regulations.

Conditions for process and air pollution equipment operations must be established for the compliance test and must be adhered to by the facility after the compliance test.

The first portion of this section should present the basis for the evaluation of the representativeness of the facility operation during the compliance test. The baseline conditions for the process operations established by the agency and agreed upon by the facility prior to the compliance field testing should be presented. The observer should base his determination on these conditions and not on a post test after thought. After the basis for a representativeness determination has been presented, the observer's process checklist and test log should provide sufficient data to demonstrate representativeness or non-representativeness of process operations. Any deviation from the prescribed conditions should be presented along with the expected effect on the emissions or results. Any statement or conclusion of non-representativeness of process operation with established conditions should have been documented to include the event, time and participants. References should also be used whenever possible to help support the baseline conditions set by the agency that have not been met or that may be challanged at a later data.

The baseline conditions for the control equipment are normally established from the facility request, since it is usually to their advantage to optimize the control equipment operation. Since the agency may deem that the baseline condition for the control equipment must be met during all future operations, the facility may desire to operate the control equipment at less than maximum efficiency to reduce operating expenses. The agency could not normally invalidate the compliance test from the control equipment operation stand point, unless the control equipment was operated in such a manner as to reduce the emissions only during the testing period.

If specified by agency regulations, the conditions set for and during the compliance test must be continually met to demonstrate compliance. The process operating conditions established for the test and the control equipment operating conditions set by the test would then be presented in the report to aid in future inspections.

Sampling and Analytical Procedure

The applicable sampling and analytical procedures should be referenced and presented in the Appendix since these procedures may be revised from time to time. Any additional quality assurance procedures or modifications to the prescribed procedures requested and agreed upon by the agency and emission testers, and the test protocol submitted by the emission testers should also be presented in the appendix.

A detailed written explanation of all the sampling and analytical procedures should not be presented in the text. The observer's field testing checklists should provide sufficient information for all check points by the observer to demonstrate compliance with the prescribed procedures. Any procedures or events that did not conform with the prescribed procedures should include a detailed explanation of the deviation and it's expected impact on the test results. The observer should again, as with the facility operation, aid the emission testers in adhering to the prescribed procedures. Many errors, if caught in time, will have little or no effect on the final results.

Any reported on-site sampling or analytical errors should have been discussed with the emission testing supervisor at the earliest opportunity.

All cheklists, errors, and unusual occurances should be presented in the following chronological order:

1. Calibration of sampling equipment
2. Acceptibility of sample point and point locations
3. Sample train preparation
4. Sample collection
5. Sample recovery
6. Sample transport
7. Sample analysis

All unusual events, non-prescribed procedures and errors should have been immediately logged along with the respective time and participants. These bias should not be presented in the text without proper documentation. All statements of biases should be based on written legal and technical procedures and not on the suspections of the observer. If the observer feels that the equipment has not been calibrated properly then an independant check should be made. The observer should not state that in his opinion he feels that the equipments was not calibrated sufficiently.

Review

A detailed explanation of the compliance test report and calculations review procedures are included in "Source Testing Reports Suggested Format and Review Procedures", EPA Contract 68-01-3172 Task 5.

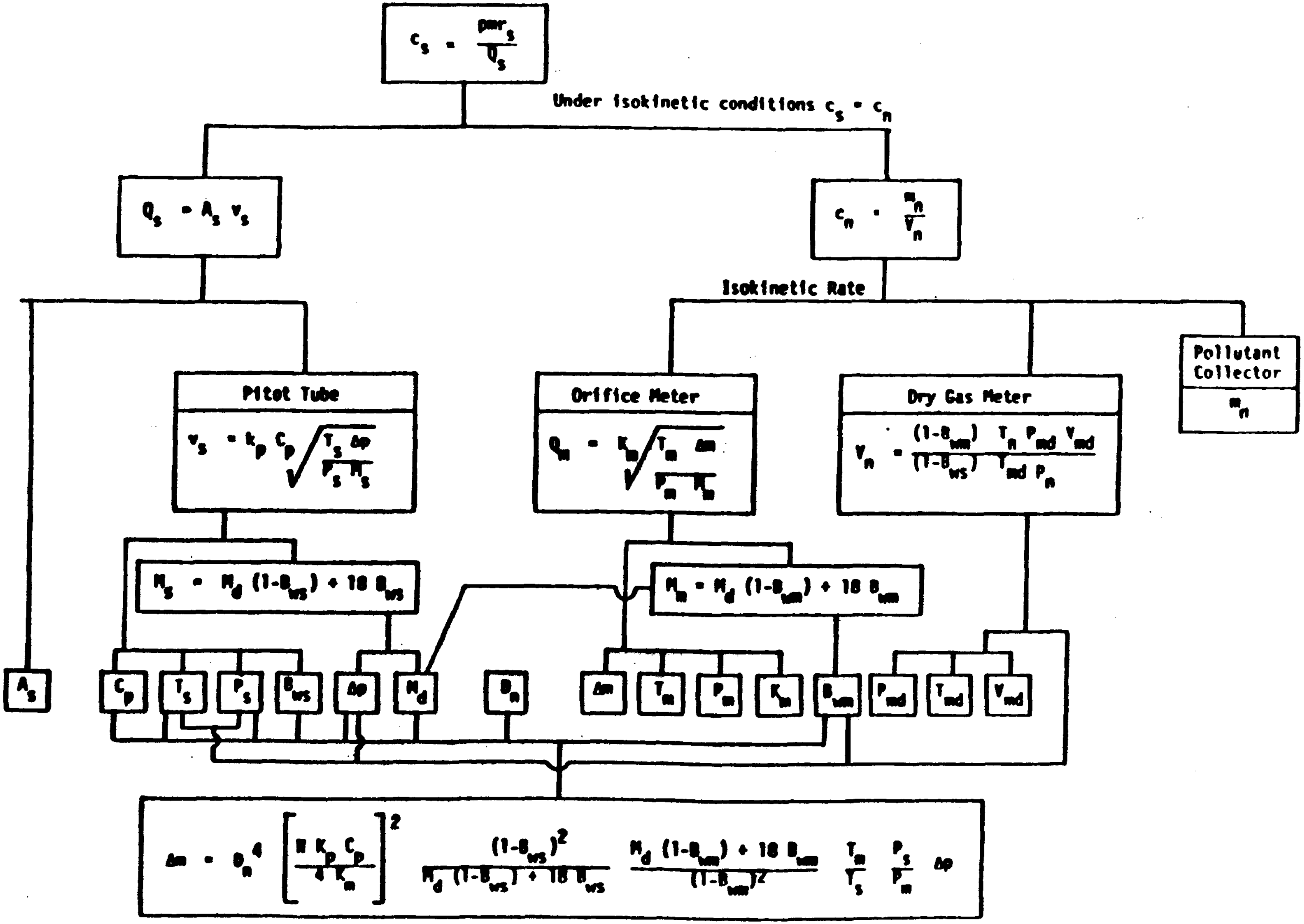
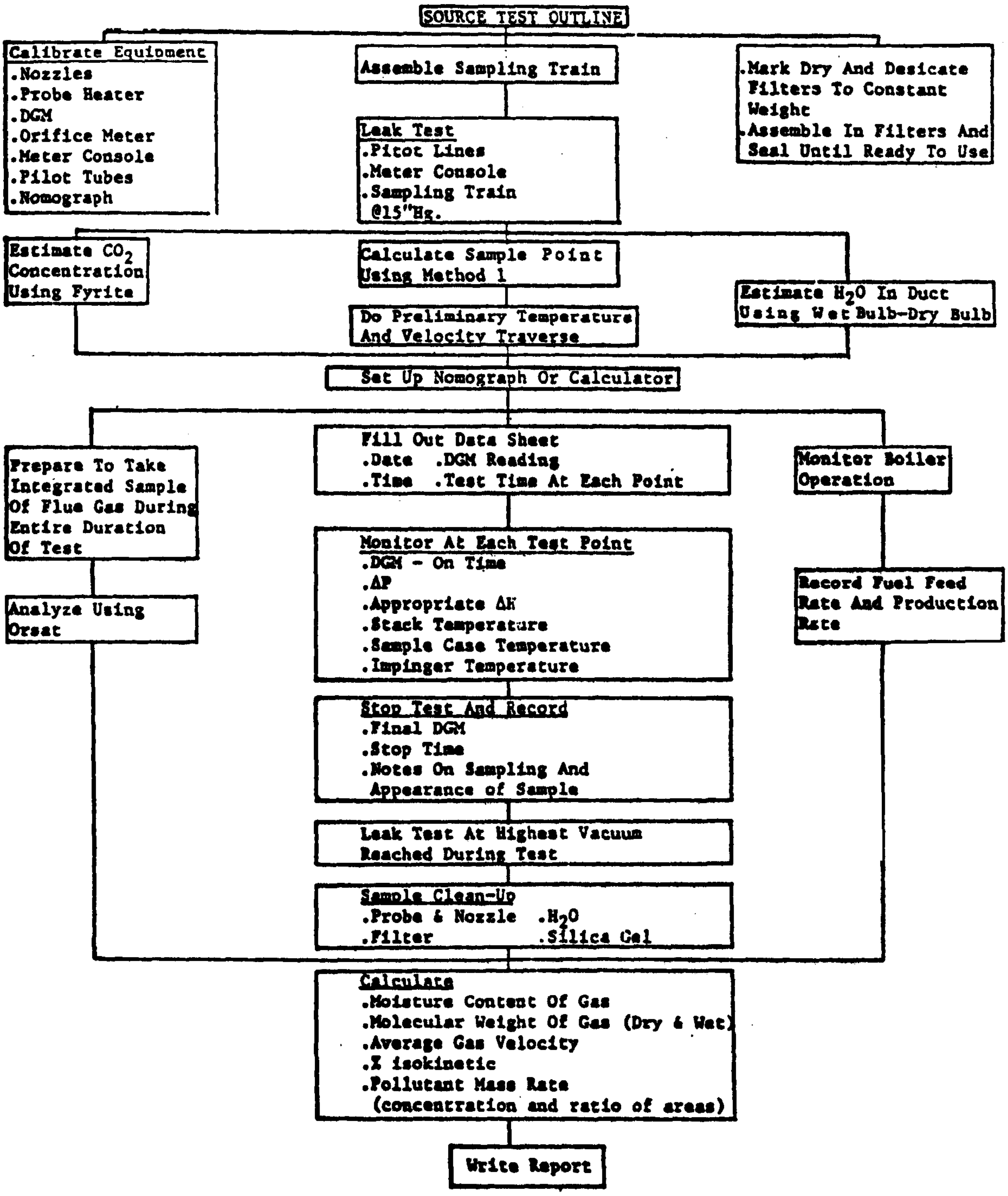


Figure 1. Schematic of Isokinetic Sampling Technique



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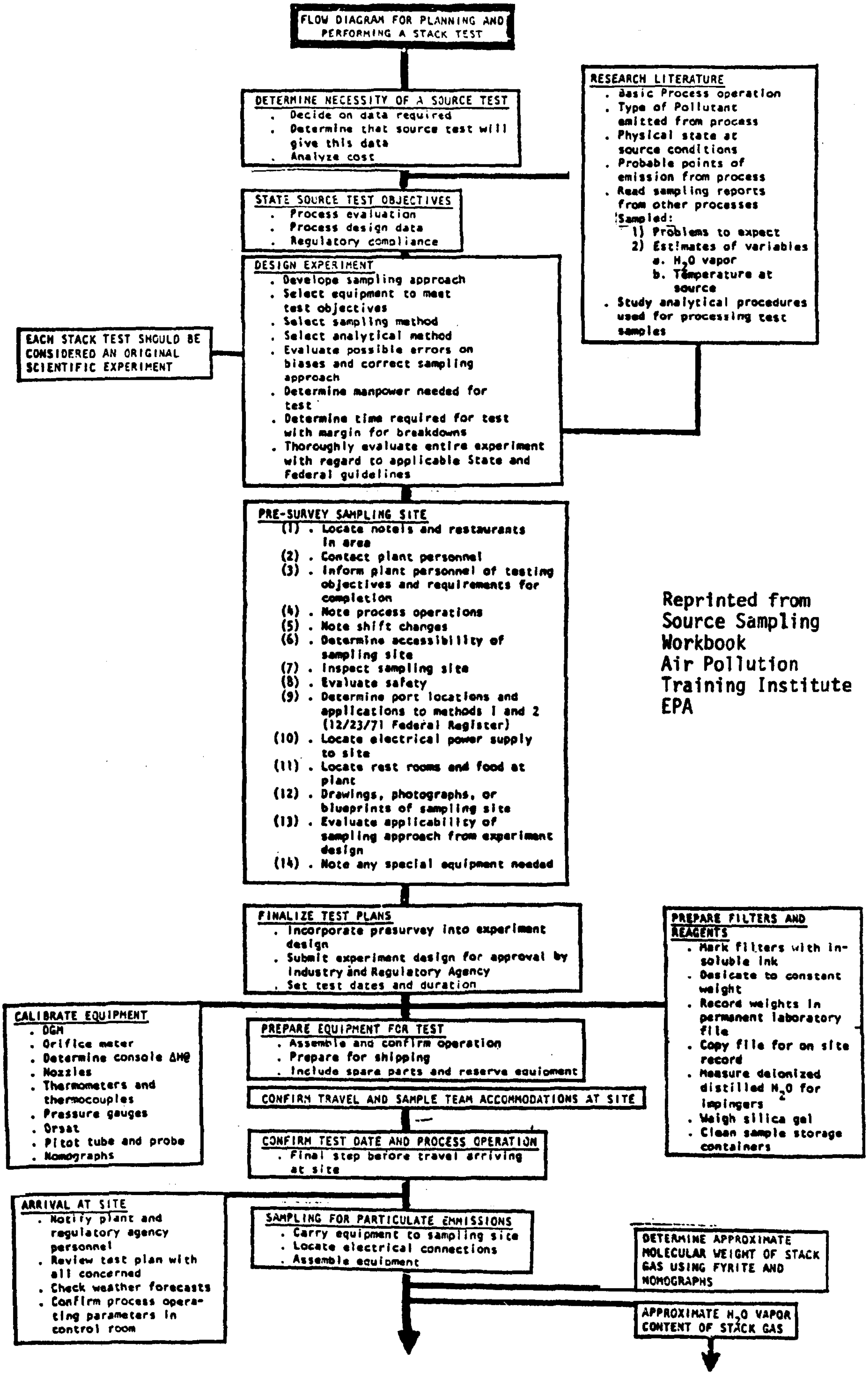

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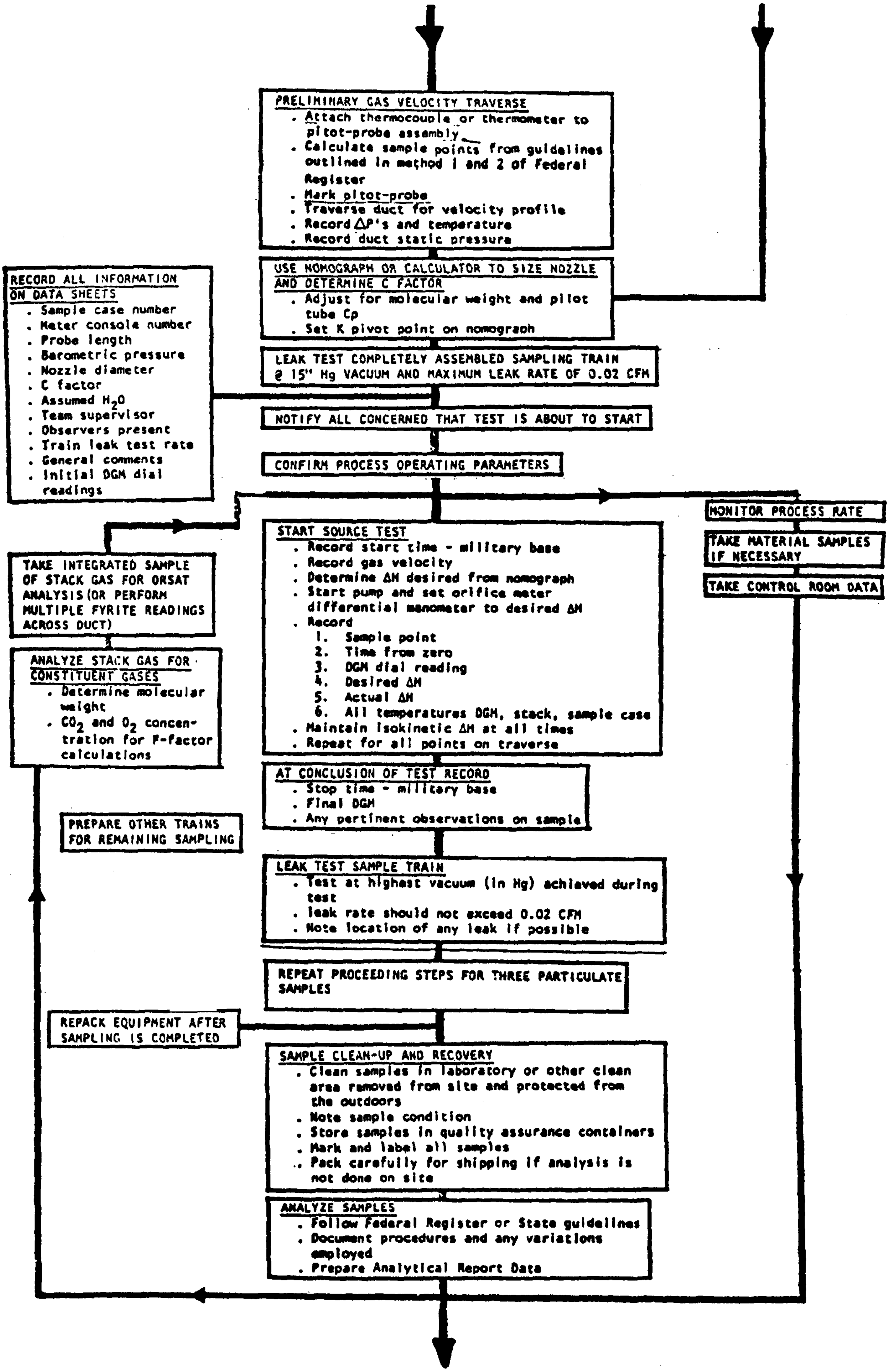
PRELIMINARY GAS VELOCITY TRAVERSE
. Attach thermocouple or thermometer to pitot-probe assembly
. Calculate sample points from guidelines outlined in method 1 and 2 of Federal Register
. Mark pitot-probe
. Traverse duct for velocity profile
. Record ΔP's and temperature
. Record duct static pressure
USE NOMOGRAPH OR CALCULATOR TO SIZE NOZZLE AND DETERMINE C FACTOR
. Adjust for molecular weight and pitot tube Cp
. Set K pivot point on nomograph
RECORD ALL INFORMATION ON DATA SHEETS
. Sample case number
. Meter console number
. Probe length
. Barometric pressure
. Nozzle diameter
. C factor
. Assumed H_2O
. Team supervisor
. Observers present
. Train leak test rate
. General comments
. Initial DGM dial readings
LEAK TEST COMPLETELY ASSEMBLED SAMPLING TRAIN @ 15" Hg VACUUM AND MAXIMUM LEAK RATE OF 0.02 CFM
NOTIFY ALL CONCERNED THAT TEST IS ABOUT TO START
CONFIRM PROCESS OPERATING PARAMETERS
MONITOR PROCESS RATE
TAKE MATERIAL SAMPLES IF NECESSARY
TAKE CONTROL ROOM DATA
TAKE INTEGRATED SAMPLE OF STACK GAS FOR ORSAT ANALYSIS (OR PERFORM MULTIPLE FYRITE READINGS ACROSS DUCT)
ANALYZE STACK GAS FOR CONSTITUENT GASES
. Determine molecular weight
. CO_2 and O_2 concentration for F-factor calculations
START SOURCE TEST
. Record start time - military base
. Record gas velocity
. Determine ΔH desired from nomograph
. Start pump and set orifice meter differential manometer to desired ΔH
. Record
1. Sample point
2. Time from zero
3. DGM dial reading
4. Desired ΔH
5. Actual ΔH
6. All temperatures DGM, stack, sample case
. Maintain isokinetic ΔH at all times
. Repeat for all points on traverse
AT CONCLUSION OF TEST RECORD
. Stop time - military base
. Final DGM
. Any pertinent observations on sample
PREPARE OTHER TRAINS FOR REMAINING SAMPLING
LEAK TEST SAMPLE TRAIN
. Test at highest vacuum (in Hg) achieved during test
. leak rate should not exceed 0.02 CFM
. Note location of any leak if possible
REPEAT PROCEEDING STEPS FOR THREE PARTICULATE SAMPLES
REPACK EQUIPMENT AFTER SAMPLING IS COMPLETED
SAMPLE CLEAN-UP AND RECOVERY
. Clean samples in laboratory or other clean area removed from site and protected from the outdoors
. Note sample condition
. Store samples in quality assurance containers
. Mark and label all samples
. Pack carefully for shipping if analysis is not done on site
ANALYZE SAMPLES
. Follow Federal Register or State guidelines
. Document procedures and any variations employed
. Prepare Analytical Report Data

CALCULATE

- Moisture content of stack gas
- Molecular weight of gas
- Volumes sampled at standard conditions
- Concentration/Standard volume
- Control device efficiency
- Volumetric flow rate of stack gas
- Calculate pollutant mass rate

WRITE REPORT

- Prepare as possible legal document
- Summarize results
- Illustrate calculations
- Give calculated results
- Include all raw data (process & test)
- Attach descriptions of testing and analytical methods
- Signatures of analytical and test personnel

SEND REPORT WITHIN MINIMUM TIME FRAME TO INTERESTED PARTIES

SOURCE SAMPLING CALCULATION SHEET

Company________________ Address ________________

Test Team ________________ Address ________________

Test Date ________________ Evaluation Date ________________

Observer ________________ Evaluator ________________

(1) WATER VAPOR VOLUME: ($V_{w\text{-}std}$)

$$V_{w\text{-}std} = 0.0471(V_1)$$

	Run_____	Run_____	Run_____	
V_1 =				ml

	Run_____	Run_____	Run_____	
$V_{w\text{-}std}$ =				scf

(2) DRY GAS VOLUME: ($V_{m\text{-}std}$)

$$V_{m\text{-}std} = 17.65Y \frac{(V_m)}{(T_m)} \left(P_{bar} + \frac{\Delta H}{13.6}\right)$$

	Run_____	Run_____	Run_____	
V_m =				cf
T_m =				^oR
P_{bar} =				"Hg.
ΔH =				"H_2O
Y =				

	Run_____	Run_____	Run_____	
$V_{m\text{-}std}$ =				scf, dry

(3) MOISTURE CONTENT: (B_w)

$$B_w = \frac{(V_{w\text{-}std})}{(V_{m\text{-}std}) + (V_{w\text{-}std})} \times 100$$

	Run______	Run______	Run______	
$V_{w\text{-}std}$ =				scf
$V_{m\text{-}std}$ =				scf

	Run______	Run______	Run______	
B_w =				%

(4) GAS ANALYSIS: (M_d)

	Run ______	Run______	Run______	
CO_2 =				%
O_2 =				%
CO =				%
N_2 =				%

	Run______	Run______	Run______	
$\%CO_2$ x 0.44 =				
$\%O_2$ x 0.32 =				
%CO x 0.28 =				
$\%N_2$ x 0.28 =				
M_d =				#/#-mole, dry

(5) GAS MOLECULAR WEIGHT: (M_s)

$$M_s = (M_d)(1 - \frac{B_w}{100}) + 18(\frac{B_w}{100})$$

	Run______	Run______	Run______	
M_s =				#/#-mole, wet

(6) ABSOLUTE STACK PRESSURE (P_s)

$$P_s = P_{bar} + \frac{P_{stat}}{13.6}$$

	Run____	Run____	Run____	
P_s =				"Hg.

(7) STACK VELOCITY: (V_s)

$$V_{s\text{-}avg} = 85.48(C_p)(\sqrt{\Delta p})_{avg}\sqrt{\frac{T_{s\text{-}avg}}{(P_s)(M_s)}}$$

	Run____	Run ____	Run____	
C_p =				
$(\sqrt{\Delta p})avg$ =				
$T_{s\text{-}avg}$ =				^oR
P_s =				"Hg.
M_s =				#/#-mole

	Run____	Run ____	Run ____	
$V_{s\text{-}avg}$ =				fps

(8) ISOKINETIC VARIATION: (I)

$$I = \frac{1.667(T_{s-avg})[0.00267(V_1) + \left(\frac{V_m}{T_m}\right)(Y)(P_{bar} + \frac{H}{13.6})]}{(V_{s-avg})(P_s)(\Theta)(A_n)}$$

	Run_____	Run_____	Run_____	
T_{s-avg} =				^oR
V_1 =				ml
V_m =				cf
V_{s-avg} =				fps
P_s =				"Hg.
Θ =				min.
A_n =				sq. ft.
Y =				

	Run_____	Run_____	Run_____	
I =				%

(9) PARTICULATE CONCENTRATION: (c)

	Run_____	Run_____	Run_____	
A M_n =				mg.
B V_{m-std} =				scf
R = A / B =				

	Run_____	Run_____	Run_____	
c = 35,310(R) =				micrograms/cubic meter, normal
= 0.0154(R) =				grains/std. cubic foot
= 2.205×10^{-6}(R) =				pounds/std. cubic foot

(10) VOLUMETRIC FLOW RATE (Actual): (Q)

For circular ducts

$Q = 47.1\,(V_{s\text{-}avg})(D_s)^2$

For rectangular ducts

$Q = (L)(W)(V_{s\text{-}avg}) \times 60$

	Run_____	Run_____	Run_____	
$V_{s\text{-}avg}$ =				fps
D_s =				ft.
L =				ft.
W =				ft.

	Run_____	Run _____	Run_____	
Q =				acfm

(11) VOLUMETRIC FLOW RATE (Standard Conditions): (Q_{std})

$$Q_{std} = \frac{17.65\left(1 - \frac{B_w}{100}\right)(Q)(P_s)}{T_{s\text{-}avg}}$$

	Run_____	Run_____	Run_____	
B_w =				%
Q =				acfm
P_s =				"Hg.
$T_{s\text{-}avg}$ =				^oR

	Run_____	Run_____	Run_____	
Q_{std} =				scfm, dry

(12) POLLUTANT MASS RATE: PMR

$$PMR_c = 1.323 \times 10^{-4}(R)(Q_{std})$$

	Run____	Run____	Run____	
R =				
Q_{std} =				scfm

	Run____	Run____	Run____	
PMR$_c$ =				lbs/hr

For circular ducts

$$PMR_a = \frac{1.323 \times 10^{-4}(M_n)}{} \left(\frac{D_s}{D_n}\right)^2$$

For rectangular ducts

$$PMR_a = \frac{1.323 \times 10^{-4}(M_n)(L)(W)}{A_n}$$

	Run____	Run____	Run____	
M_n =				mg.
=				min.
D_s =				ft.
D_n =				ft.
L =				ft.
W =				ft.
A_n =				sq. ft.

	Run____	Run____	Run____	
PMR$_a$ =				lbs/hr

(13) ISOKINETIC CHECK:

	Run___	Run___	Run___
$I = PMR_a/PMR_c \times 100 =$			

(14) "F" FACTOR CALCULATION

$$E = 2.205 \times 10^{-6}(R)(F)\left(\left(\frac{20.9}{20.9-\%O_2}\right)\right)$$

	Run___	Run___	Run___	
R =				
F =				
O_2 =				%

	Run___	Run___	Run___	
E =				lb/MM Btu